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THEMATIC REVIEW

School Design and Learning Environments in the City of Espoo, Finland

DECEMBER 2018

Acknowledgements

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Executive Summary

This report presents the main findings and recommendations resulting from a review of education infrastructure investments in the city of Espoo, Finland, carried out by the CEB's Technical Assessment & Monitoring Directorate. The objective of the review was to examine the links between school design and learning environments. The report provides Espoo officials with recommendations for enhancing the effectiveness of the education investment and identifies good practices that could be shared with other countries.

The City of Espoo and the Finnish education system are internationally recognised as top performers for learning outcomes and one of the most equitable. However, rapid population growth, increasing numbers of children and foreign-language residents, and general tightening of the public budget pose challenges to service delivery just at a time when education infrastructure is expected to adapt to new learning curricula.

Notwithstanding these challenges, the commitment to education remains very high on the part of all the stakeholders met in the city of Espoo. This commitment is reflected in the strategy for the City, the continuous financial support provided to the sector over the years, and the deep value and trust placed in their highly educated teachers. The eight schools visited by the review team already reflect some elements of the vision promoted by the new curriculum introduced in 2017, including the presence of differently sized learning spaces, heightened transparency and increased flexibility. The average learning space per child tends to be more generous than in other countries, given the use of spaces such as corridors and common areas for learning activities.

The review team identified a series of key themes to encourage further discussion and exploration by Espoo teachers and city officials in their search for effective strategies to guide investments in the education sector. These include:

- the need to find the right balance between cost-effectiveness and the promotion of effective learning environments;
- the value of systematically involving the school community in the design process;
- the importance of providing the necessary support for teachers to transition into new learning environments, by developing and implementing an Effective Spatial Professional Development programme.

Ultimately, the effectiveness of any investment depends on how well it is used. In this regard, international research is unanimous in identifying teachers as the factor that correlates most strongly with student achievement. Thus, as part of any build, investing in teachers' effective use of spaces must be a priority and an important component in the budgeting process.

Introduction

This report presents the main findings and recommendations resulting from a review of education infrastructure investments in the City of Espoo, Finland. Part of the 2016-2019 investments are being co-financed by an €80 million loan provided by the Council of Europe Development Bank (CEB). The review was carried out by the Technical Assessment and Monitoring Department (TAM) of the CEB as part of its regular technical monitoring review. In agreement with the education officials of the City of Espoo, the objectives were expanded to have a more in-depth examination of the links between school design and learning environments. More specifically, the review sought (i) to assess how a selection of Espoo's schools compared to one another in terms of current international trends in school design and (ii) to explore how the selected facilities were performing pedagogically, i.e. the way in which the buildings service the schools' original educational vision, and the way teachers and students utilise the opportunities provided by the building design to maximise student learning.

The purposes of this review were to provide Espoo officials with recommendations on how to enhance the effectiveness of the education investment carried out and for the CEB to identify effective practices that could be shared with other member countries. A team of experts led by Ms Yael Duthilleul, Education Advisor of the CEB, and comprising Mr Alastair Blyth (Architect), Prof Wes Imms, (Education specialist) and Ms Kristina Maslauskaite (Research Analyst of the CEB) visited Espoo the week of May 14-18, 2018. Mr Tigran Shmis (Senior Education Specialist at the World Bank) joined the review team as part of a CEB – World Bank professional exchange programme.

Prior to the visit, the team undertook a review of existing policy documents, studies and statistics on the City; selected the schools to visit; designed specific survey instruments to collect background information on the selected school buildings, their students and teachers; and organised a series of meetings with City officials and school staff. All visits and data collection efforts were organised thanks to the support of the International Affairs Unit from the Education and Cultural Services of Espoo. Information on the schools selected and the instruments designed for data collection purposes can be found in Annex 1.

The team visited eight schools in Espoo. Four of them had benefitted from the CEB's loan (three comprehensive schools and one day-care centre). The three schools selected were the only ones from the proposed investment plan that had been completed at the time of the visit. The daycare centre was selected for its proximity to one of the schools to be visited and its location in a highly socially diverse area. Total investments costs were not a criterion. In addition, the review team proposed to visit two other comprehensive schools which had been built previously and which had been recognised internationally for the quality of their design. The City also proposed to add two other schools (a primary school and an upper secondary school) that reflected their search for new cost-effective models for the delivery of school services. It must be noted that the data collection exercise focused on the six schools identified by the review team and not on the additional two, subsequently added to the agenda, on City Official's recommendation. For this reason, some sections will occasionally refer to eight schools. However, most of the data analysis was largely restricted to the six selected schools.

During the visit, the review team met with school principals, teachers and students from the selected schools as well as with officials from the Education, Finance and Premises Department and with the Deputy Mayor, all of whom provided extensive information on the current status of education in the City and the challenges ahead. Annex 7 presents the agenda for the week.

The report starts with a brief introduction to the City and its education context, followed by a presentation of the conceptual framework developed to respond to the key objectives of the review. The main findings make up the core of the report, which concludes with a set of recommendations.

City Context

Growing Population and Wealth, Economic and Social Challenges

Espoo is the second largest city in Finland with a population of 275 000 (or 5% of the national population). Espoo belongs to Finland's most populous Uusimaa region, which covers only 3% of Finland's territory, but is home to 30% of its inhabitants and generates almost 40% of its national GDP[1]. Since 1950, the population of the entire Helsinki area has more than doubled, and that of Espoo has increased tenfold because of the Great Migration from rural areas to cities[2]. Espoo is a young and increasingly diverse city: 20% of the city's overall population is under 15 years of age and 4.8% of the population was born in another country ("*New Finns*"), including 20% of the children in early education. The share of foreign-language population of working age in Espoo is forecast to represent 30% by 2030. It is a highly well-educated city with 50% of the population holding a university degree. The city's population has been increasing by an average of 4 500 new residents annually (new-borns and immigrants).

Fast population growth, an ageing population and a simultaneous increase in the number of children and foreign-language residents are leading to growing service needs and challenging service production and delivery. The monetary scale of the investment programme is unprecedented. The economic operating environment, sustainable development, digitalisation, urbanisation, ageing, replacement of jobs lost in the technology industry and the integration of immigrants are great challenges for Espoo. The city's economy is also tightened by the tax-based equalisation between municipalities and population growth that is stronger than the growth in tax revenue. In the past, challenges have been resolved with the help of economic growth, but after the financial and euro crisis, this is uncertain. The general consensus is that growth will be slow for a long time, development needs will have to be prioritised and operations streamlined in a responsible manner (The Espoo Story, 2017).

Within this challenging context, education investments remain a priority. Almost half of the City's budget (43%) was allocated to education in 2017. However, sustained investments come with attention paid to making more efficient use of resources. Espoo's officials are looking for options to better respond to this objective by experimenting with alternative school models. The "school-as-a-service" model (e.g. two high-schools share laboratories, sport facilities and leisure areas with Aalto University and a "module-prefabricated model" elementary school) are evidence of these efforts. Both models were visited by the review team.

Education Context

Increasing Diversity, Deteriorating Infrastructure, Declining PISA Scores

Finland gained international recognition as the top performer and one of the most equitable systems in the world according to the Programme for International Student Assessment (PISA) from the very start of the Programme in 2000. Nonetheless, its performance has been declining since 2006, even if it remains the best performing country overall in Europe. This drop, as well as the increase in the number of low performers from 7% to 12%, is being taken seriously by government officials who have called for strong action and the involvement of all education stakeholders in the process of ensuring the system regains its positioning.

The education sector in Finland, in general, is facing several challenges. The continuous increase in the number of students enrolled, combined with deteriorating physical infrastructure, suffering from mould contamination, bring pressure to increase capacity, improve educational infrastructure, and develop measures to facilitate integration. Because of the problems related to air quality and mould in old school buildings approximately 3 000 pupils in Espoo are currently studying in temporary school buildings where they may spend 4 to 5 years until their new school is completed.

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1 European Commission (2018) *Helsinki-Uusimaa Region* [Online] Available at: https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/base-profile/helsinki-uusimaa/helsinki-uusimaa-region [Accessed on 27 February 2018]

2 Espoo City (2017) *The Espoo Story* [Online] p.1 Available at: http://www.espoo.fi/download/noname/%7B00F4B1D2-BB41-4301-91C9-727A8E8C15C3%7D/98265 [Accessed on 27 February 2018]

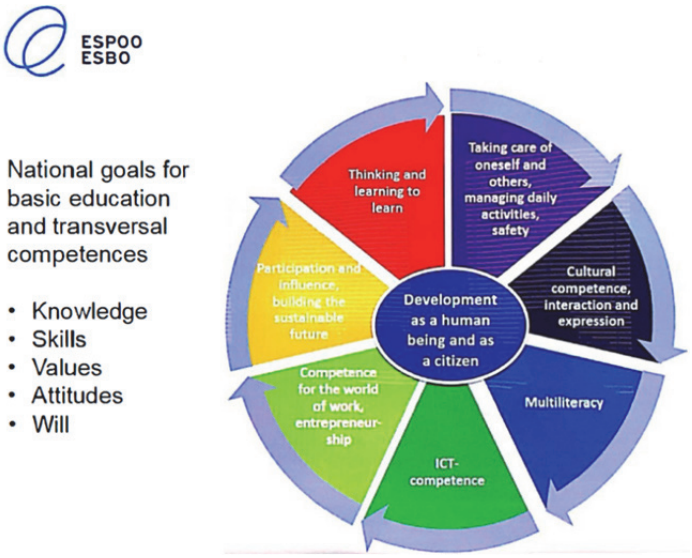
New Curricula and Vision for Learning, Education as a Priority, High Value and Trust in Teachers

The new national core curriculum and local[3] curricula that were introduced between 2015 and 2017 for all education levels are one of the responses to this call for action to improve results. The new curriculum reflects a new, inspiring and visionary conception of learning that promotes autonomy in the learning process. It is based on the understanding that learning takes place in interaction with other students, teachers and communities, and recognises the importance of fostering multidisciplinary thinking. Multidisciplinary learning modules and cross-curricular activities are expected to take place at least one week per year. It reflects a shift from "what" to learn to "how" to learn and places students centre stage. Figures 1 and 2 below present the key elements of the new basic education curriculum.

Learning is thought to take place not just in a classroom but in the whole school and surrounding environment. This new conception of learning has a direct impact on the conception of the physical space designed for learning, as learning can take place anywhere and is not just confined to the classroom. Major investments in education infrastructure are on-going to renovate and expand schools to meet the demands of an increasing and more diverse population and to respond to this new vision of learning. Further work is also needed to promote a new working culture, methods and pedagogy and to promote teacher co-operation.

Figure 1: Conception of Learning

Figure 2: Rethinking Competences



Education remains a priority for Finnish society, as reflected in the political commitment of elected officials, who put education first and allocate the necessary resources for its development. To this shared agreement on the importance of education is added the great pride that Finnish society has in its teachers. Teachers are respected and valued professionals, trusted by society. It is the best students who are selected for teachers' education programmes. School teachers are also required (and have been for a long time) to complete a masters level of education.

Education in Espoo

Finland's education system is renowned worldwide for its achievements both in absolute terms and in terms of homogeneity of performance in and between schools[4]. Espoo's education results are some of the best in Finland. The city has been recognised as a UNESCO Learning City since 2013 and was given the Educating Cities Award of Living Together in Cities in 2016[5]. The Espoo city strategy for the years 2017-2021 sets out the objective for Espoo to have the best learning results in Finland and at the same time to prevent inequality between schools so that "every parent can trust that the local school provides quality education".

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3 Local curricula are developed under the framework of the national core curriculum. As providers of education services, individual municipalities decide on how their curricula should be implemented on the basis of their local priorities.

4 Bastos, R., M., B. (2017) *The Surprising Success of the Finnish Educational System in a Global Scenario of Commodified Education* [Online] Available at: http://www.scielo.br/scielo.php?pid=S1413-24782017000300802&script=sci_arttext&tlng=en [Accessed on 27 February 2018]

5 Espoo City (2017) *Espoo as a Place to Study* [Online] Available at: https://ec.europa.eu/esf/transnationality/filedepot_download/1249/1466 [Accessed on 27 February 2018]

In Espoo, in 2018, there were 88 public comprehensive schools (including 11 Swedish schools) serving a total of 30 900 students and 12 upper secondary schools (including one Swedish school) serving 5 000 students. In addition to this, Espoo has 16 basic art education schools, three vocational institutes with 12 000 students, two polytechnics, one university, and more than 223 municipal daycare centres. Each year, the school population in Espoo expands by approximately 900 additional students, most of them coming from abroad (800 in comprehensive schools and 100 in upper secondary schools), which means that, on average, a big new school is needed on an annual basis to ensure enough space for all. Forty-one different languages and six different religious education courses are provided in Espoo to respond to curriculum requirements that ensure foreign-born children have the right to preserve their language and religion.

Conceptual Framework for Effective Learning Environments

The review team developed a conceptual framework based on two axes: the architectural characteristics of the building itself and the use given to the building by teachers and students to achieve the educational objectives of the school. Under the first axis, each school visited was assessed according to three key principles that signal important developments in education infrastructure these days (type of space, flexibility and transparency). Under the second axis, the learning environments were examined through five concepts: twenty-first century learning skills, student deep learning, teacher mindframes, a typology of learning environments and effectiveness evaluation. These two axes are further detailed in the following sections.

School Design

In broad terms, the trend in the spatial design of school buildings is to move away from providing a one-size-fits-all model, where classrooms of the same size are accessed from one or two sides of a corridor. This conventional school building planning model has been challenged for many years in various forms, from the ideas of Montessori to the open-plan designs of the 1960s and 1970s. Along with changes in the design of the physical environment, there has been a corresponding change in the use of language to describe the physical environment in terms of *learning spaces* rather than classrooms. Not only does this emphasize the importance of learning but it captures the notion that *most space within a school building can be used for learning*.

International focus has been on *designing spaces that assist or support the concept of differentiated learning*, a broad goal of global education for decades and a core theory underpinning Finland's new curriculum. The design of spaces being built in recent times around the globe to meet this progressive agenda is conceived to assist teachers in broadening traditional didactic instruction approaches, and for students to control their own learning to a greater extent. These builds are not considered a solution to education's problem of student-centred learning, but a tool to assist in achieving that goal.

To be an effective tool, the actual design of the spaces is critical. The search for options has led to new designs, some of which are today called Innovative Learning Environments (ILE). For the purpose of this review, the school buildings visited were assessed according to three aspects that tend to be present in these novel environments: the *types of spaces available in the school and their use*; the *flexibility* of the building, and the *transparency* that facilitates putting learning on display.

Types of spaces and their use

As a response to developments in the conception of learning and individual student needs, the spatial design of school buildings has moved away from a one-size-fits-all model to one where a variety of different sized spaces are clustered together to give the users the choice over what spaces to use for different activities. Along with the evolution of standard classrooms into a range of different spatial configurations, there is more focus on how to use the whole school building for learning. In other words, rather than restrict learning activities to a narrowly defined set of classroom spaces, the focus is on how other areas, such as corridors and canteen, could be used to foster learning and/or the social

interactions associated with learning. This has taken the form of a 'streetspace', where the circulation route through the building becomes more than a corridor and provides zones designed to enable different types of learning activities to take place along its way. Their proximity to the main learning zones enables such spaces to be used as break-out space for group work, or for independent learning. Another new and distinguishable space to emerge is the 'commons' area which is best defined as a semi-enclosed learning space that is not part of the main circulation route and is not a classroom space, but provides a range of settings for group, individual and quiet work. Such spaces may be scattered throughout the school or consolidated in one place as a multi-purpose "central commons" area that can be used for having a meal, performances, or assemblies, and which becomes the "heart" of the school building.

Flexibility

Flexibility of school buildings has also become part of the picture with the recognition that a building should be able to respond to the needs of users as they change over time. This capacity to accommodate change can be examined over three different time horizons, the long term, the medium term and the short term, in the following way:

a) *Adaptability,* where the building is responsive to change over the long term. For example, it can be made larger to accommodate more students. This involves substantial changes to the fabric and possibly even the structure of the building. To evaluate the adaptability of the building would demand analysis of the structural design, which is beyond the scope of this review.

b) *Adjustability,* where parts of the building can be reconfigured over the short to medium term by manipulating elements to create different spatial arrangements. For example, to make a space larger, smaller, or a different shape.

c) *Agility*, which refers to short-term flexibility where the settings, furniture and IT equipment can be rearranged quickly and easily. This relates to changing the use of the space and is the kind of change that individual users might be able to make themselves. An agile learning space is one that can respond to the needs of students and teachers quickly and, in particular, one where the furniture and technology such as projectors and display screens can be easily rearranged. This short-term flexibility of the school building can be complemented by an assessment of the "flexibility in use", that is the extent to which users can use the spaces because they have a choice of whether to rearrange the settings, and can do so easily and quickly, or whether to use other appropriate spaces nearby.

Transparency

Schools are designed today with greater elements of transparency through the building, which is often achieved by creating open spaces or using glazing between spaces in the form of fully or partially glazed walls. The arguments for this are that it creates a sense of connectedness whereby people can be participants in education whether as observers or active players. It also contributes to making learning visible, valuable and shared.

People can feel more connected in the spatial environment when they can see what is happening around them, move easily from one place to another, and feel part of that environment. In schools, connectedness can be afforded by visibility across spaces, either because there are no solid walls or because there are glass walls; it can also be afforded by how close the spaces they often use are to each other and how easy it is to move from one space to another.

For a more detailed presentation of these concepts see Annex 2.

Use of Learning Environments

The framework utilised to examine the use of learning environments of the schools visited in Espoo was guided by the five theoretical concepts underpinning the work of the Learning Environment and Applied Research Network (LEaRN)[6].The five concepts are briefly presented below. For more detailed information see Annex 3. Although not an evaluation, the review of the schools in Espoo will draw on these principles to collect the data needed to meet the goals described above.

Twenty-first century learning skills

In general, this concept argues that the twenty-first century requires graduates to have a set of skills that are not necessarily addressed by traditional compulsory-education programmes; these skills focus on interpersonal qualities rather than functions that can be seen as routinely cognitive. Four key characteristics summarise these qualities – Communication Skills, Critical Thinking Skills, Creative Thinking Skills, and Collaboration Skills, in other words the 4Cs.

It is further argued that the 4Cs cannot be adequately developed through traditional 'teacher-centric' pedagogies, a feature of traditional classroom environments, and that flexible, adaptive learning spaces must be built that accommodate student-centric pedagogies; development of so-called Innovative Learning Environments (ILEs) is argued to have the capacity to meet this need.

Student deep learning

In simplistic terms, superficial learning is what occurs when students study simply to meet assessment requirements, and deep learning is using knowledge to explore relevance and build personal beliefs. In the context of this project, 'deep learning' is considered the optimum. Measurable characteristics of deep learning are embedded in LEaRN's Space Design and Use (SDU) survey[7] completed by the principals of the schools visited.

Teacher mindframes

Educational research consistently finds that the most significant factor impacting student learning outcomes is the quality of the teaching. Hattie conflated quality or 'high effect' teacher actions into a set of 10 characteristics – the '10 Teacher Mindframes' (Hattie, 2017). These "mindframes" are embedded in the School Design and Use (SDU) survey.

The existence of an informative 'typology' of learning environments

It cannot be assumed that innovative learning environments (ILEs) conform to an easily summarised type. On the contrary, they vary considerably. The five typologies of learning spaces summarised by Fisher and Dovey[8] are the result of an analysis of design characteristics in international school design awards. The resultant 'typology' of these solutions provides a characterisation of spaces for further analysis and examination. These five typologies are embedded in LEaRN's SDU survey.

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6 Mahat, M., Bradbeer, C., Byers, T & Imms, W. (2018). *Innovative Learning Environments and Teacher Change: Defining Key concepts*. Technical Report 3/2018. Melbourne, Australia: LEaRN, University of Melbourne. Retrieved from http://www.iletc.com.au/new-report-iletc-defining-key-concepts/

7 Imms, W., Mahat, M., Murphy, D. & Byers, T. (2017). *Type and Use of Innovative Learning Environments in Australasian Schools – ILETC Survey.* Technical Report 1/2017. Melbourne, Australia: LEaRN, University of Melbourne. Retrieved from http://www.iletc.com.au

8 Dovey, K. & Fisher, K. (2014). "Designing for Adaptation: The School as Socio-Spatial Assemblage." *Journal of Architecture* doi.org/10.1080/13602365.2014.882376

Evaluation of the effectiveness of innovative learning environments

Evaluation of learning environments is an imprecise and underdeveloped concept. However, some significant milestones towards this goal have been accomplished by the LEaRN research centre. An overview of this conceptual approach is presented in Imms et al[9].

Main Findings

School Design

Of the eight schools visited, two schools were renovation projects (Tapiola and Päivänkehrä), five were new constructions, and one school (Haukilahti) was not accommodated in one building, but followed an entirely different spatial strategy by sharing spaces with a University nearby. None had been built or renovated since the new curriculum framework came into effect, so they had not been designed with the new Finnish vision regarding learning environments in mind, although some of the features that support this vision are evident in these buildings.

Types of spaces and their use

Information was collected on the proportion of the overall floor area of each school that is used for administration, students, community and circulation, and on the extent to which the circulation area is also used for teaching and learning activities. Table 1 below summarises how the floor area of each school is subdivided.

It is interesting to observe that, while about half of the total floor area is allocated for learning and a significant share is set aside for administrative use, the average surface and learning area per student tends to be significantly more generous than that in some other countries. Just for comparison, taking the Kirkkojärvi and Saunalahti schools and calculating a similar sized secondary school in England i.e. a school with 800 students, the overall amount of space per student given in the area design guidelines that cover state-funded schools in England would range from 4.1 to 5.5 m²/student, depending on the type of school and specific programme and, on average, the area per pupil in classrooms is about 1.83 m²/student[10], while in Espoo the area per student can be up to three times these values. Similarly, comparing with the education design standards for the State of Alberta in Canada[11], the average overall area per student for a similar sized school would be approximately 9m²/student and the average area per student for learning activities is approximately 5.4m²/student. The use of circulation areas for learning purposes and the generous total surface available certainly contribute to increasing these averages. The proportion of the total floor area given to circulation compares favourably with England's design guidelines which suggest 25.5% for secondary schools and about 23% for primary schools; in Alberta the proportion is lower, at 16%.

Imms, W., Cleveland, B. & Fisher K.,Eds. (2016). *Learning Environments Evaluation. Snapshots of Emerging Issues, Methods and Knowledge*. Amsterdam, The Netherlands: Sense Publishing.

[10] Area Guidelines for mainstream schools Building Bulletin 103, Department for Education, United Kingdom, 2014. These guidelines refer to England only. Note that, in the UK, education is a responsibility devolved to national parliaments and assemblies, Scotland, Wales and Northern Ireland do not publish area guidelines.

[11] School Capital Manual, Alberta Education, Canada 2015

Table 1: Summary of how the floor area of the school is subdivided

School	Proportion of total floor area (%)					Total area m²	Number of students ****	Total area m²/ student	Learn m² / student ****
	Admin *	Learning activities **	Community***	Circulation	Circulation - learning				
Aurora	23	50	7	19	1	6 276	463	13.6	6.78
Päivänkehrä	20	56	0	19	6	6 510	499	13	7.19
Saunalahti	24	52	5	18	2	9 225	800	11.5	6
Tapiola	32	46	0	19	3	11 229	983	11.4	5.24
Kirkkojärvi Daycare						2 160	130	17	
Kirkkojärvi School	26	51	0	17	7	8 381	770	11	5.55

The data in this table have been taken from the data sheets completed by the School principals and Espoo officials.

*Administrative activities (i.e. not used for teaching). **Student activities (i.e. learning and recreation). ***Community uses only (e.g. parents' room, healthcare, extended services). **** The numbers of students refers to the capacity of the school given in the background data sheet. *****The area of learning space has been calculated by taking the percentage of the overall area devoted to student activities given 3 and dividing by the number of students.

In the schools visited, although the structures of the existing buildings presented constraints and therefore limitations as to how the buildings could be re-designed (for example, the historical nature of the Tapiola school building that required preservation), some of the new types of spaces that are becoming frequent in new buildings, such as learning commons, were obvious.

In the renovation and extension of the Päivänkehrä School, different sized spaces were created, allowing for more individual or small group work to take place as well as larger groupings of students. A large "Central Commons" space was also created at the entrance, connecting the learning areas and the sports facilities, which were originally two independent buildings. This new "Central commons" area is a multi-purpose space used for dining and performances (the music learning space is located next to it) as well as large group assemblies. The sliding walls connecting the "Central Commons" to the sports area enable the overall space to be enlarged in the case of performances or assemblies.

The Kirkkojärvi and Saunalahti schools were designed by the same architectural firm and built in 2010 and 2012, respectively. Both schools were internationally recognised for their design[12]. Similar design principles were adopted for both schools in which a group of classrooms is clustered around a semi-enclosed "commons" type space that can be used for group work. In these two schools the specialist areas and workshops such as cooking, wood, arts and textiles spaces were grouped off a single corridor. Like Päivänkehrä, these two schools have a "central commons" multi-purpose space which is accessed directly from the main entrance and gives direct access to other parts of the school. It thus provides a 'heart' to the school which can be used in a variety of ways, either for assemblies, dining, performances, or as a general social area.

The Aurora school, completed in 2016, is also a multi-purpose building, including a daycare centre and a health centre, and follows some of these same principles: it has a central multi-purpose "commons" space, that can be used for dining and performances, and classrooms clustered around a shared common space equipped with comfortable and moveable furniture that can be used for individual learning activities as well as break-out groups.

[12] In 2011 Kirkkojärvi school received the International Architecture Award, and in 2013 Saunalahti school was awarded the Prize for the Environmental Project of the Year.

Flexibility in use

In addition to the concepts of "adjustability" and "agility" presented above, this section also explores the "flexibility in use" of the school building. Table 2 summarises the adjustability, agility and flexibility in use of the schools visited. A more detailed analysis of the characteristics of each school is presented in Annex 4.

Table 2: Summary of adjustability, agility and flexibility in schools

	ADJUSTABILITY *(Space can be reconfigured in the short to medium term flexibility)*	**AGILITY** *(Easy use of spaces- short term flexibility, quick rearrangements possible)*	**FLEXIBILITY IN USE** *(short- term flexibility supported by Agility / interconnectivity, adjacency)*
Aurora	Generally, the classrooms are fully enclosed spaces therefore cannot easily be joined with adjacent spaces	Furniture can be moved but display fixed screens / whiteboards	Some classroom spaces are linked by doors and generally classrooms are clustered around a central "streetspace" offering opportunity to use this extra space for learning activities.
Karhusuo *module-prefabricated model*	Significant areas can be easily reconfigured	Furniture can be moved but display fixed screens / whiteboards	Spaces can be connected but no "commons" or "streetspace"
Kirkkojärvi	Classrooms could be combined by demolishing walls, but not an easy solution	No wheels on furniture; display fixed screens / whiteboards	Limited by the extent of adjacent spaces that could be used for teaching. Although students do have some choices – commons / central commons area
Päivänkehrä	Some class spaces interconnect with each other allowing some adjustability	Furniture can be moved but display fixed screens / whiteboards	There would be more flexibility if more classrooms were connected. The central commons can be connected to the sports area through sliding walls for performance space and assemblies
Saunalahti	Classrooms could be combined by demolishing walls, but not an easy solution	No wheels on furniture; display fixed screens / whiteboards	Limited by the extent of adjacent spaces that could be used for teaching. Although students do have some choices – commons / central commons area
Tapiola	Some classrooms can be connected to corridor space	Furniture can be moved but fixed display screens / whiteboards	There would be more flexibility if more classrooms were connected

Best practice Good Limited

In terms of being able to reconfigure the spaces, the Karhusuo School seemed to offer the greatest flexibility in being able to provide different spatial configurations to meet different needs. The walls appeared to be easily moveable, as demonstrated by the teachers during the visit where the review team could see that some were open and some closed, suggesting active use. The quality of acoustic separation, where sound may leak through the junctions around the partition, can be an issue if careful attention is not given to this problem at the design stage. However, this was not commented on by the staff as a matter of concern.

The Karhusuo School, like the others, had furniture that could be moved relatively easily and tended to have a fixed position for the LCD display screens and whiteboards. The fixing of the whiteboard does suggest a single focal point in the classroom. Although the furniture in the space can be rearranged, when doing so the tendency may be still to focus on the 'front'. The Kirkkojärvi and Saunalahti schools, while inspiring buildings seemed more constrained by the lack of openable walls. In spite of the limited adjustability of its classroom walls, Aurora school offered a variety of spaces for structuring learning using the different sizes of common spaces adjacent to the classrooms and the main central commons.

Transparency

Increased transparency is becoming a common feature in schools. Glazed doors and walls and open spaces are being systematically introduced as a way to support the creation of a learning community that is connected, values learning and makes it visible. Concerns that people have about either being observed or being in a 'goldfish bowl' and students being distracted by what is happening outside the space can be met by using a patterned finish on the glass, thereby making that part of the glass translucent but not transparent. With the use of glass, a balance needs to be struck between the value that it provides and the constraints that it imposes. In many instances partially, glazed walls may be sufficient to achieve the desired sense of connectedness.

Several of the schools visited made extensive use of fully glazed walls which offer a high degree of transparency. In the case of Tapiola, the renovation transformed the walls connected to the corridors into fully glazed walls. This full exposure of students can be seen as an extreme on the transparency axis. In other schools, the use of glaze was more limited to classroom doors, even double doors as in Aurora school or some parts of the walls and doors as in Karhusuo, whereas Saunalahti made extensive use of glazed walls for the workshop areas. Overall, Aurora school appears to be the school that better responds to the flexibility in use and increased transparency expected today and provides a learning environment that stimulates their use in different forms. Table 3 summarises the technical characteristics of the schools visited in terms of flexibility and transparency.

Table 3: Comparison of the technical characteristics found in the schools linked to flexibility and transparency

	RENOVATION		NEW CONSTRUCTION				
	Päivänkehrä	Tapiola	Aurora	Karhusuo	Kirkkojärvi	Saunalahti	Kirkkojärvi Daycare
	TECHNICAL CHARACTERISTICS						
Size*	Generally 56 - 60 sqm	**	20 - 55sqm	**	42 - 90sqm	40 - 80sqm	**
Shape	Rectangular	Rectangular / hexagon	Rectangular	Rectangular	Rectangular	Rectangular	Rectangular
Adjacencies	Connected to corridors Classrooms paired	Connected to corridors	Clustered off common learning space	Connected to corridors; paired to other classrooms	Classrooms off corridors 'Commons' spaces linked to corridors	Classrooms off corridors 'Commons' spaces linked to corridors	Clustered off a common learning space
Interconnectivity *(Openable walls; doors)*	Some classrooms connected	Some glass walls sliding panels	No	Classrooms connected in different permutations	No	No	No
Furniture	Chairs on wheels Desks mostly single	Chairs on wheels and adjustable Tables of various sizes	Adjustable chairs on wheels Triangular tables	Chairs on wheels Desks mostly single Bean bags and sofas	No wheels on chairs Desks mostly single	No wheels on chairs Desks mostly single Sofas in class	No wheels on chairs Desks mostly single
Whiteboards/ screens display	Fixed at one end of room	Fixed at one end of room	Fixed at one end of room	Fixed at one end of room	Fixed at one end of room	Fixed at one end of room	Fixed at one end of room
	TRANSPARENCY						
Glass walls	On some corridor walls	Glass vision panels	Vision panels and glazing between classrooms and common learning space	A little through some doors and partial walls	Some	Some	Some glazed class rooms; vision panels in doors

NOTES: * Space sizes read from the plans supplied by Espoo and given as ranges as there is some variation;
** No data on classroom sizes.

Best practice Good Limited

Learning Environments

Seven out of eight schools provided their "Education Vision" statement, four completed the Space Design and Use (SDU) survey[13] and six completed the school background questionnaire prior to the visit. The Premises Department provided the school plans and completed the School Background Data Sheet for the six schools visited. Some of these background questionnaires were minimally completed.

Field data was obtained through a combination of informal observations and interviews. In nearly all cases, the spaces were in active use, occupied by students and teachers undertaking normal daily school tasks.

Informal interviews comprised a round-table discussion led by the review team, with a convenience sample (selected by the Principal) of between three and five members of the teaching staff. In at least two cases, students assisted in the school tour and provided their perceptions of the school and its operation.

More details on the data collected and the results of the survey can be found in Annexes 5 and 6. From all these data, the review team identified the following issues concerning the link between school building design and teaching/learning environments:

There were mixed experiences in terms of meaningful teacher participation in the design process. In the two retrofit projects, teachers felt their ideas were received and accommodated to some degree within the design process. In the new builds, the opposite was the case, with most teachers saying their ideas did not translate to the actual build, or they were not listened to, or they had very limited representation on the design committees. Of particular importance was the lack of any formalised school design team, a group with a mandate to participate in the design process from early conceptualisation through to long-term inhabitation.

There appeared to be low teacher 'ownership' of the builds. A consistent view from the schools visited was that, in new builds, teachers were required to learn how to use the building on actual occupation. This resulted in poor pedagogic use of the new opportunities provided by the building. The consistent absence of effective school-based design teams resulted in teachers often feeling they had no ownership of the ideas that drove the design. This contrasted with the retrofit projects, where a high level of teacher voice was noted, resulting in teachers being able to discuss the building's features in light of the pedagogies they were using.

Having a clear educational vision for the school appears to make a difference in working with a design team. In one of the school staff common areas visited by the team (Saunalahti), artefacts explaining the learning structures, goals and vision of the school – a common tool when building and developing a cohesive learning culture amongst teachers – were displayed. Teachers in that school were the ones who were most able to clearly and succinctly describe the educational vision for the school. This is not to be confused with student social and emotional well-being aspirations, which is a well-articulated and strong feature in all schools, nor does it suggest such beliefs did not exist or drive a healthy teaching and learning culture in the other schools visited; on the contrary, the schools exhibited highly professional standards and practices. It does, however, suggest that this seeming lack of a meta-understanding of the school's educational purpose could lead to difficulties when engaging in the educational brief/design brief negotiations with architects. In other words, architects might not be given a clear understanding of the educational purpose of the building. The need for this set of beliefs to originate from the actual school, as opposed to a centralised committee, is rooted in the understanding that all schools hold, foster and utilise quite unique cultural structures. It is these structures that a new build must accommodate, as compared to having to adjust the structures to suit an inappropriate design.

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[13] Imms, W., Mahat, M., Murphy, D. & Byers, T. (2017). *Type and Use of Innovative Learning Environments in Australasian Schools – ILETC Survey*. Technical Report 1/2017. Melbourne, Australia: LEaRN, University of Melbourne. Retrieved from http://www.iletc.com.au

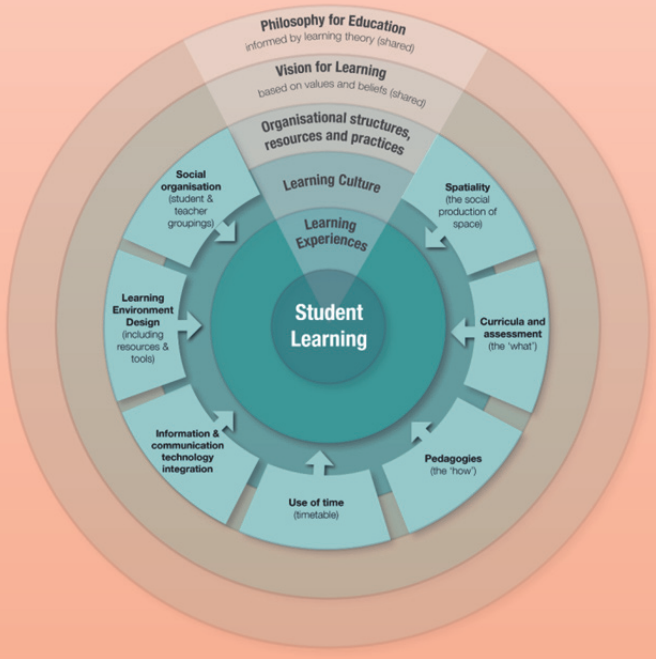
From Education Vision to Education Brief

An "educational vision" document summarises the epistemological beliefs a school holds as fundamental to its operation. It presents the philosophy of the school and how it drives its vision for learning, which in turn creates and manages its organisational structure and practices. The school educational vision is often embedded briefly in school websites and displayed in staff rooms and other school areas to guide strategies for better teaching and learning. When well-articulated, the educational vision of a school is evident when 'good' teaching and learning is discussed by staff and students.

The "educational vision" is an essential input for developing an "educational brief", a document that the architect will use as a reference to begin conceptualising the new school building project. The educational brief often constitutes the only formal pre-design request from staff to an architect regarding how teachers want the new spaces to operate pedagogically. Providing such information ensures that design decisions are underpinned by the school's core beliefs and vision as reflected in its practice. It guides the decisions that are made as to what purpose the new building must meet and how that purpose is translated into actual learning spaces.

Commissioning a new build in schools should, to some degree, follow the pathway indicated by the diagram presented below (while acknowledging each situation differs). In this model, the philosophy of the school drives its vision for learning, which in turn creates and manages its 'organisational structure and practices'.

Figure1. Approaching spatio-pedagogical projects, or 'How to proceed with your pedagogy and space project' (redrawn) (Cleveland, 2011, p. 252) – used with permission*



Following this process ensures that design decisions are underpinned by an evidence base that is relevant to the school's core beliefs and vision. The decisions that evolve from these first three layers culminate in the 'education brief'.

* Cleveland, B. (2011). Engaging spaces: Innovative learning environments, pedagogies and student engagement in the middle years of school (Unpublished PhD Thesis). The University of Melbourne, Melbourne, Australia.

The architect matters. There was a strong correlation between choice of architect and school satisfaction with the build. Favoured architects were those who not only consulted the staff, but went further to understand the educational priorities of the new facility. Such interactions reflected the 'good' architects' capacity to engage with the teaching staff during planning and building.

Leadership matters. Effective use of new learning environments is only one small component of a successful teaching culture. Good learning and teaching is a complex arrangement of many factors, of which the school's spatial arrangements is only one. School leaders carry a significant role in establishing vision, developing strategies, and encouraging good engagement by staff in the intended use of a new building, and staff and student transition into new spaces. In the site schools, there was a discernible correlation between principals who could articulate how the educational and architectural 'visions' overlapped, and perceptions of teacher satisfaction with the new spaces.

Time is a critical factor. In all the schools visited there was a view that successful pedagogic use of a retrofit or new build requires a great deal of time. This includes planning time, and time taken to transit into new builds. Good pedagogic use of a retrofit or new build does not happen automatically.

Teachers do not always have the required knowledge on the pedagogic potential of space. The subject is rarely covered in teacher training programmes, professional development in this area is sparse, and there is no solid body of research that easily feeds such information to the teaching workforce. Schools act largely in isolation when attempting to understand how space matters. This was characterised during the tours and discussions with the team, as teachers struggled with the design lexicon and had poor understanding of the design process and of the language surrounding the affordances of their school's spatial arrangements.

Each build is a unique experience. Even in two of the schools visited that had the same architect and a very common design strategy, it was clear that the schools operated quite differently. A 'one-size-fits-all' approach to school visioning, school design, and teacher transition into the spaces is useful but does not maximise the overall potential of the investment. While commonalities do exist, the visits illustrated very clearly that each school has a unique community and learning culture that often requires an individualised approach.

Main Conclusions

Changing Context

Espoo is a safe, culturally diverse and demographically growing city. The number of children and foreign-language residents, as well as the number and share of the elderly is increasing at a fast pace, which puts pressure on the delivery of social services. While Espoo can be considered a relative well-off municipality in Finland, the current economic context, with limited expectations for growth in the coming years, combined with population growth stronger than the growth in tax revenue, are putting pressure on the City's potential to provide the necessary high-quality services it has provided in the past. The need to find more cost-effective approaches to the delivery of services is an objective of the City Strategy.

New challenges are also experienced at education level. Finnish student outcomes in PISA tests have been declining in the past years. While Espoo's students are among the Finnish top performers, reading and literacy skills have also been declining in Espoo, as observed in their national assessments, and officials expressed concern over the underachievement of boys. Gaps between the achievement and motivation of non-Finnish speaking students (now referred to as "new Finns") have also been noted and there is an urgency to support their successful inclusion.

Education as a Priority

Officials at national and local levels are well aware of these challenges. Education remains their priority, as reflected by the Finnish Government Action Plan 1/2016, which states that, by 2025, Finland will be a country where people always want to learn new things and will have become the leading country in the fields of education, knowledge and learning. These values are reflected in the national education goals, aimed at supporting pupils' growth as human beings, enabling them to become ethically responsible members of society, and at building skills and competences for meaningful life-long learning to ensure a sustainable future for all (Basic education and Upper Secondary Education Acts).

A New Curriculum with a New Vision for Learning

The revisions to the national curriculum introduced in the last couple of years for all education levels are an effort to respond to these challenges with a new vision for learning. Education officials understand that the international recognition gained through successful PISA results were the consequence of the 1960s-1970s reforms, which led to the establishment of the comprehensive basic education system and to the Masters education level requirement for teachers. But Finland has changed since then and they believe it is important to introduce certain transformations to continue to grow and develop. The success of the Finnish education system rests on its capacity to see the challenges early on and anticipate the transformations that are needed.

The new curriculum, or new vision of learning, preserves the key elements of Finnish identity: high value of trust and autonomy of their teachers and staff, no nationwide testing system that could destroy the spirit of collaboration that exists in schools today, and a strong belief in the importance of having highly educated teachers. In the absence of a national testing system or national inspectorate, the national curriculum is a key tool for steering the system.

The new vision of learning reflected in the curriculum places the learner at the centre of the learning process, shifts the focus of attention from what to learn to how to learn, conceives learning as taking place in interaction with others, and promotes collaboration in teaching and the development of transversal competences. Learning is believed to take place everywhere and is not confined to the classroom. The importance of having a learning environment that is aligned with such a vision is acknowledged in the curriculum and the planned new investments in education infrastructure taking place in Finland will respond to this new vision.

Highly Valued and Well-Educated Teachers

Finland is said to have the best teachers in the world: they are highly valued and respected by society and experience a high degree of professional autonomy in their jobs. The Finnish education system is based on trust (as reflected by the lack of national examinations and the absence of a school inspectorate system) and on having highly educated teachers. Finnish teachers are satisfied with their jobs, as reflected by the 91% satisfaction expressed by lower secondary teachers in the OECD's TALIS (Teaching and Learning International Survey) 2013 survey. Almost 60% of Finnish teachers believe the teaching profession is valued in society (compared to the 30% OECD average) and almost 85% of them would still choose to work as teachers if they could decide again (compared to less than 80% for the OECD average). The teaching profession continues to attract talented candidates: since teacher education is a popular field of study, higher education institutions in Finland are in a position to select the best-suited candidates and most motivated applicants. Of all education programmes, the one for teachers is the most difficult to gain admission to. Since 2011, only 10 to 11 percent of the applicants have been admitted. In 2016, the proportion of applicants admitted (11%) to teacher education was smaller than the proportion admitted to medical or law faculties.

A Significant Education Investment Programme

For Espoo, education remains a clear priority even though the general policy line adopted by the City Council is that of cost and debt reduction. The city officials reaffirm that the investment amount earmarked for education (approximately €100 million annually) will not be reduced as they would rather cut other types of infrastructure investments than reduce it. Nonetheless, to deal with increasing student numbers, deteriorating air quality in old school buildings and the new requirements of the national curriculum, more schools will have to be built with the same amount of money. Espoo's Education Committee has prepared a school network plan with the aim of optimising education services by closing small, old, outdated schools and opening bigger, safer and more innovative spaces in the expanding city areas. If this plan is adopted by the City Council, there will be significant pressure to go over the investment ceiling to update City's educational infrastructure.

The 2015-2020 investment programme co-financed by the CEB foresees the construction or renovation of nine schools and eight daycare centres for a total of €323 million. Almost half of the investments are planned for the Leppavaara area, while Tapiola and Matinkyla will receive approximately 20% each. These three areas are rapidly expanding in terms of both the total number of students and the number of foreign-born students enrolled in the schools, suggesting that the CEB funds are in fact reaching those most in need.

Recommendations

The high value placed on education and its well-educated teachers already sets Finland apart from most other countries. The significant share of resources allocated to the education sector reflects the high priority it is given. But it is its capacity to think ahead and introduce a visionary curriculum to prepare the system to meet future challenges that makes it exemplary.

The recommendations presented below derive from the review team's brief immersion into the Espoo context, situation and previous experience. The recommendations are to be considered 'talking points' to encourage further discussion and exploration by both Espoo teachers and city officials.

Find the Right Balance between Cost-Effectiveness and Promoting Effective Learning Environments

To respond to the increasing demands for renovated and expanded education infrastructure, the Premises Department is under pressure to find more cost-effective solutions for the construction and renovation of school buildings. The Schools-as-a-Service model, which aims to reduce investment cost by having schools benefit from existing facilities such as laboratories, food and sports areas, is a solution suitable for upper secondary students who can walk independently from one area to the other. The efforts to standardise designs and test module-pre-fabricated schools that can accommodate for some flexibility in pedagogical arrangements is another approach being explored. Prefabricated construction for schools has a long history, particularly through the development of modular classrooms designed to be used temporarily on school premises during the 1960s and 1970s to cater for fluctuations in student numbers[14]. More recently the experiences carried out by the Department of Education and Early Childhood Development of the state of Victoria, Australia, and the Agency for Infrastructure in Education (AGIOn) in Flanders[15] could provide useful information for Espoo officials in search of alternatives.

During the meetings held, the review team observed a certain disconnect between the "cost-effectiveness" concerns of the Premises Department and the "learning processes and outcomes" focus of the Education Department. The recently published "Pedagogical Learning Environment Instructions"

[14] Lenssen, P. (1973), *C.R.O.C.S. A Swiss Industrialised School Building System*, OECD Publishing, Paris
[15] OECD 2011-OECD Centre for Effective Learning Environments webinar series: *"Standardised design" for Schools: Old Solution, New Context?*

attempt to address this gap. The document presents a list of principles and characteristics that should guide the design of a new or renovated school to form a "pedagogically versatile, flexible and functional entity". Guidelines for the planning and design process are included and operational requirements are listed, including concerns over acoustics and safety. Having a list of key features that all schools should have and that should be preserved from costs-reduction efforts could help strengthen the connection between cost-effectiveness and promoting effective learning environments.

For example,

(i) the need to ensure all schools have the capacity to offer a wide range of learning spaces that can accommodate groups of different sizes, from individual learning spaces to pairs of students, to small and large groups, with flexibility along the day, week and school year in line with current curriculum needs and learning theories
(ii) the capacity of the school buildings to be adaptable over time, to respond to changes in purpose and demographics as a way to promote sustainability
(iii) the necessary flexibility to ensure that space can fit different purposes and publics during the day and school year, a central multi-purpose commons space that serves for dining and performances, adjacent to a library and sports facility, which can be open to the community and foster encounters and social interactions that can promote learning at all times.

While all these principles are already present in many schools and reflected in the Pedagogical Learning Environment Instructions, it may be necessary to make them a requirement. Alternatives could include:

(i) further standardisation by developing a standard palette of materials, components and pre-fabricated modules that can be used across different school projects. A carefully selected range will still enable creative building design, but offer advantages including economy of scale, and confidence that particular components or prefabricated modules are appropriate and robust enough for the context;
(ii) less complex building forms and shapes. Although the form of the building is constrained by the shape of the site, complex forms can be inherently more costly to construct and maintain, and can also be less energy efficient. They will have more external wall area than a simple rectangular form, leading to overall expensive cladding solutions, and a greater surface area exposed to the weather and possibly requiring more maintenance. It is possible to imagine a standard compact design that could be cost-effective while at the same time providing for the necessary space that fosters interactions and flexibility in the arrangements of the different learning areas.

Without these considerations, there is a risk that pressures over cost-savings may impact negatively on the effectiveness of the learning environments.

Systematically Involve the School Community in the Design Process

Discussions with principals and staff of the eight schools visited revealed a wide range of experiences in the level of involvement of the school community in the design process. Research evidence suggests that when the school staff is involved in the design process, the potential offered by the new learning environments tends to be more effectively used. Fostering such exchanges systematically and allowing for the necessary time and resources to be allocated for such purposes can promote a more effective design and use of the premises.

The fact that there is such a diverse range of users, all with their respective needs and approaches to teaching and learning, supports the argument for involving them in the conversation. The development of an educational brief as well as the design and construction brief is an iterative process which involves testing and retesting ideas so as to refine the understanding and refine the problem. This suggests a process which involves regular conversations with the school community at specific points in time, from early definition of the education brief through to finalisation of the design.

This is often achieved through design workshops involving all the people, or a representative sample, in order to get the full breadth of understanding. It may involve testing pedagogical ideas, testing spatial solutions as well as visiting and observing other schools. Through this approach, the school community develops a better understanding and shared vision of their needs and how they can use the spaces being designed to support their work.

In practice, this would require the following:

(i) Develop an effective design process. If more effective pedagogic use of the new designs is to occur, the high-quality design processes in place in this school district require the addition of a pre-design educational component. It was evident that, while City Education officials had some input early in the design process led by the City Premises Department, effective school-based input was sought at a much later stage when major decisions had already been virtually locked into place.

(ii) Empower effective teacher participation in the design, occupation and inhabitation of new spaces. As an addendum to (i) above, it is highly recommended that the professionals who will actually teach in these spaces should be part of a pre-planning working group. It is this body of professionals who best understand the nuances of the learning community that will occupy a new build, thus are in a privileged position to articulate the concepts that drive its conceptualisation

(iii) Utilise 'best learning environment practices'. This means seeking examples globally of outstanding pedagogic use of innovative learning environments, and using that knowledge to guide Espoo's particular needs. Finland is at the forefront of effective educational practice and has achieved this position by developing a unique approach using quality global evidence as a guide. A similar approach must be strongly embedded in Espoo's learning environment development

(iv) Develop effective school 'spatial learning' teams. Many schools mentioned the fact they were represented on the design teams, but predominately by the principal only, and in some cases it was questioned how much their input was utilised. One recommendation is the formation of school-based design teams, instigated at the earliest (pre-design) stage, with a mandate to provide critical school-based knowledge to the larger design team at each stage of the process.

Provide the Necessary Support to Teachers to Transition into the New Learning Environments by Developing and Implementing an Effective Spatial Professional Development Programme

The highly educated Finnish teachers are used to solving the challenges they encounter by themselves since the system trusts their professionalism to find the right answers, and preserves their autonomy to do so. Nonetheless, discussions with teachers of the eight schools visited revealed their need for support in the transition to these new spaces, new curriculum, and increasingly diverse contexts. Some very experienced teachers confirmed that their initial training was not sufficient to tackle these new challenges. While a large number of courses and seminars exist to support their professional development, they indicated that these seminars were somehow disconnected from the day-to-day challenges. Younger teachers did not feel any better prepared to respond to the new pedagogical approaches promoted that encourage team teaching and the promotion of transdisciplinary competences.

The reality is that the ultimate effectiveness of any investment depends on how well it is used. An expensive and high-quality build represents a poor return on investment if it is not utilised well. After all, the ultimate goal is not to produce a wonderful school, but to produce a school that is wonderful because it works so well for students. The facilities must, as a priority, aim to improve student learning experiences and outputs. In this regard, international research is unanimous in identifying the teacher as the factor that correlates most strongly with student 'success'. Thus, as part of any build, investing in teachers' effective use of the spaces must be seen as a priority, and an important component of the budgeting process.

Concerns with the new challenges faced by teachers led the Ministry of Education to announce at the January 2016 Teacher Forum their aim to renew teachers' initial and continuous professional development. Almost 100 forum members and experts were involved in the development of the Teacher Training Development Programme and nearly two thousand education experts, students and teachers participated in the development programme.

Several of the teachers met indicated having participated in a Mentors' training programme the previous year, as part of a national initiative, but these programmes did not seem to focus on how to make effective use of the new, innovative learning environments. While the high level of trust in the professional competences of the teachers and the respect expressed for their autonomy is commendable, there is a risk that too much respect for their professional competence may be preventing them from receiving the necessary support to transition into new learning spaces and practices. While the competent and well-educated Finnish teachers will always find a way to resolve their challenges, it may take longer than necessary to find the answers by themselves. More guidance and support during the transition, such as the opportunity to test and experience the proposed innovative environments through prototype classrooms, as part of an Effective Spatial Professional Development Programme, could contribute to a smoother transition and promote more effective use of the potential of these learning environments.

In order to achieve this, gaining evidence of how well the spaces 'work' in terms of quality teaching and learning becomes a priority. This information drives ongoing professional development, and better design of future schools. It is this cycle of continuous evidence-based development that must underpin Espoo's massive investment in modern learning environments. This means developing a method of evaluating the impact of space on student learning.

To support the implementation of these recommendations, it would be useful to further develop data collection efforts, as gathering good evidence is essential to driving good practice. It is also necessary to have teachers' spatial awareness recognised as simply one aspect of an overall strategy for teaching improvement. Even with quality evidence, significant support is required to create a 'spatial-change' culture among teachers in a municipality recognised internationally for its high quality. The scope for educational improvement through teachers' better use of spatial designs is significant. Professional development is critical for this to happen. Building useful and useable professional development modules and structures that support quality teaching practices would be of value. Finally, benchmarking against world best practice can be beneficial. The challenge is to not reinvent the wheel. Significant evidence is mounting globally concerning the design and use of quality schools. In particular, advances are being made in teacher use of modern learning environments, and how to assess their educative performance. Finland is home to many exemplar designs, and could therefore find it useful to benchmark its own advancements against significant work done internationally.

Annex 1 School Selection and Data Collection Instruments

The review team designed two questionnaires and an interview protocol to collect the necessary data. They are presented below. In addition, the principals completed the School Design and Use Survey presented in Annex 6.

A. Schools Visited

Table 1: Schools visited by the Review Team

SCHOOL	EDUCATION LEVEL	AREA	TYPE OF WORKS
Investments co-financed by CEB			
Aurora	Comprehensive school, daycare centre and nursery	Leppavaara	New construction
Kirkkojärvi	Daycare centre	Vanha Espoo	New construction
Päivänkehrä	Comprehensive school	Matinkyla	Renovation
Tapiola	Middle and upper secondary school	Tapiola	Renovation
Schools not co-financed by CEB			
Kirkkojärvi	Comprehensive school	Vanha Espoo	New construction
Saunalahti	Comprehensive school	Espoonlahti	New construction
New cost-effective models for schools			
Haukilahti *Schools as a Service*	Upper secondary school	Tapiola	Renovation
Karhusuo *Module-prefabricated model*	Elementary school	Vanha Espoo	New construction

B. Espoo Schools Background Datasheet on Teachers and Students

SECTION 1: THE SCHOOL									
1.1	**Name of school:**								
1.2	**How long has the Principal at the school been in post?**			Years:					
1.3	**Role of the current Principal in latest renovations**								
	a.	Was the Principal involved?		Yes:			No:		
	b.	Please briefly describe your role: ……							
SECTION 2: ABOUT THE STUDENTS AT THE SCHOOL									
2.1	**a.**	**Total school enrolment** *(number of students)*							
	b.	**Number of students enrolled in each year level**							
		(Please give year or grade levels and numbers for each)							
	c.	**Number of students with special needs enrolled at the school**							
	d.	**Total student capacity of the school**							
2.2	***Information on the background of the students***								
	a.	**Number of foreign-born students enrolled**							
	b.	**Number of Swedish speaking non-Finnish students**							
	c.	**Nationalities represented at the school (please list)**							
2.3	**What special activities are provided to support the integration of foreign-born students?** *(List types of activities)*								
SECTION 3: ABOUT THE TEACHERS AT THE SCHOOL									
3.1	***Number of teachers employed at the school***								
	a.	**Number of teachers** *(A full-time teacher is employed at least 90% of the time as a teacher for the full school year. All other teachers should be considered part-time.)*							
		i)	Full-time teaching staff						
		ii)	Part-time teaching staff						
	b.	**Number of non-teaching staff**							
		i)	Full-time non-teaching staff						
		ii)	Part-time non-teaching staff						
	c.	**Annual teaching staff turn-over**							
3.2	***Teachers' work experience***								
	a.	**How long teachers have been at the school** *(Percentage of total)*:							
		i)	Less than one year:						_____%
		ii)	1 to 5 years:						_____%
		iii)	6 to 10 years:						_____%
		iv)	More than 10 years:						_____%

	b.	**Teaching experience, percentage that have been teachers for:**		
		i)	Less than one year:	_____%
		ii)	1 to 5 years:	_____%
		iii)	6 to 10 years:	_____%
		iv)	More than 10 years:	_____%
	c.	**Number of teachers that have work experience outside teaching**		
3.3	***Teachers' workload***			
	a.	Average weekly workload for teachers employed full time		hrs
	b.	Average number of hours per week that teachers spend planning, sharing experiences as a team (per subject, grade, or overall school)		hrs
3.4	***Teacher professional development***			
	a.	Number of days per year that teachers are given for professional development activities *(Average)*		____days
	b.	Number of days (Approx.) that these professional development activities take place:		
		i)	In the school	____days
		ii)	Outside the school (e.g. attending courses, seminars etc)	____days

C. Espoo School: Background Data Sheet

THE SCHOOL		
Name:		
Year school building originally constructed:		
SPATIAL CONFIGURATION AND SIZE		
Total land area of the school site:		**m2**
Total gross internal floor area of the school buildings (total floor area measured to the inside of external walls)		**m2**
Proportion of overall floor area for:		
	Administrative activities (i.e. not used for teaching / learning activities)	**%**
	Student activities (i.e. learning and recreation)	**%**
	Community uses only (e.g. parents' room, healthcare, extended services)	**%**
Proportion of the overall floor area for circulation space (such as corridors, staircases and hallways)		**%**
Proportion of the circulation space used for structured or unstructured learning/ teaching activity		**%**
FINANCING AND MANAGEMENT OF THE SCHOOL BUILDING(S)		
Source(s) of funding (approximate %):		
	Government:	**%**
	Benefactors, donations, bequests, sponsorships, parent fund raising:	**%**
	Other:	**%**
Cost of maintenance during the following years(where applicable):		
	2015	
	2016	
	2017	
Annual operational costs of the building(s) (or give period if not annual)		
	Total running costs:	
	Maintenance and repairs:	
Where the school building(s) has been recently renovated, operational costs of the building(s) up to the end of the financial year immediately before the renovation:		
	Total running costs:	
	Maintenance and repairs:	
Cost and nature of major repairs and maintenance over last five years		
	Cost:	
	Nature of work:	
NEW CONSTRUCTION / RENOVATION (New building construction includes a whole new building or a building addition which is a new structure)		

Total gross internal floor area (floor area measured to the inside of external walls)		
	New building(s) constructed (m2)	
	Renovated buildings (m2)	
Form of procurement:		
Start and completion date of construction/renovation works:		
	Start date:	
	Completion date:	
Cost of construction project:	**Total project cost:**	
	Professional fees	
	Design:	
	Supervision (project management)	
	Construction:	
	Structure	
	Services	
	External works	
	Fittings, furnishings and equipment	
Nature of renovation work:		
SOURCE OF ENERGY AND ENERGY USE		
Annual energy use	**Electricity**	**kWh:**
	Gas	**kWh:**
	Other	**kWh:**
Where the school has been recently renovated, the annual energy use for the year immediately before the renovation:		
	Electricity	**kWh:**
	Gas	**kWh:**
	Other	**kWh:**
Energy produced on school site:	**Photovoltaic panels**	**kWh:**
	Solar panels	**kWh:**
	Wind turbine	**kWh:**
	Geothermal	**kWh:**
	Other	**kWh:**
HOURS SCHOOL IN USE		
Hours per day during term time the school is used for education		
Hours per day during term time the school is used for after school activities		
Hours during the year the school is used for education		
DATA ACCESS		
Speed of the school's internet access:	**Download speed**	
	Upload speed	

	Line speed	
BYOD policy. Are students required to bring their own device (leased, bought, or regularly take home a school-owned device)?		
COMMUNITY USE		
Proportion of the overall internal space that can be used by the community for:		
	Delivering community services during the school day	%
	Delivering community services after school hours	%
	Community activities after school hours	%
Facilities shared by the school with other schools		
	Classrooms	
	Internal sports facilities	
	Outside sports facilities	
	Library	
	Other	
Frequency that the school (or parts of it) is used by the community		
	Every day	
	At least once a week	
	At least once a month	
	Occasionally (less than once a month)	
	Never	
Hours per day the school (or parts of it) is used by the community for a community activity		

D. Interview Protocol - Guiding Questions

The interview protocol contained three clusters of questions.

- Questions seeking an understanding of the **key educational principles** that frameworked teaching practices in the school. This cluster served to *establish the educational intent* of the new build. Questions included:
    - What is good learning?
    - What educational knowledge/theories shape your teaching approaches?
    - What will good learning look like in ten years' time?
    - Were these beliefs accommodated within the design process?
    - Did you participate in the design process?

- Questions seeking an understanding of the building's **educational performance**. This cluster served to *explore perceptions of alignment between design and pedagogic intent*. Questions included:
    - What does this building allow you to do well, pedagogically?
    - Do you feel the building holds back your best practice?
    - What does good learning look like, and do you see it here?

- Questions seeking an understanding of the **educational impact** of the building. This cluster served to *explore the building's performance in terms of meeting its educational aims*. Questions included:
    - Is this building letting you teach as best you can?
    - How do you recognise good learning when it occurs?
    - What design features would you now change?

Annex 2 Characteristics of School Design

Space Types and Uses

Evolution of existing types of space

There is a trend towards designing schools with more open space and with fewer walls between learning spaces, although it falls short of the open-plan forms created during the 1960s and 1970s. The far end of this spectrum might be characterised as a school building with spaces that tend to comprise a mixture of semi-enclosed and fully enclosed spaces with varying degrees of convertibility enabled by the provision of sliding or folding walls. Plans with this type of space are often arranged so that there is a large space connected to smaller spaces which may not be entirely closed off, but are defined by a wall on two or three sides and described as the 'learning landscape' model (Schneider, 2015)[16]. Although this might describe the direction of travel in terms of school building design, relatively few schools have been designed like this.

The uniformity of 'classrooms' in the conventional model is giving way to greater variation in the sizes of learning spaces. To some extent there has always been some variation in classroom space sizes for example, science laboratory classrooms have generally been larger than standard classrooms for the same group size. However, there is now greater focus on creating smaller spaces, providing opportunity for small group work, individual work or quiet areas. These may often be clustered with larger spaces as shared breakout spaces.

There has also been growing emphasis on creating multi-functional spaces with larger spaces such as halls being convertible to an auditorium, or to a sports hall. The trend is to reduce the amount of space that has a fixed or specialist use because it limits the use and is less efficient. For example, in a science laboratory, the fixed benches containing the sinks are placed around the perimeter of the room so that moveable tables and chairs can be put in the middle of the space, thus enabling the space to be more easily used in different ways.

There has also been a growing focus on the use of external areas for learning, for example by creating external classrooms which may be accessible from internal spaces. Clearly the applicability of this strategy depends on the climate.

New types of space

There are some new spaces that are now appearing more frequently in schools. These are the following:

Street-space: learning zones are being incorporated within circulation routes so that corridors are becoming what Dovey and Fisher[17] describe as 'streetspace'. These zones are free spaces for students to use whenever they like, or can be used for specific structured learning activities where they are adjacent to larger learning spaces.

Commons space: this is a semi-enclosed learning space that provides a range of settings for group, individual and quiet work. They are not necessarily large spaces; Dovey and Fisher suggest that they should be greater than 40m². These spaces are not part of the main circulation route in that people will not pass through them to get anywhere else. They may be scattered throughout the building, perhaps combined with clusters of learning spaces.

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[16] Schneider, J., *Learning from school buildings*, in Ed: Meuser, N., School Buildings: Construction and design manual, Dom Publisher, Berlin, 2014

[17] Dovey, K; Fisher, K, *Designing for adaptation: the school as a socio-spatial assemblage*, Journal of Architecture, 2014 19(1), pp.43-63 (21)

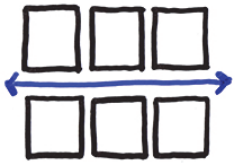
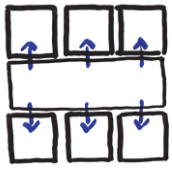
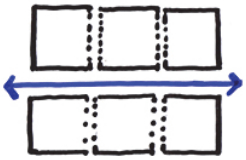
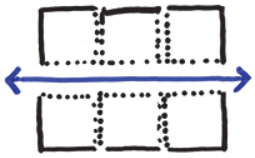
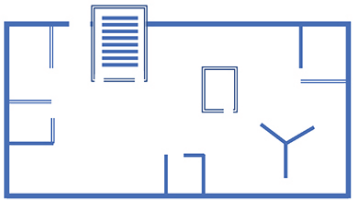
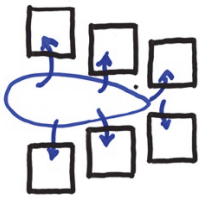
Central commons area: this is primarily an area for social interaction, but may have a range of different 'learning settings' such as quiet areas, or areas for group study or individual work. This space will often incorporate the dining/canteen areas and possibly the library. The trend has been to locate this space in a relatively central position in the plan of the school, near the entrance and in a way that gives access to the teaching areas. In school buildings that are more than one storey high, this space may well be an open space the full height of the building with a visual connection to each floor.

Creating a relationship between spaces

The individual spaces are the 'building blocks' for the overall school spatial design. What is also important is how the spaces are assembled to create relationships between them. Grouping spaces in a particular way suggests a possible pattern of use, but also, as Hillier (2005) points out, "space is an intrinsic aspect of everything humans do (…), in the sense of moving through space, interacting in space"[18]. There is a growing trend towards grouping spaces in a range of different ways and using openable walls such as sliding or folding partitions to provide more flexibility.

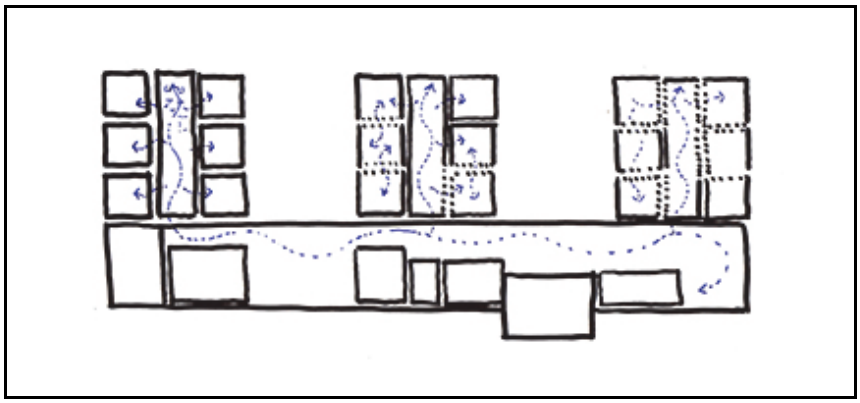
The spaces might be grouped around a common learning space to form a learning cluster, or open onto an adjacent streetspace to enable teachers to create different permutations of spatial arrangements, or the space may be opened up so that there are no fully enclosed spaces. Researchers have mapped these differently: Schneider (2015) who describes learning clusters[19], Loop.bz, a Danish consulting firm, talked of traditional, varied and learning landscapes, and Dovey and Fisher (2014) presented five broad cluster types that lie along a continuum from the traditional corridor to fully open plan[20]. Diagram 1 summarises the different groupings. Different versions of these arrangements may appear in the same school, for example diagram 2 below shows a finger plan form with different cluster arrangements.

Diagram 1: Summary of the space groups

 A. Traditional classroom grouping. Fixed walls	 B. Learning cluster with common learning space or streetspace. Fixed walls	 C. Learning clusters with openable walls between classrooms
 D. Learning clusters with openable walls between classrooms and the central learning space or corridor	 E. Fully open plan	 F. Hybrid cluster part corridor, part open learning space

[18] Hillier B (2005) "The Art of Place and the Science of Space." *World Architecture* 11/2005 185, Beijing, Special Issue on Space Syntax pp 24-34 in Chinese, pp 96-102 in English.
[19] Schneider, J., "Learning from School Buildings," in *School Buildings: Construction and Design Manual*. Ed. Meuser, N. Dom Publisher, Berlin, 2014.
[20] Dovey, K.; Fisher, K., "Designing for Adaptation: The School as a Socio-Spatial Assemblage." *Journal of Architecture*, 2014 19(1), pp.43-63 (21).

Diagram 2: Different clusters can appear in the same school building



This diagram shows a layout plan with different cluster arrangements

Flexibility

One reason for the evolution of space types is the changing approach to teaching and learning that has developed from a better understanding of how students learn. The greater focus on different approaches to learning, from whole group presentation to individual work, requires spaces that can accommodate this variety but that can also be reconfigured during the day.

Flexibility of school buildings has become important because of the recognition that a building should be able to respond to user needs as they change over time. Three arguments often underpin the need for flexibility. First, a building constructed to meet a limited set of demands may well be liable to early obsolescence; second, spatial efficiency – it is more efficient to use the same space for different activities than have several different spaces used infrequently; third, the size and arrangement of spaces may need frequent adaptation to suit variations in, for example, sizes of student groups. Not only is education subject to continuous change, whether driven by government policy, technology or pedagogical approaches, but also the needs of students and teachers can change from day to day. The less flexible a building is, the more it will constrain how people can use it.

There is no single definition of flexibility with an agreed meaning. However, a useful way of considering this is to consider how a building should respond over three different time horizons, the long term, the medium term and the short term. Taking these time-horizons into account, there are three broad ways in which a building can accommodate change:

- *Adaptability,* where the building is responsive to change over the long term. For example, it can be made larger to accommodate more students. This involves substantial changes to the fabric and possibly the structure of the building.
- *Adjustability,* where parts of the building can be reconfigured over the short to medium term by manipulating elements to create different spatial arrangements. For example, to make space larger, smaller, or a different shape.
- *Agility*, which refers to short-term flexibility where the settings, furniture and IT equipment can be rearranged quickly and easily. This relates to changing the use of the space and is the kind of change that individual users might be able to make themselves. An agile learning space is one that can respond to the needs of students and teachers quickly and, in particular, one where the furniture and technology such as projectors and display screens can be easily rearranged. The flexibility afforded by the furniture and ICT equipment is key to this, and so too is the general usability of the environment, which should ensure students and teachers can move openable or folding walls easily.

To evaluate the adaptability of the building would demand analysis of the structural design, which is beyond the scope of this review. From the point of view of this review the three particular aspects to consider are adjustability, agility and flexibility in use. To evaluate adjustability, we can look at the extent to which there are ways of reconfiguring the spaces, generally with the use of openable walls. Agility can be evaluated by considering the ease with which it is possible to rearrange the furniture, IT equipment and any openable walls. Flexibility in use refers to flexibility from a user perspective: How does the space, configuration of individual spaces and assembly of all of the spaces support different uses? This brings together aspects of adjustability and agility. A number of technical characteristics of space support flexibility and can be used as a basis for the analysis. They are summarised below:

Summary of Technical Characteristics Supporting Flexibility

Size of space

The space used for learning, or any other activity, has to allow not just for the people but also for their ability to move around the room, and must allow for space between people or groups of people, as well as any necessary supporting furniture. Accessibility by wheelchair not only means providing sufficient width of uninterrupted space, but also space for the wheelchair to turn and be pulled up to a table or desk. The space needed for people to walk around a room may be less.

The size of the space in terms of floor area determines how many people can use the space for any given activity or purpose. For example, in a space which is 10m x 6m, it may be possible to seat 50 people in lecture room style with no tables and allowing space at the front for the presenter, and at the back and sides for circulation. However, in the same space you might be able to seat 30 people seated at desks, again in rows facing the presenter. If group tables were needed, then the capacity would be still less, possibly 24.

Other factors which also impact on capacity include shape (discussed below), the amount of equipment in the room, and furniture that cannot be easily moved. How the furniture in the space can be laid out is determined by its shape as well as the location of entry and exit points and how far people are from each other or from the teacher.

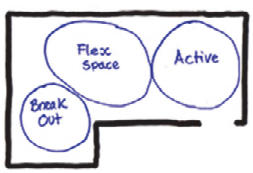
For specialist spaces such as science laboratories, the space allowance per student is often greater to allow for fixed furniture such as benches and sinks, but also enough space to conduct the specific investigative activities required by the curriculum.

Shape of space

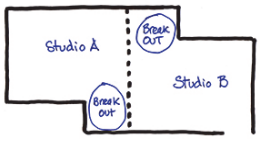
The shape of the space suggests how the space may be used for different arrangements and groupings of furniture. Conventionally, a rectangular shaped space is used, although irregular shapes such as trapezoids and circles and ovals can work with different furniture arrangements. Spaces with tight angles can be harder to use efficiently.

The shape of a space can suggest that there is an opportunity to create different zones. For example, an ‘L’-shaped room lends itself to being arranged so that one activity can take place in one leg of the ‘L’ and another activity can take place in the other. This feature can be useful for zoning space, as, for example, in diagram 3. This may be a more useful feature for classrooms for younger students.

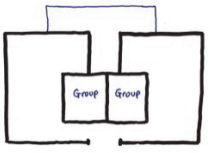
Diagram 3: Different options for arranging spaces to create a range of opportunities



A: ‘L’-shaped room with three activity zones



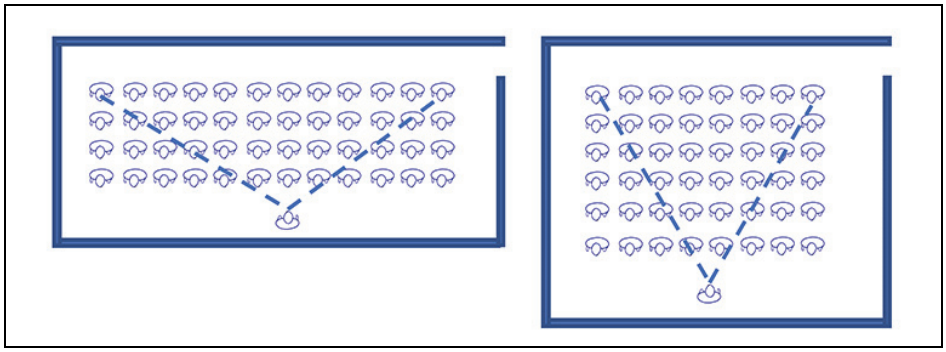
B: Two ‘L’-shaped rooms divided by an openable wall



C: Learning suites divided by group rooms that could be opened

A long thin shape might well reduce its usefulness as there are very long rows with longer distances between the presenter and the end of each row than might be the case in a squarer-shaped space. See diagram 4.

Diagram 4



Adjacency

Spatial adjacency describes whether one space is next to another. It is often important to cluster certain spaces so that people can access them easily and quickly. It is also important to keep some separation between certain types of spaces, for example, keeping spaces with noisy activities away from those where there may be a need for quietness. Common clusters include small group rooms with a larger learning space to create variety and flexibility of use. Other ways in which spaces can be grouped are noted above.

Interconnectivity

Openable walls are the principal feature, and these enable different spaces to be joined or subdivided. Doors between spaces are more limited, but provide physical links. While openable walls are useful for reconfiguring spaces, users can find them difficult to move because they are heavy or awkward. Also, if poorly fitted and there are gaps at the top or bottom of the panels, then sound can travel easily between spaces; care is therefore needed to ensure that sliding partitions provide the level of sound quality needed.

Furniture

Although there is some discussion in research on the ergonomics of furniture, little linkage is drawn with student outcomes. Some research suggests that discomfort with seating was more likely to be raised at secondary level because the students are bigger (Nielson, 2004). Some argue that the ergonomics of furniture may be more important in spaces where students will be focusing for longer periods of time than in those areas where there is more casual use, such as cafeterias, or when students are more likely to be moving around, such as in art or science. Whether adjustable furniture is the solution may depend on the extent to which students are expected to move around a space during a class and so have to keep readjusting the height of the chairs or tables.

Round tables facilitate conversation, but rectangular tables can be put together in different ways to create a larger surface for a different sized group.

Being able to move the furniture easily facilitates quick rearrangement of spaces to create different learning settings.

White board and display screens

Given that common features of learning spaces are whiteboards and display screens connected to multi-media terminals, an issue that does arise is the extent to which these can be easily relocated in a space. If they are fixed in one position, for example mounted on a wall at one end of the room, then the focus of the space tends to remain fixed, whereas the teacher may want to that focus.

Transparency

Another clear trend these days is that schools are designed with greater transparency through the building. This is often achieved by creating an open space, or using glazing between spaces in the form of fully or partially glazed walls. The arguments for this are that it creates a sense of connectedness whereby people feel more connected to the school as a whole and can be participants in education whether as observers or active players. However, there are arguably both advantages and disadvantages in increasing transparency, and little research to draw upon in the matter.

The benefits generally include the value of passive supervision, where it is argued that students working in groups outside the main classroom or learning space can be easily seen; a sense of openness while retaining acoustic separation that makes the culture of learning visible and increases the perceived connections of people to the school; and the opportunity to bring natural light further into the building. However, while some argue for the benefits of monitoring student activity others argue that greater transparency leads to students being distracted and that teachers and students lose some privacy and feel uncomfortable with being 'observed'[21] This would suggest that a balance needs to be struck to maximise the benefits of transparency but alleviate the disadvantages, whether by reducing the extent of fully glazed walls or by being very selective about where transparency is actually used.

People can feel more connected in the spatial environment when they can see what is happening around them, and can move easily from one place to another so they feel part of it. In schools, connectedness can be afforded by visibility across spaces, either because there are no solid walls or because there are glass walls; and it can also be afforded by how close the spaces people often use are to each other, and how easy it is to move from one space to another.

[21] *The impact of physical design on learning spaces*, Ministry of education, New Zealand, 2016

Annex 3 Use of Learning Environments

Research Protocol: Selected Espoo District LEaRN Evaluation

Five theoretical concepts underpin the LEaRN contribution to this analytical framework.

21st century learning skills: At best, a re-conceptualisation of international curricular goals, but in reality a loosely conceptualised phenomenon, these skills have been prescribed in key policy documents from a number of countries over a long period of time (for example the UKs *Plowden Report*, and Australia's *Melbourne Declaration*), and have been developed into a wide educational discourse. In general, this concept argues:

- The 21st century requires, and will require, graduates with a set of skills not necessarily being addressed by traditional compulsory-education programmes;
- These skills focus on interpersonal qualities, rather than functions that can be seen as routine cognitive;
- Four key characteristics summarise these skills – Communication Skills, Critical Thinking Skills, Creative Thinking Skills, and Collaboration Skills, or the 4Cs.

As a component of this conversation:

- It is further argued that the 4Cs cannot be adequately developed through traditional 'teacher-centric' pedagogies, which are a feature of traditional classroom environments;
- Flexible, adaptive learning spaces must be built to accommodate student-centric pedagogies;
- It is argued that the development of so-called Innovative Learning Environments (ILEs) has the capacity to meet this need.

Student deep learning

Differentiated learning (the concept that students learn in different ways, and instruction must recognise and facilitate this) is one principle that has driven much quality educational curriculum theory for many decades. It underpins innovations such as problem-based learning, inquiry-based learning, and student-centred learning. An indicator of differentiated learning is the degree to which students occupy a 'superficial to deep learning' continuum; in simplistic terms, superficial learning is what occurs when students study simply to meet assessment requirements, and deep learning is using knowledge to explore relevance and build personal beliefs. In the context of this project, 'deep learning' is considered the optimum. While deep learning theories enjoy a wide and varied educational research discourse, Biggs is one proponent who has articulated measurable characteristics of deep learning (see table below). These are embedded in LEaRN's Space Design and Use (SDU) survey (Imms, et al, 2017[22]).

[22] Imms, W., Mahat, M., Murphy, D. & Byers, T. (2017). *Type and Use of Innovative Learning Environments in Australasian Schools – ILETC Survey.* Technical Report 1/2017. Melbourne, Australia: LEaRN, University of Melbourne. Retrieved from http://www.iletc.com.au

Table 1: Measurable characteristics of deep learning

	Deep learning	Surface learning
Definition	Examining new facts and ideas critically, and tying them into existing cognitive structures and making numerous links between ideas.	Accepting new facts and ideas uncritically and attempting to store them as isolated, unconnected, items.
Characteristics	Looking for meaning. Focusing on the central argument or concepts needed to solve a problem. Interacting actively. Distinguishing between argument and evidence. Making connections between different modules. Relating new and previous knowledge. Linking course content to real life.	Relying on rote learning. Focussing on outwards signs and the formulae needed to solve a problem. Receiving information passively. Failing to distinguish principles from examples. Treating parts of modules and programmes as separate. Not recognising new material as building on previous work. Seeing course content simply as material to be learnt for the exam.
Encouraged by students	Being intrinsically curious about the subject. Being determined to do well and mentally engaging when doing academic work. Having the appropriate background knowledge for a sound foundation. Having time to pursue interests, through good time management. Positive experience of education leading to confidence in ability to understand and succeed.	Studying a degree for the qualification and not being interested in the subject. Not focussing on academic areas, but emphasising others (e.g. social, sport). Lacking background knowledge and understanding necessary to understand material. Not enough time / too high a workload. Cynical view of education, believing that factual recall is what is required. High anxiety.
Encouraged by teachers	Showing personal interest in the subject. Bringing out the structure of the subject. Concentrating on and ensuring plenty of time for key concepts. Confronting students' misconceptions. Engaging students in active learning. Using assessments that require thought, and requires ideas to be used together. Relating new material to what students already know and understand. Allowing students to make mistakes without penalty and rewarding effort. Being consistent and fair in assessing declared intended learning outcomes, and hence establishing trust (see Constructive Alignment).	Conveying disinterest or even a negative attitude to the material. Presenting material so that it can be perceived as a series of unrelated facts and ideas. Allowing students to be passive. Assessing for independent facts (short answer questions). Rushing to cover too much material. Emphasizing coverage at the expense of depth. Creating undue anxiety or low expectations of success by discouraging statements or excessive workload. Having a short assessment cycle.

Houghton, W. (2004) *Engineering Subject Centre Guide: Learning and Teaching Theory for Engineering Academics. Loughborough: HEA Engineering Subject Centre.*

Biggs, J. (1999). *Teaching for Quality Learning at University.* SHRE and Open University Press.

Entwistle , N. (1988). *Styles of Learning and Teaching,* David Fulton.

Ramsden, P. (1992). *Learning to Teach in Higher Education,* Routledge.

Teacher mind-frames

Educational research consistently finds that the most significant factor impacting students' learning outcomes is quality of teaching. As one example, Hattie's (2011/2017) synthesis of >1000 meta analyses on student learning outcomes creates an empirical 'hierarchy' of the educational factors proven to impact student learning. High-effect (>d 0.4) factors in this hierarchy are facilitated by teacher actions. Hattie conflated these into a set of 10 characteristics – the '10 Teacher Mind-frames' (Hattie & Zierer 2017[23]). These are embedded in the SDU survey.

The existence of an informative 'typology' of learning environments

It cannot be assumed ILEs conform to an easily summarised type. On the contrary, they vary considerably, with this diversity driven by (1) complex community needs, or educational philosophies underpinning their design; (2) the pedagogic aspirations of the school, to be enacted in the design; (3) architectural responses to these educational briefs; (4) the actual use of the spaces. In combination, these factors result in a myriad of design solutions. The typologies, summarised by Dovey and Fisher (2014),[24] are the result of an analysis of design characteristics in international school design awards. The resultant 'typology' of these solutions is not intended to illustrate actual designs; instead they provide a characterisation of spaces for further analysis and examination. These five typologies are embedded in LEaRN's SDU survey.

Evaluation of the effectiveness of innovative learning environments

Evaluation of learning environments is an imprecise and underdeveloped concept. However, some significant milestones towards this goal have been accomplished by organisations such as the OECD's CELE group, and the LEaRN research centre. Six issues are characteristic of these goals:

- No one evaluation tool can adequately capture the required data;
- Any evaluation must incorporate the *needs* of the clients and the *purpose* of the build (Imms, Cleveland and Fisher, 2016[25]);
- It is possible to empirically summarise the pedagogic and design intentions of the build – this is preferable to singular qualitative analyses;
- The simplest but methodologically weakest approach is to carry out pre- and post-implementation surveys;
- The most difficult but methodically most effective approach consists of randomised control trials or, if not possible, comprehensive longitudinal studies that utilise complex psychometric measures;
- The best approach when considering cost and effect, is a repeated measures design capable of isolating space as a variable, such as a single-subject research design (for example Byers and Imms, 2016[26]).

An overview of this conceptual approach is presented in Imms (2016a). The Espoo project, while not an evaluation, will draw on these principles to collect data needed to meet the goals of the review.

In terms of evaluation tools capable of capturing these data, LEaRN has a suite developed over the past decade of research. However, in recognition of the short field work timeframe and limited budget, this project will utilise one validated tool, LEaRN's SDU survey. From this, a cluster of interview/observation topics will be derived.

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Annex 4 Technical Characteristics of Schools Visited

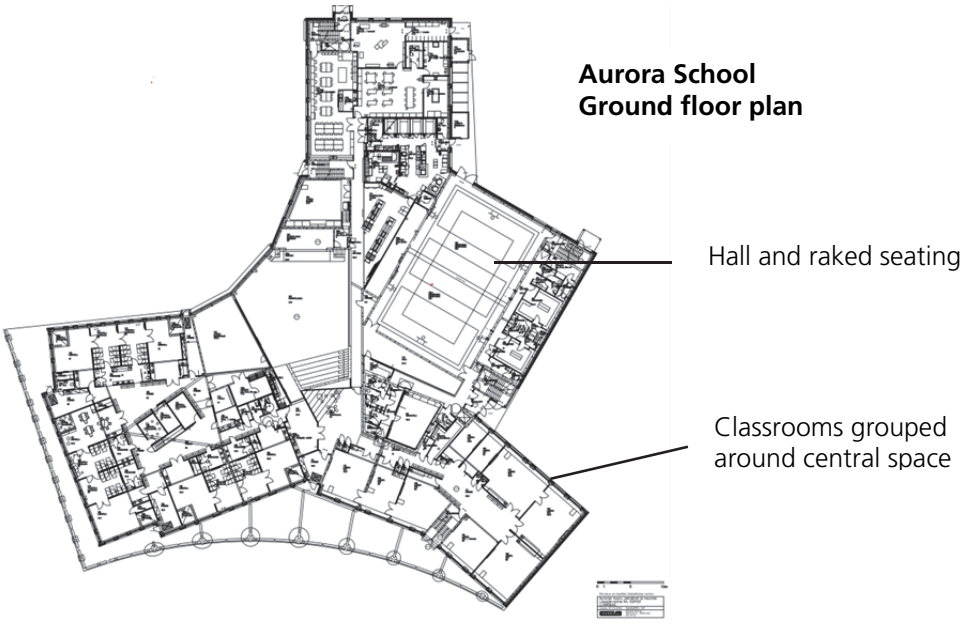
❶ Aurora School

The building is planned around a central space, which forms the school hall and auditorium, and three wings. In one wing is the daycare centre, which is single storey (this part of the building was not visited during the review visit), the second wing has the classrooms grouped around a central learning space over two storeys, and the third wing has art and music classrooms with a maternity and child health clinic on the first floor.

Each wing is relatively wide, which means that the centre of such a plan could be very dark. However, this has been avoided by opening up views through the building that also bring light deeper into it. Glazed panels are used in many parts of the interior of the building to enable the light to penetrate through the building. The overall impression is a visually light building where one gets a sense of the connection between spaces.

The main entrance to the building brings people into the central space from which the main circulation route will take them to the different parts of the building. While the daycare centre can be accessed from within the building, it also has its own main entrance.

Throughout the building, the surface materials include concrete and natural finish wood, with splashes of colour from the furniture.





1. Technical characteristics of the main learning spaces

- **Size**: Classroom sizes range from about 20sqm to 55sqm.
- **Shape**: Rectangular
- **Adjacencies**: Classrooms are clustered. Groups of 4, 5 and 6 open off a common learning space. Some classrooms have doors connecting to adjacent classrooms.
- **Interconnectivity**: Not a feature in this school.
- **Furniture**: Generally, the chairs are adjustable and can be wheeled across the rooms. In the classrooms, triangular shaped tables are used and can be arranged in a variety of layouts for individual or group work. Circular and rectangular tables are used in some other areas.
- **Whiteboards / display screens**: Whiteboards/blackboards are fixed at the front of the classroom.
- **Transparency**: Some of the spaces have glazed panels, some have full-height glazing and some only have vision panels and fully glazed doors. High level glazing along the top of the interior walls of the classrooms adjacent to the internal learning space and corridors enable light to penetrate into the interior.

2. Classrooms

The classrooms are in groups of 4, 5 or 6 and clustered around common open learning areas where informal learning settings have been created and lockers and coat racks are located. The main hall has, on one side a stage, and, on the other, raked seating that steps up to form a stairway to the next level. In the daycare section, which occupies the ground floor of one wing, activity rooms are arranged around a central common space. Adjacent to each activity room is a sleeping area providing separate but connected spaces for sleeping and play.

3. Library/commons

The library/commons area is situated on the first floor, adjacent to the stairway at the top of the auditorium. It is a fully enclosed space with a glazed wall on one side overlooking the kindergarten on the floor below. Bookshelves are arranged around the perimeter of the space, with freestanding tables and chairs throughout the space.

4. Multi-function space

The school hall has a multi-function purpose being used for performances, school assembly and dining. At one end of the auditorium there is a stage and, at the back opposite the stage, there are fixed benches that rise up like a ‘grand stairway’. To one side, there is a second large multi-functional space, accessed off the main space.

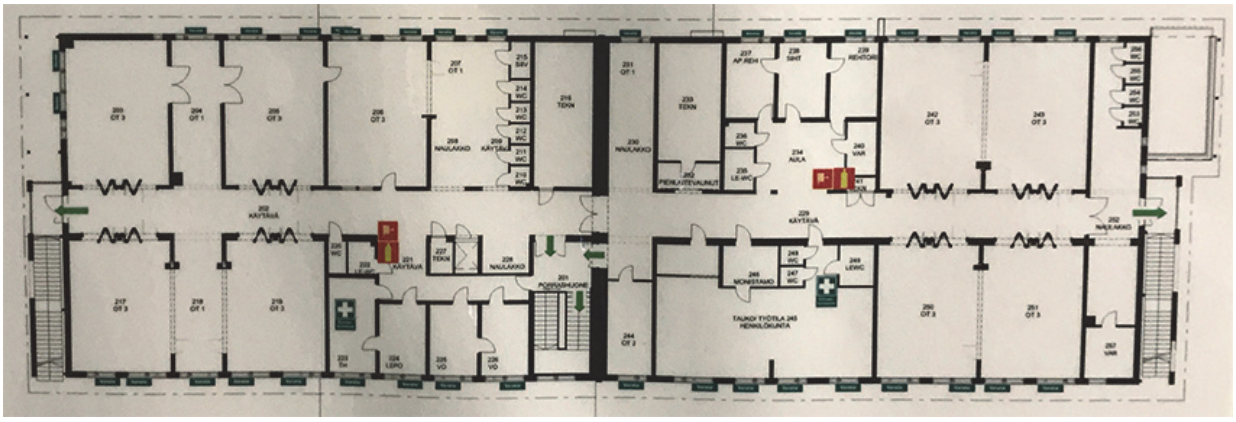
5. Adjustability, Agility and Flexibility in use

Most of the learning spaces, i.e. classrooms, have fixed walls and therefore there is limited opportunity to adjust their size. The spaces themselves seem to be quite agile and the furniture can be easily rearranged. The flexibility in use of the spaces, or the immediate choices that teachers and students may have for using different spaces or spatial configurations, is to some extent constrained by the fixed walls of the classrooms; however, the larger spaces, such as the multi-purpose spaces and library/commons, do offer some opportunities for flexibility.

❷ Karhusuo School (module-prefabricated model)

The Karhusuo School is constructed using prefabricated modular units which are assembled on site. One advantage of this approach to construction is speed: being able to mass produce modules in a factory is quicker than site-based construction because the modules can simply be copied, thus reducing unique features, and a factory is not affected by weather, which may stop site-based construction. Another advantage is lower cost: automated systems can be used in the fabrication and the same tooling, moulds and construction used, thus reducing the need for bespoke solutions. If the building is designed to an industry standard modular dimension, components such as ceiling tiles, windows, partition panels can be used without needing any special components. With a focus on fewer construction details, because the components are essentially being repeated, the quality of the product can be maintained. Moreover, in a factory the modular components can be assembled and modified if necessary before final production, which is harder to do on a construction site.

The plan of the Karhusuo School is linear with classrooms either side of a corridor running down the centre of the building. The main entrance is at one end of the building in line with the corridor which runs down the centre of the building. To one side, the corridor opens directly into the dining area, which is approximately the size of three classrooms. Staircases at the end and in the middle of the building lead to the upper floor.



Classrooms separated by folding partitions which have writeable surfaces

The corridor may be too small to create learning activity zones

The corridor opens into the dining area

1. Technical characteristics of the main learning spaces

- **Size**: The classrooms are all of similar size.
- **Shape**: Rectangular
- **Adjacencies**: Classrooms off corridors. Some pairs of classrooms linked by folding walls for their full width so that the classrooms can be joined together in a variety of permutations. Also, in some cases folding walls can open onto the corridor.
- **Glass walls**: Not a feature in this school.
- **Interconnectivity**: As noted above, a few classrooms are connected to each other and/or the corridor by folding walls which can be fully opened up to create a much larger space.
- **Furniture**: Generally, classrooms have chairs on wheels with single rectangular desks without wheels, although they seemed light enough to be relatively easily movable. We observed some rooms particularly used for art with larger tables.
- **Whiteboards / display screens**: Whiteboards are fixed at the front of the classroom.

2. Classrooms

The classrooms are of uniform size and are linked to each other in one of two different ways. Some classrooms are linked by a folding wall which can be opened to create a larger space. Other classrooms are linked by doors so that the overall configurations of the rooms remain the same but enable connectivity between the two. While the classrooms open off the corridors on both floors of the building, several have folding walls to the corridor. In one part of the school, a pair of classrooms are not only linked to each other by retractable walls, but both also open onto the corridor with a mirrored pair of classrooms on the other side of the corridor, potentially providing a large open space. At one end of the building, on the first floor, classrooms are separated from each other by a narrower space that serves the rooms on each side of it via a folding wall, which increases the options (see plan).

3. Corridors

Although the corridor had some seating in it, it may be too narrow to create spaces which could be used as learning areas. As noted elsewhere, some of the classrooms can be opened up onto the corridor.

4. Adjustability, Agility and Flexibility in use

Adjustability is facilitated by extensive use of folding partitions, as discussed above. The spaces seem to be quite agile and the furniture can be easily rearranged.

The school offers some flexibility in use, primarily by adjusting the size of the spaces, although the dining area provides another space that could be used for learning activities. The corridors do not offer any significant opportunity for creating learning zones.

❸ Kirkkojärvi School

The Kirkkojärvi School was constructed in 2010. The plan of the school is in the shape of two 'V'-shaped wings that are linked by an atrium, a multi-purpose space that is three storeys high and forms the heart of the school. The main entrance is directly into the atrium, which is a multi-functional space used for general assembly and dining; it is also the most public part of the building.

The plan of the school is arranged so that the primary school is in the smaller wing and the secondary school in the larger. Classrooms are grouped along with a semi-enclosed 'home' area, forming learning clusters. Each home area has its own colour scheme which is reflected in the corridors leading to the classrooms. The home areas have their own lobbies to the external yards, although they are kept separate from the main public space in the centre of the building. The aim is to provide some intimacy and connection for groups of students, but at the same time to enable them to be part of the whole school.

The corridors, which get wider towards the end of each wing and open into a home area, a semi-enclosed learning space, are generally lined with lockers neatly positioned so that the front face of the lockers align with adjacent wall surfaces, which illustrates the attention paid to design detailing in this school.

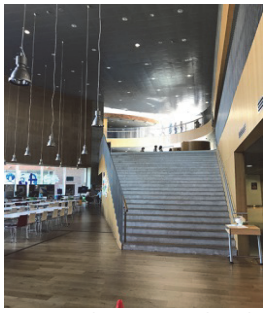
During the review visit, the corridors spaces were being used as 'streetspace' in that there was informal seating available for students.

In general, the classrooms range from 42sqm to 60sqm, are rectangular in shape and open directly onto the corridors. There are some classrooms that are larger, up to 90sqm, such as for technical and practical classes. There appear to be no moveable partitions between the rooms or other spaces. The doors to the classrooms have full height vision panels allowing some view into the rooms.

The wall finishes are generally exposed brick, which gives the building a warm and robust feel. The ceiling finishes throughout are a dark grey, which reduces the reflectance of the ceilings.

Conversations with the teachers suggested that the classrooms on the south façade tended to be too cold in winter. However, no temperature data was gathered during the review visit to verify this.

Atrium space which gives access to the public areas of the building. At one end is a stage



A grand stairway leads up from the atrium to the first floor

From the home base, the classrooms are accessed off the corridor

The library

In the classrooms the desks tended to be in rows

Each end of the wings give access to the home bases on the ground and first floors

1. Technical characteristics of the main learning spaces

- **Size**: In general, classrooms range from 42sqm to 60sqm. Practical classrooms are generally larger, up to 90sqm.
- **Shape**: Rectangular
- **Adjacencies**: Classrooms off corridors.
- **Interconnectivity**: Openable walls are not a feature in this school, but some classrooms are connected by doors.
- **Furniture**: Generally, classrooms have chairs on wheels with single rectangular desks without wheels although they seemed light enough to be relatively easily movable. We observed some rooms particularly used for art with larger tables.
- **Whiteboards / display screens**: Whiteboards are fixed at the front of the classroom.
- **Glass walls**: Generally not a feature in this school except for the practical classrooms on the ground floor.

2. Learning clusters

Each learning cluster has five or six classrooms and an open learning space. The open learning spaces are either connected directly to the outside play areas or are connected via a stairway.

3. Library / Open commons

A library area opens off the main atrium space, providing a separate but connected space to the atrium. It is adjacent to the main entrance and its central location places it along the circulation route

4. Multi-purpose

The position of the multi-purpose commons area means that it is at the heart of the building and is a hub from which the main circulation routes radiate. As a multi-use space with a stage at one end it can be used in a variety of ways from large gatherings, performance space and for dining – the catering facility is adjacent to it.

5. Adjustability, Agility and Flexibility in use

Most of the learning spaces, i.e. classrooms, have fixed walls and therefore there is limited opportunity to adjust their size.

❹ Päiväkehrä School

The school was originally constructed in 1975 and renovated in 2016/17. The renovation included adding some new accommodation and altering the position of the library.

The plan of this building is arranged into three wings. In one wing, the classrooms are arranged along corridors with internal open courtyards; a smaller wing has a double-loaded corridor with six classrooms on the ground floor and nine learning spaces on the first floor. The third wing contains a sports hall/gym and kitchen.

An important part of the renovation was the link that was constructed between the sports hall and the main building. This created a large multi-functional space which forms the hub of the school, providing an area that can be used in a variety of ways. The main entrance to the school is through this space.

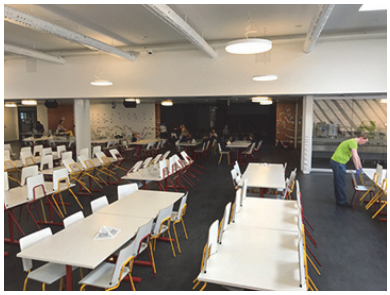
Corridor lined with lockers

Classrooms connected by a small work space

Display cabinets provide an opportunity to show students' work

A glazed rooflight runs along the length of the new roof linking the teaching wing on the right to the sports hall.

The link between the teaching wing on the right and the sports hall.



On the far side of the multi-function space is a stage and the sports hall behind.

1. Technical characteristics of the main learning spaces

- **Size**: Classroom sizes generally range from about 56sqm to 60sqm. A range of layouts was observed, some group layouts and conventional presentation styles
- **Shape**: Rectangular
- **Adjacencies**: Classrooms off corridors. There were pairs of classrooms linked by an enclosed teacher workspace that can accommodate two teachers. This small space has glazed partitions and a glazed door to each classroom offering the opportunity for interconnectivity between two rooms. Other pairs of classrooms are connected by double doors. Two pairs of classrooms on the first floor have an openable wall along their full width so that the classrooms can be joined together.
- **Interconnectivity**: As noted above, a few classrooms are connected by openable walls which can be fully opened up to create a much larger space.
- **Furniture**: Generally, classrooms have chairs on wheels with single rectangular desks without wheels although they seemed light enough to be relatively easily movable. We observed some rooms particularly used for art with larger tables.
- **Whiteboards/display screens**: Whiteboards are in a fixed position.
- **Transparency**: Glass walls are not a feature of the classrooms apart from class panels in the connecting teacher offices. The glazed doors and glass vision panels beside the doors give some sense of transparency and make the activities in the classroom visible from the corridors. As the glazed areas are relatively small they limit the distraction and enable the classroom to maintain a degree of enclosure.

2. Fixed function classrooms

There is a range of fabrication classrooms where students use metal and wood to make objects. These have a range of benches and other supporting equipment. We noticed that they had moveable LCD screens rather than relying on a screen in a fixed position. Power cables also dropped down from the ceiling providing a high degree of flexibility in being able to rearrange the layout of the room and, possibly, in the long term, being able to use the space for different activities.

3. Commons/library

The library, which is about twice the size of a classroom, is positioned centrally in the larger wing of the building; two of its four walls are fully glazed onto adjacent corridors and a third wall has windows, making this a very light space. When entering this wing from the main entrance, the library space is the most prominently visible learning space. In this space there is a range of moveable furniture and book shelves.

4. Streetspace and corridors

The corridors, which seemed to be reasonably generous in width, are lined with some lockers and are just adjacent to the external courtyard with high tables for students to work at. There are some alcoves or ends of corridors with seating. It would be interesting to see if learning zones could be incorporated into them.

5. Multi-function space

This large multi-function rectangular space links the teaching wing with the sports hall and catering kitchen and main classroom wings, and forms the main entrance to the school. The two side walls including the entrance are glazed. Sliding wall panels on the back of the adjacent sports hall enable the two spaces to be opened up. There is a raised dais against one wall on which is fixed a large projection screen.

6. Staff work rooms

The teachers have a work and social area and there are several small meeting rooms.

7. Adjustability

In terms of adjustability, interconnectivity between classrooms offers scope for spatial reconfiguration, although it is not possible to open the space out fully.

8. Agility

The spaces themselves seem to be quite agile and the furniture can be easily rearranged.

9. Flexibility in use

The flexibility in use is made easier by the greater interconnectivity of some of the spaces in this school, which provides more opportunity to use different spaces, although the choice may be limited by the lack of variety of space types.

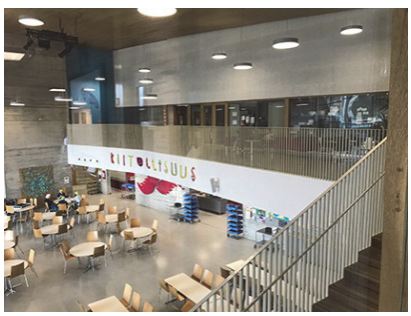
❺ Saunalahti School

The Saunalahti School was designed by the same architect as the Kirkkojärvi School and constructed two years later. Although it uses a similar architectural language/grammar, such as the clustering of the classrooms, wall finishes and detailing of the finishes in general, the most noticeable difference was the ceiling finish which is much lighter in colour.

The building is arranged around a central 'heart' space, a multi-purpose space which is used as a dining hall and general assembly area. Adjacent to the main entrance, it is the most public part of the building. The central space gives access to the learning areas for different age groups as well as the communal facilities including a library and youth centre.

The classrooms for the younger students are organised as home areas with their own lobbies to the outside yards.

The building is positioned on the site so that the school yard for the younger students gets the morning and mid-day sun, as their school day is shorter, whereas the yard for the older students gets the sun later in the afternoon.



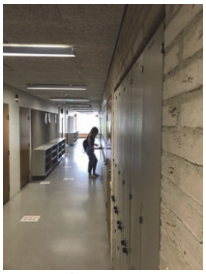
Looking over the atrium/multi-purpose space

Science spaces

Generic classroom spaces


The library is adjacent to the main entrance and available for community use


Finding a nook where students can make their own learning space



Corridors open into a common learning space

Technical characteristics of the main learning spaces

1. Classrooms:

- **Size**: In general, classrooms range from 40sqm to 60sqm. Practical classrooms are generally larger, up to 80sqm.
- **Shape**: Rectangular
- **Adjacencies**: Classrooms off corridors. A few classrooms have doors that connect them to adjacent classrooms.
- **Interconnectivity**: Not a feature in this school.
- **Furniture**: Generally, the chairs and tables, although relatively light in weight, are neither adjustable in height nor have wheels. However, as observed during the review visit, the fact that the chairs cannot be wheeled across the rooms did not stop the teachers using a range of settings in the spaces.
- **Whiteboards / display screens**: Whiteboards/blackboards are fixed at the front of the classroom.
- **Transparency**: Glass walls are generally not a feature in this school except for the practical classrooms on the ground floor.

2. Library/commons

The library is placed adjacent to the entrance on the ground floor. The corner of the library next to the entrance has sliding glass panels so that it can be opened up into the entrance foyer space.

3. Atrium

The position of the atrium means that it is at the heart of the building and is a hub from which the main circulation routes radiate. The entrance to the school is placed near the library so that visitors are brought in adjacent to the library which is a community resource. As a multi-use space with a stage on one side, it can be used in a variety of ways from large gatherings, as a performance space and for dining – the catering facility is adjacent to it.

4. Adjustability, Agility and Flexibility in use

Most of the learning spaces, i.e. classrooms, have fixed walls and there is therefore limited opportunity to adjust their size.

❻ Tapiola School and High School

The renovation of the Tapiola School was completed in 2016. Deterioration in the fabric and poor air quality caused particularly by damp had led to the need to move students out in 2011-2012. However, as the school is located in a nationally significant cultural-historic area, one of Finland's first 'Garden Cities', it was not possible to demolish the school. The building has therefore been extensively renovated. Although part of it had to be completely rebuilt, the overall plan and urban design form had to be preserved. A mechanical ventilation system, the plant and ductwork were constructed under the building rather than being placed on top of it, as might often be the case. Construction of the original building was completed in 1958, with further additions built during the 1960s and 1980s.

The plan of the building and the arrangement of the classrooms follow a conventional layout with classrooms along corridors. In some cases, there are fully glazed partition walls on the corridor wall of some of the classrooms and some of these glass walls slide open so that classrooms can be fully opened into an adjacent hall area. Although none of these were open during our visit, teachers did comment that they would have liked more moveable walls, suggesting that they might take advantage of such opportunities. The use of glazing does enable light to enter spaces from two sides and reduces the sense of enclosure.

Most of the classrooms are rectangular, but twelve are hexagonal, reflecting some of the experimentation in school design internationally during the late 1950s and 1960s, with experimentation with room sizes and shapes.

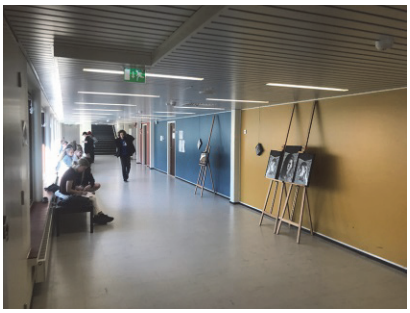
The main auditorium and canteen area are adjacent to the main entrance on the east side of the building. The sports hall is on the west side of the building. The architects chose to use some of the original colours on corridor walls. Not only does this give an insight into what the building might have been like, but the use of colour in this way breaks up the perceived length of the corridor.

Courtyard plan


The form of the original building has been preserved


Classroom: Glass wall to corridor with sliding panels


Science classroom: Cabinets and sinks around perimeter so that the centre of the room can be used in different ways


The corridors have been painted using some of the original colours


Library/Commons


Sports hall. Original concrete roof preserved

1. Summary of space types

Space type	Comment
General classroom	Rectangular and hexagonal
Fixed function classroom	For sciences; cooker/domestic; wood/metal work; language labs; auditorium
Commons/Library	Yes, but fully enclosed
Streetspace	Yes, but limited
Meeting rooms	Yes
Multi-function space	Canteen space
Halls	For sports and exercise
Teacher work spaces	Meeting rooms
Outdoor learning space	External courtyard areas

2. Technical characteristics of the main learning spaces

This summary focuses on the main learning spaces, the classrooms.

- **Size**: Typically, the rectangular classrooms accommodated 24 to 25 students. During the review visit most were conventionally set out with desks arranged in rows facing the front. Although we have not been given specific sizes of the spaces, they looked to be sized to accommodate about 25 students.
- **Shape**: Rectangular and hexagonal. The shape of the hexagonal classrooms, particularly in a relatively small room, does not lend itself to a conventional layout of desks in a row; in the rooms we saw desks were grouped.
- **Adjacencies**: Classrooms directly connected to corridor. Science labs have a common preparation room.
- **Interconnectivity**: Some of the glazed partitions along corridor walls had sliding panels that would open the room onto the corridor.
- **Furniture**: The issues to watch for are adjustability (e.g. adjusting height of the chairs to suit student size) and movability so that the setting can be reorganised easily and quickly. Generally, classrooms have chairs on wheels with single rectangular desks without wheels although they seemed light enough to be relatively easily movable. Some rooms have tables that two of three

students could sit at rather than a single table/desk. The chairs are height adjustable. The science classrooms have higher tables that seat two students.

- **Whiteboards/display screens**: Whiteboard and display screens are fixed at the front of the classroom.
- **Transparencyv** Along corridor walls of classrooms. It was noticeable that some of the glass walls had been used for display, suggesting either there was not enough display space or that sticking student work on the glass wall was a way of reducing transparency.

3. Summary of classrooms

While the furniture was generally moveable, the fixing of the display screen and whiteboard on one wall of the classroom suggests a dominant focus, although of course this does not stop teachers rearranging the setting so that there is a focus on another part of the room, but without the use of the display screen. In most of the classrooms, the furniture was conventionally set out, with display areas along one wall as well as storage space. The use of glass walls on the corridor side of some classrooms enabled light to penetrate the room from two sides. In some cases, the glass walls can be opened up onto the corridor offering the opportunity to create a larger space; the practicality of this may depend on teaching modalities in adjacent areas because of potential disturbance. In some cases, the glass walls were used for display and some teachers did comment on their concern about students being distracted by what was going on in the corridors. In the science classrooms, sink units and work surfaces for conducting experiments are arranged around the perimeter of the space.

4. Commons/library

The library space can be fully enclosed, although the walls along the side of the corridor are fully glazed with sliding glass panels so that the space can be opened onto the corridor. While there are some book shelves, the space generally has freestanding furniture with circular tables as well as more informal seating areas enabling students to work in groups or individually, which was evident during the review visit.

5. Streetspace and corridors

Adjacent to the hexagonal classrooms, the corridor widens to form a semi-enclosed hallway space approximately half the size of a classroom. The classrooms opposite these semi-open areas have sliding glass walls. Other than at these points, the widths of the corridors are uniform. Although there were some benches in the corridors and some seating in the semi-enclosed hall way spaces, it was not clear that these were being used as learning spaces.

6. Multi-function space

The canteen area, which is adjacent to the main entrance hall and the auditorium, is in fact a multi-function space which could be used in a range of ways. At the time of the visit, it was set out as a canteen. Student lockers and coat racks separate the canteen from the corridor leading to the back of the auditorium.

7. Adjustability

In terms of adjustability, the school is relatively constrained by the existing plan layout and there is little opportunity to reconfigure the spaces, certainly quickly or easily. It may be possible to combine some classrooms to form larger spaces, but this depends on the internal structure, which was not analysed during this review,

8. Agility

The spaces themselves seem to be quite agile and the furniture can be easily rearranged.

9. Flexibility in use

The flexibility in use, or the immediate choices that teachers and students may have to use different spaces or spatial configurations, is constrained by the difficulty in adjusting spaces and the fact that the main teaching spaces are located off the corridors with few small spaces or areas where students can work outside the classrooms.

❼ Kirkkojärvi Daycare Centre

The Kirkkojärvi Daycare Centre includes a kindergarten for 126 children and a youth centre. Although these functions are separate, the sports hall is shared between the two centres.

This rectangular building is two storeys high and compact. On the ground floor is the youth centre, part of the kindergarten, a sports hall and catering facilities. The first floor includes the rest of the kindergarten and office space and meeting rooms.

The form of the building is a rectangular block with large windows that give views across the landscape. The plan of the building is divided into three zones. One zone for the kindergarten and youth centre, one for the two-storey high sports hall and one that has the catering facilities with offices above. This gives a clear definition to the functions within the building.

Although there is a main entrance to the building and the kindergarten and youth centre are accessed from the main internal circulation route, they both have their own separate external entrances used by the children, parents and students.

The kindergarten is arranged in three clusters, each of which comprises four activity rooms, some of which double as sleeping areas made possible by neat fold-away cots, around one side of a common space, which acts like a foyer or home base; along the opposite side of the foyer are toilets and bathrooms. One cluster is on the ground floor adjacent to the youth centre. Each cluster has its own entrance directly from the outside via a lobby for coats and shoes off the common space.

Grouping the spaces in this way reduces the perceived scale of the building for the children who will generally only use the one part of it. This domestic scale allows for intimacy and familiarity with the spaces they use.

The ceiling height throughout the kindergarten areas is uniform. However, the sleeping areas do have windows and they also have blinds. The colours of the surface finishes are soft with colour differentiation created by surface decoration.

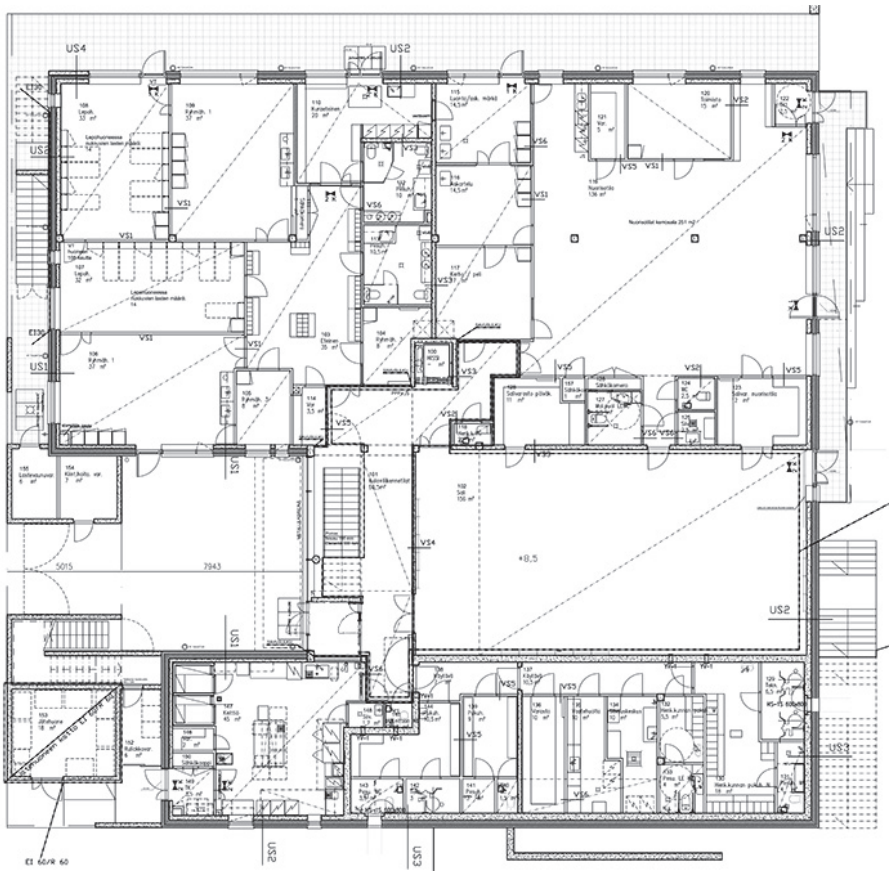
Children will spend much of the time they are at the school in the play-room activity areas, which therefore need to be designed to facilitate different types of activity whether individual or in small groups.
There is a range of moveable furniture that enables the subdivision of space and the grouping of children. The furniture is both age appropriate and in soft colours and generally wooden.

Although the walls between the activity spaces are not moveable or openable, there are interconnecting doors which enable some flexibility and observation between the spaces.

The external play space has a mixture of partially covered and fully open areas, with different surface treatments and small grassed play areas. The covered areas offer protection from both the rain and the sun. This allows for a range of different play opportunities for different age ranges – included a basketball net as well as swings.

In a kindergarten, the spaces should be designed to enable easy interaction between children and visual supervision by the staff. In the Kirkkojärvi Daycare Centre, the size of the space and yet the intimacy suggested by the design of the spaces does appear to make it easy for children to interact without feeling overwhelmed by the building, with, at the same time, there being easy visual supervision.

Plan and images of the Kirkkojärvi Daycare Centre



The form of the building is a simple compact rectangular block

The common space serving a group of activity spaces

The activity spaces have a range of furniture with tables and chairs for the older children

The building includes meeting spaces as part of the administrative areas

The sleeping cots fold down

Annex 5 Data Collection Results

Seven out of eight schools provided their "Education Vision" statement, four completed the Space Design and Use (SDU) survey[27] and six completed the school background questionnaire prior to the visit. The Premises Department provided the school plans and completed the School Background Data Sheet for the six schools visited. Some of these background questionnaires were minimally completed.

Field data was obtained through a combination of informal observations and interviews. No formal classroom observations or interviews were conducted due to time restraints. Informal observations comprised about one hour of guided tours in each facility led by the school principal or her/his representative. In the majority of cases these looked at all school facilities, from school infrastructure machinery through to classroom spaces, staff spaces, outdoor spaces, and informal learning areas. In nearly all cases the spaces were in active use, being occupied by students and teachers undertaking normal daily school tasks

Informal interviews comprised a round-table discussion lead by the review team, with a convenience sample (selected by the Principal) of between three and five members of the teaching staff. These comprised leading teachers across a range of disciplines and school administration positions. In two cases, early-career teachers were included. In one case, only the Principal was available for the informal interview, but two additional teachers provided brief discussions during the tour. In at least two cases, students assisted in the school tour and provided their perceptions of the school and its operation.

Informal interviews were led by the review team with the Education Specialist and team members extending the key elements of the discussions through additional questioning.

The interview protocol contained three clusters of questions: (i) questions seeking an understanding of *the key educational principles* that framework teaching practices in the school. This cluster served to *establish the educational intent* of the new build: (ii) questions seeking an understanding of the building's *educational performance*. This cluster served to *explore perceptions of alignment between design and pedagogic intent*; (iii) questions seeking an understanding of the *educational impact* of the building. This cluster served to *explore the building's performance in terms of meeting its educational aims*. Follow-up questions explored in more general terms the level of involvement of the school staff during the design and construction phases, their experiences in the use of the new spaces and their identified needs for additional support in the transition to the new learning spaces.

With regards to the antecedent material, analysis indicated some common trends. The Space Design and Use surveys indicated (See Annex 6 for results):

- A strong reliance on traditional, 'teacher-centric' classroom design. Between 75%-100% of the spaces in the site schools utilised 'closed cell' learning designs, with seating arrangements favouring a front-of-room focus on the teacher.
- A tendency to apply a range of teaching approaches within these classroom settings. This means that, while teacher-centric pedagogies were dominant, they were not exclusive. The school principals noted a range of other instruction types being applied.
- A positive attitude to the affordances being offered by these designs, with the provision of technology being highly regarded, the opportunity for 2D and 3D display spaces slightly less so, and similar attitudes concerning the ready accessibility of 'hard' teaching resources such as texts. Consistently rating lowest on perceptions of affordances of the spaces was flexibility of furniture, and the capacity for the classrooms to be easily re-configured for activities other than traditional didactic instruction.

[27] Imms, W., Mahat, M., Murphy, D. & Byers, T. (2017). *Type and Use of Innovative Learning Environments in Australasian Schools – ILETC Survey*. Technical Report 1/2017. Melbourne, Australia: LEaRN, University of Melbourne. Retrieved from http://www.iletc.com.au

- Ratings of principals' perceptions both of the 10 mind frames and of students' deep learning were at or above the SDU average. This runs counter to findings from the large-scale survey (n=822) from schools in Australia and New Zealand, where a strong correlation was found between the teacher-centric classroom layouts (featured in many of the Espoo schools) and student superficial learning. This suggests the more teaching-centric approaches identified in the sample Espoo schools are proving effective in a way not evident in the larger SDU population. It also suggests that a more student-centric approach, assisted by more flexible classroom designs, may well accelerate Espoo students learning outcomes. The benefit of teacher-centred practices combined with inquiry-based methods have shown to have the most positive impact on student learning across the globe as evidenced in latest PISA results (McKinsey, 2017)[28]. It could well be that in Espoo it is this combination of practices that is having a positive impact.

The *educational vision* statements (the philosophical beliefs that drive teaching and learning in a school) were brief, and no *educational brief* statements (the advice to architects about the educational needs of the new designs) were provided. It must be noted that these are not necessarily widely accepted terms. However, the content of an educational vison is considered basic documentation in schools today. The educational brief is extrapolated from this foundational document and often constitutes the only formal pre-design request from staff to an architect regarding how teachers want the new spaces to operate pedagogically.

The vision statements provided to the team were noteworthy for their focus on student well-being and community issues as central to the school's purpose. They consistently cited the need to address broad curriculum goals. In terms of their usefulness to a designer conceptualizing a new or retrofitted space, they only briefly mentioned the qualities of learning and teaching the school espoused; little of this material could be used to formulate an Educational Brief for designers, that is, a guide to assist physical qualities to meet educational aspirations.

The *School Background Datasheet on Teachers and Students* profiled student and staff numbers, student ethnicity, special needs and other characteristics, teacher workloads, and integration policies for each school. These sheets also indicated the role the principal (but not the teachers) played in the retrofits/builds. Of interest from these descriptions was:

- The schools had a say in the design, but the nature of this contribution was unspecified; four of the six site schools had principals who were involved in the retrofits/builds.
- The schools were not unduly challenged to provide specialist support; approximately 10% of the students in the site schools were deemed to have 'special needs' (unspecified).
- Most of the schools visited enjoyed a relatively mono-cultural student population; approximately 90% of students in the site schools were Finnish born except for the school and daycare centre located in Vanha Espoo, a very socially diverse area where about one third of the students in the school are of foreign origin and 80% of the daycare children were also reported to be of foreign origin.

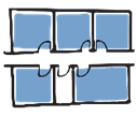
The schools all had experienced staff; approximately 45% of teachers in the site schools had been in the profession more than 10 years.

[28] McKinsey & Company (2017). *How to Improve Student Education Outcomes. New Insights from Data Analytics.* McKinsey Analysis.

Annex 6 Results from the SDU Survey (Imms et al, 2017[29])

The SDU survey was submitted to the five schools initially selected by the Review team with the exception of the daycare centre to which the SDU content was not appropriate. Four out of the five schools completed the online SDU. The results are presented below.

School 1

Types of learning spaces	Type A - Traditional closed classrooms entered by a corridor	Type B - Traditional classrooms with breakout space	Type C - Traditional classrooms with flexible walls and breakout space	Type D - Open plan with the ability for separate classrooms	Type E - Open plan with some adjoining spaces
					
	75%	25%	0%	0%	0%

Typology of teaching approaches	Typology 1 - Teacher facilitated presentation, direct instruction or large group discussion	Typology 2 - Teacher facilitated small group discussion or instruction	Typology 3 - Collaborative/shared learning, supported by teachers as needed	Typology 4 - Team teacher facilitated presentation, direct instruction or large group discussion	Typology 5 - One-on-one instruction	Typology 6 - Individual learning
						
	25%	25%	25%	5%	10%	10%

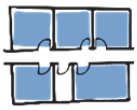
Learning and teaching affordances 1=strongly disa 2=disagree 3=agree 4=strongly agr	Wi-Fi	Mobile devices such as laptops, IPads etc	Display technologies such as interactive whiteboards etc	Display areas for visual media and 2D work such as pin boards	Display areas for 3D work such as shelves	Hands-on resources such as texts and material objects	Furniture for the desired learning activities	Floor area for readily reconfiguring the learning space
	4	3	4	3	2	3	3	3

Teacher mind frames		**Student deep learning**	
School mean	Average mean*	School mean	Average mean*
3	3.07	2.7	2.7

*Australia and NZ means (Imms, Mahat, Byers and Murphy, 2017)

[29] Imms, W., Mahat, M., Murphy, D. & Byers, T. (2017). *Type and Use of Innovative Learning Environments in Australasian Schools – ILETC Survey*. Technical Report 1/2017. ILETC Project: Melbourne.

School 2

Types of learning spaces	Type A - Traditional closed classrooms entered by a corridor	Type B - Traditional classrooms with breakout space	Type C - Traditional classrooms with flexible walls and breakout space	Type D - Open plan with the ability for separate classrooms	Type E - Open plan with some adjoining spaces
					
	75%	0%	20%	0%	5%

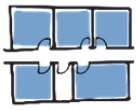
Typology of teaching approaches	Typology 1 - Teacher facilitated presentation, direct instruction or large group discussion	Typology 2 - Teacher facilitated small group discussion or instruction	Typology 3 - Collaborative/shared learning, supported by teachers as needed	Typology 4 - Team teacher facilitated presentation, direct instruction or large group discussion	Typology 5 - One-on-one instruction	Typology 6 - Individual learning
						
	40%	25%	10%	10%	5%	10%

Learning and teaching affordances 1=strongly disa 2=disagree 3=agree 4=strongly agr	Wi-Fi	Mobile devices such as laptops, IPads etc.	Display technologies such as interactive whiteboards etc.	Display areas for visual media and 2D work such as pin boards	Display areas for 3D work such as shelves	Hands-on resources such as texts and material objects	Furniture for the desired learning activities	Floor area for readily reconfiguring the learning space
	4	4	4	4	1	3	4	2

Teacher mind frames		**Student deep learning**	
School mean	Average mean*	School mean	Average mean*
3.38	3.07	2.4	2.7

*Australia and NZ means (Imms, Mahat, Byers and Murphy, 2017)

School 3

Types of learning spaces	Type A - Traditional closed classrooms entered by a corridor	Type B - Traditional classrooms with breakout space	Type C - Traditional classrooms with flexible walls and breakout space	Type D - Open plan with the ability for separate classrooms	Type E - Open plan with some adjoining spaces
					
	19%	69%	0%	0%	12%

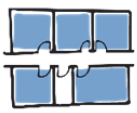
Typology of teaching approaches	Typology 1 - Teacher facilitated presentation, direct instruction or large group discussion	Typology 2 - Teacher facilitated small group discussion or instruction	Typology 3 - Collaborative/shared learning, supported by teachers as needed	Typology 4 - Team teacher facilitated presentation, direct instruction or large group discussion	Typology 5 - One-on-one instruction	Typology 6 - Individual learning
						
	37%	27%	2%	27%	5%	2%

Learning and teaching affordances 1=strongly disa 2=disagree 3=agree 4=strongly agr	Wi-Fi	Mobile devices such as laptops, IPads etc.	Display technologies such as interactive whiteboards etc.	Display areas for visual media and 2D work such as pin boards	Display areas for 3D work such as shelves	Hands-on resources such as texts and material objects	Furniture for the desired learning activities	Floor area for readily reconfiguring the learning space
	4	4	4	4	4	4	3	2

Teacher mind frames		**Student deep learning**	
School mean	Average mean*	School mean	Average mean*
3.13	3.07	2.9	2.7

*Australia and NZ means (Imms, Mahat, Byers and Murphy, 2017)

School 4

Types of learning spaces	Type A - Traditional closed classrooms entered by a corridor	Type B - Traditional classrooms with breakout space	Type C - Traditional classrooms with flexible walls and breakout space	Type D - Open plan with the ability for separate classrooms	Type E - Open plan with some adjoining spaces
					
	45%	45%	10%	0%	0%

Typology of teaching approaches	Typology 1 - Teacher facilitated presentation, direct instruction or large group discussion	Typology 2 - Teacher facilitated small group discussion or instruction	Typology 3 - Collaborative/shared learning, supported by teachers as needed	Typology 4 - Team teacher facilitated presentation, direct instruction or large group discussion	Typology 5 - One-on-one instruction	Typology 6 - Individual learning
						
	40%	20%	10%	30%	10%	0%

Learning and teaching affordances 1=strongly disa 2=disagree 3=agree 4=strongly agr	Wi-Fi	Mobile devices such as laptops, IPads etc.	Display technologies such as interactive whiteboards etc.	Display areas for visual media and 2D work such as pin boards	Display areas for 3D work such as shelves	Hands-on resources such as texts and material objects	Furniture for the desired learning activities	Floor area for readily reconfiguring the learning space
	4	4	4	4	3	4	3	2

Teacher mind frames		**Student deep learning**	
School mean	Average mean*	School mean	Average mean*
3.0	3.07	2.8	2.7

*Australia and NZ means (Imms, Mahat, Byers and Murphy, 2017)

Annex 7 Agenda of Meetings

Monday 14th of May

10.00 – 12.00

Meeting with the Steering Group of the Finnish Education Unit
Current status of education in Espoo, implementation of the new curricula, issues and challenges, policy priorities and objectives, initiatives to integrate new migrants; staffing and financing; teachers' professional development; monitoring and evaluation, education statistics, social and economic data.

12.00 – 15.00

Lunch and meeting with the Technical and Environment Services
Overall presentation of the department, key responsibilities, budget and staffing; the planning process, criteria to guide investment decisions; key features of the new school designs; supervision and cost management, post-occupancy evaluation

Tuesday 15th of May

9.00 – 10.30

Meeting with the Financial Department
City strategy, investment plan, annual budget, investment priorities, education investments, investment trends, monitoring impact.

11.00 – 13.30

Visit to Auroran Koulu
- Tour of the premises with school staff and city official responsible for management of the design and construction
- School lunch
- Discussion with a small group of teachers
- Meeting with the principal

14.00 – 15.45

Visit to Päivänkehrän Koulu
- Tour of the premises with school staff and city official responsible for management of the design and construction
- Discussion with a small group of teachers
- Meeting with the principal

Wednesday 16th of May

9.00 – 11.15

Visit to Tapiolan Koulu and Tapiolan Lukio
- Tour of the premises with school staff and city official responsible for management of the design and construction
- Meeting with the principals
- Discussion with small groups of teachers

13.00 – 14.00

Visit to Haukilahden Lukio (general upper secondary school) and presentation of 'School as a Service'

Thursday 17th of May

9.00 – 10.30

Visit to Kirkkojärvi Day Care Centre
- Tour of the premises with school staff and city official responsible for management of the design and construction
- Meeting with the daycare leader
- Opportunity to discuss with kindergarten staff

10.30 – 13.00

Visit to Kirkkojärvi School
- Tour of the premises with school staff and representative responsible for management of the design and construction
- Meeting with the principal
- School lunch
- Discussion with a small group of teachers

14.00 – 15.00

Meeting with Deputy Mayor Aulis Pitkälä
Meeting with Deputy Mayor Aulis Pitkälä and Planning Manager Juha Hovinen

Friday 18th of May

9.00 – 11.00

Visit to Saunalahti School
- Tour of the premises with school staff and city official responsible for management of the design and construction
- Meeting with the principal
- Discussion with a small group of teachers

11.30

Lunch and wrap-up with city officials

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