Designing for learning

-An overview and evaluation of the Swedish school building history combined with strategies for designing schools.

A Master's Thesis in Architecture
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Abstract

The Swedish school system has been described as experimenting with children. The criticism is mainly that new systems and pedagogical ideas were implemented quickly without being based on research. Have architects also treated the school building experimentally without reflecting on the potential consequences of their design?

The aim of the thesis is to develop design strategies that promote learning that can be used when designing school environments. My goal is that the master thesis could be used by architects to get a better understanding of how school buildings should be designed in order to optimize learning and avoid repeating the mistakes found in historical examples. My research question have been:
How should we design schools to promote learning according to research and evaluation of historical building typologies?

To accomplish the aim and answer the research question, I reviewed research on school design linked to academic performance. Then, I analyzed historical school buildings by comparing them to the research. Thereafter, I designed two classrooms and adjacent group rooms, translating the research into design. Lastly, the literature review and historical analysis was concluded into design strategies aimed to guide architects to design schools that promote good academic performance.

Research shows that lighting, color, material and room shape has a great impact on students' behavior. Knowing how students are affected by our design choices is crucial when creating the right environment for the right task.

The result of the historical evaluation shows that there has been a lack of understanding childrens' needs when designing schools. We can see repeating trends in the school design. More than once have schools been built that aren't adequate learning spaces. It seems like architects and stakeholders haven't learned from previous mistakes, partly because research on school architecture and evaluations of school buildings' effects on academic performance has been scarce.

Children are sensitive to auditory and visual stimulation when trying to concentrate. Most of the strategies are helping the students to focus on the task and avoiding distractors. Strategies that promote good academic achievements should be taken into consideration from the first design step.

Key words

Learning environment | School building | Concentration difficulties | Pedagogy | Education

Student background

2021- Master's program - Architecture and urban design,
Chalmers University of Technology

2017-2020 Bachelor degree in architecture, Umeå school of architecture.

2020- Supply teacher
I have been working as a supply teacher in Gothenburg for three years. I teach all subjects and the students' ages are between 6-15. I have been to various schools around the city. Therefore I have been able to teach in a lot of different school buildings with different spatial qualities. This has increased my interest in the combination of architecture and pedagogy.

2022 Leader for *Angereds Unga Stadsutvecklare*, involving youths from the suburb in architecture.

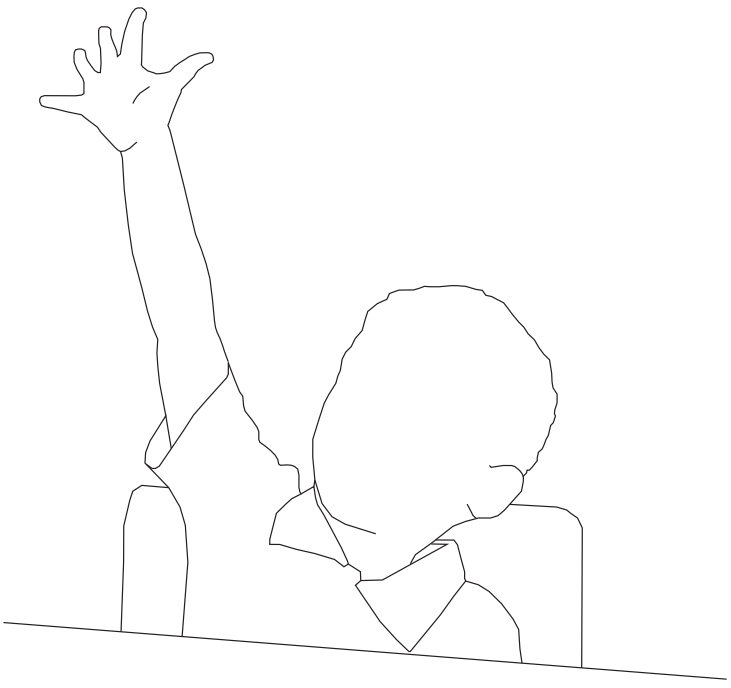
Acknowledgements

This thesis would not have been conducted without the support and assistance that I was given. Firstly, I want to express my sincere gratitude to my supervisor Julia Fredriksson for guiding me in this work. I have felt a great support throughout the entire work, with great discussions and positive reinforcement.

I especially want to thank my examiner Kristina Grange for all the valuable feedback, pushing me to develop my thesis and evolve as a writer as much as possible.

I must also express my gratitude for all the positive words and constructive feedback from my friends and colleagues at Chalmers. Your work has been a great source of inspiration.

I would like to extend my thanks to all the incredible teachers and educators I have had the honor to work with throughout the years as a supply teacher. Your work is invaluable for the students but also for our society as a whole. I would also like to thank my students for teaching me so much about life, especially kindness, diversity and empathy.



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1 Introduction

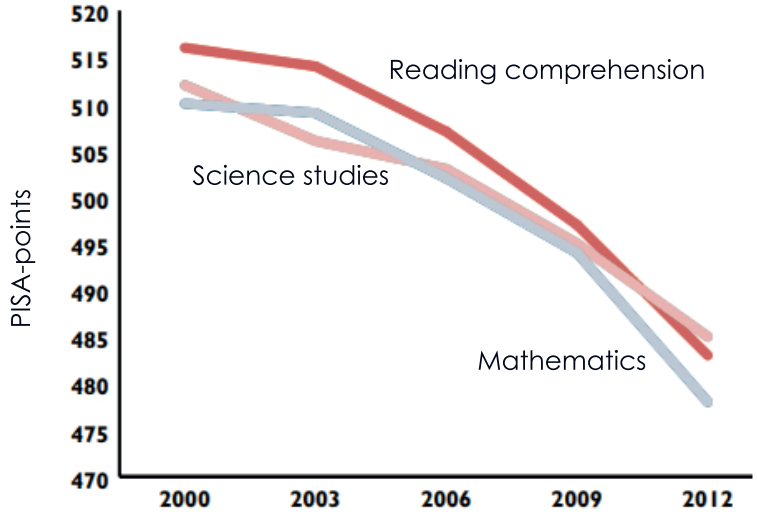
School lunch somewhere in Gothenburg in the 1970s (Jonsson & Lindman, 2021)

In my work as a supply teacher. I have noticed a repeating scenario. There is a trend that during the first five minutes of the lunch, the students are not allowed to speak. This has been motivated with the arguments that the children don't eat quickly enough if they are allowed to talk or that the sound environment is so bad that both students and teachers need a break from the noise pollution. These points are totally valid when the environment of the school is as it looks like today. To me, more reasonable solutions to this problem would be to go to the sources of the problem. Children should not learn by early age that eating is something that has to be rushed, instead they should be given sufficient time to finish their food without hurrying. An average lunch time in school is about 20 minutes, but that also includes long queuing time, meaning that in reality only 10-15 minutes can be spent eating. When it comes to sound it is important to learn when it is okay and not okay to be noisy. With that said I don't agree that mealtime should be where children learn to be quiet. Instead it is, for example, important to be quiet when someone else is presenting. In order to decrease the need of five quiet minutes, the sound environment needs to be taken care of throughout the day with smaller groups in each room as well as sound protecting materials. I believe that this is a perfect example of a school related problem that could be solved by architecture.

This example is just one of many examples that I have witnessed in my role as a substitute teacher that highlights how the design of the physical school environment negatively affects students' behavior, learning opportunities and impacts the teaching. It has made me think about the consequences of architects' design of school buildings and what knowledge exists about how schools should be designed to support learning.

School lunch at Mossebergsskolan in 1963 (Jonsson & Lindman, 2021)

School results in Sweden between 2000-2012



(Henrekson & Jävervall, 2016, p.10)

To better understand the importance of the school building, Krupinska (2022) highlights that the primary school is the biggest workplace in Sweden and affects over one fourth of the Swedish population's daily life.

In the rooms of the school building the future generation is being taught mandatory skills and learn how to navigate the world around them. The school building could not be compared with other public buildings where you can come and go as you please. Children spend a lot of their time in these buildings without any freedom to leave or quit.

According to Henrekson & Jävervall (2016), the school results in Sweden plummeted between 2000 and 2012. They are gradually increasing since then but are still low compared to before the drop. Large gaps in knowledge will have severe effects on our society. Kornhall (2013) describes the close connection between poor school results and psychosocial problems like criminality, mental illness, drug usage and suicide later in life. Low or incomplete grades from grade 9 is the biggest risk factor for criminality.

Kornhall continues: "It is actually self-evident. What future is there for a child who hasn't even finished elementary school?" (p.46).

Barrett et al. (2015) found in their study, *Clever Classrooms* that 16 percent of the academic results of the students could be derived from factors in the physical environment. The psychologist Hejlskov-Elfvén (2015) writes about "Special education architecture", and describes that children with neuropsychological difficulties are affected even more by their built environment than the average student. This means that the school building has even larger effects on children that are usually struggling to keep focus.

Both Krupinska (2022) and Larsson et al. (2007) describe a lack of research within the field of school buildings. Why aren't we more interested in this important typology?

Low or incomplete grades from grade 9 is the biggest risk factor for criminality.

”

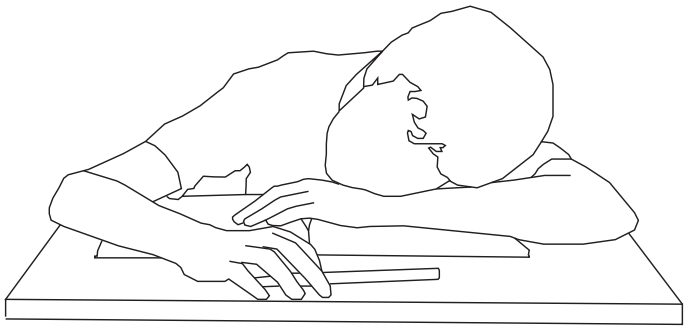
It is actually self-evident. What future is there for a child who hasn’t even finished elementary school?

”

(Kornhall, 2013, p.46)

Aim

The aim of the thesis is to develop design strategies that promote learning that can be used when designing school environments. My goal is that the master thesis could be used by architects to get a better understanding of how school buildings should be designed in order to optimize learning and avoid repeating the mistakes found in historical examples. My research question has been: How should we design schools to promote learning according to research and evaluation of historical building typologies?



Research question

How should we design schools to promote learning according to research and evaluation of historical building typologies?

Glossary

This thesis contains notions that will not be explained in the text. These are some of the notions and what I mean when using them.

Age integrated- When a "class" is configured with students of various ages.

Concentration difficulties- The struggle to focus on a task without being distracted or interrupted. Trouble to sort sensory information.

Home room- A classroom that is not subject specific but Instead each class has their own room and the subject teacher moves from class to class.

Home department/unit- A smaller part of a large school. It is a way of dividing a school both physically with the building and by creating smaller work teams.

Neurodevelopmental disorders- include various diagnoses that affect the brain function and the nervous system such as ADHD and Autism spectrum disorder.

Skolöverstyrelsen- A public authority responsible for questions concerning the Swedish school. Skolöverstyrelsen was established in the 1920s and was replaced by *Skolverket* 1991.

Special education architecture- Architecture adapted to the needs of people with neurodevelopmental disorders.

Subject room- A "classroom" which is designated for a specific subject, not a specific class. The room typically includes specialized equipment for the subject.

Universal design- to design environments or products to be accessible for the maximum number of people possible, regardless of ability or disability.

Method

In order to accomplish the aim and answer my research question I conducted the study in four steps. The method was in four steps but I have worked back and forth between the different steps throughout the process.

In the first step I recognized the current situation and challenges of the Swedish school and studied what issues have been identified as problems by educational researchers. Then I made a literature study that looks at the research on classroom and school design for increased concentration and academic results. The research is then made into drawings to exemplify what the research means spatially.

Thereafter, I did an analysis of the different school building typologies through history. The analysis is supported by historically typical cases. The analysis was done by evaluating the typologies based upon the research from step one together with how the building has been described by users.

In the next step I was made an example of what an evidence based school could look like, translating the research into a design. This part aims to test if and how the research can be combined.

In the last part I summarized the gathered knowledge from the research and the historical evaluation into design strategies that can be used by architects when designing a school.

Delimitations

This master thesis will only look at historical examples in a Swedish context, whereas the research is from various countries. The analyzed examples are schools within the span from grade zero to grade nine. Higher education or preschool examples will not be included. The master thesis is not going to put emphasis on building cost and construction.

Theory

Architecture is an interdisciplinary field and in order to be successful it needs to build upon knowledge from several professions. In order to get a deeper understanding of the school building and its effects on students, the sources used are from a variety of research fields. The research referenced in this master thesis is not only architecture related but combined with psychological, pedagogical and criminological research.

This master thesis can be seen as a response to the experimental approach that the Swedish school has been criticized for. This master thesis analyzes and reflects upon learning in relation to physical space from a research and evidence based perspective.

Reading instructions

Chapter 1 Introduction
The first chapter introduces the Swedish school buildings' meaning and relevance in the society. Here you find the aim, the delimitations and the methods used.

Chapter 2 School environment for learning
The second chapter is looking at research about learning environments from several fields. The research is illustrated by drawings.

Chapter 3 The history of the school building
The third chapter concludes how the school building has evolved historically. The aim of the typologies and their results are being analyzed. This chapter discusses what we can learn from the historical examples.

Chapter 4 Design test
In the fourth chapter the research from chapter two are implemented in a design test. The test is made in order to get a feeling of how the evidence based school environment could look like.

Chapter 5 Design strategies
The last chapter can be seen as a toolbox of evidence based design strategies for learning environments. The final chapter reflects upon the result of the thesis. This chapter summarizes the work and responds to the research question.

2

School environments for learning

Evidence based school design

How should we design schools in the future?

The Swedish school system has been described as experimenting with children. The criticism was mainly that new systems and pedagogical ideas were implemented quickly without being based on research (Kornhall, 2013). In this chapter I have gathered the most important findings on research on school environments and its effect on students' performance. The topics studied are the ones that I, through my research, have found to be the most influential aspects.

The research referenced in this chapter is partly from research on students with neurodevelopmental disorders. The school building should provide good study environments for all children including the ones with disabilities. I believe that if the school environment is designed for those who struggle with keeping focus the most it will benefit the concentration of all students. This could be seen as universal design.

According to the Center of Excellence in Universal Design (2023), universal design is the design and composition of an environment so that it can be accessed, understood and used to the greatest extent possible by all people regardless of their age, size, ability or disability. An environment (or any building, product, or service in that environment) should be designed to meet the needs of all people who wish to use it. This is not a special requirement, for the benefit of only a minority of the population. It is a fundamental condition of good design. If an environment is accessible, usable, convenient and a pleasure to use, everyone benefits. By considering the diverse needs and abilities of all throughout the design process, universal design creates products, services and environments that meet peoples' needs. Simply put, universal design is good design.

In order the facilitate people with differing abilities, of differing ages and sizes within society, systems and building must be designed with the user at the center of the design process. A universally designed environment promotes equality and makes life easier and safer for everyone.

By taking a universal design approach, architects can more effectively meet the needs of every student when designing schools. Universal design allows both able and non-able persons to have similar experiences within a building. Students with different needs no longer necessarily have to be separated from their peers to have those needs met.

Effective collaboration between the client and the architect plays a central role in the universal design of schools. Architects not only need tools to think about usability at all design levels, but the ability to collaborate with the client and users in every phase and an understanding of the different needs of the children who will attend till school. In my thesis, I refer to several studies focusing on designing for students with disabilities. The reason for this is that I believe that an understanding of the needs of children with disabilities, is necessary for architects to create universally designed schools that works for every student.

3 § Alla elever ska tillförsäkras en skolmiljö där utbildningen präglas av trygghet och undervisningen av studiero. Med studiero avses att det finns goda förutsättningar för eleverna att koncentrera sig på undervisningen.

3 § All students must be assured of a school environment where the education is characterized by security and the teaching by a calm study environment. A calm study environment means that there are good conditions for the students to concentrate on the teaching (SFS 2022:940, 5 kap. 3 §).

The Swedish law does not regulate things such as class size or classroom size. It does however specifically point out that each student has the right to be in a calm study environment which should give the students what they need in order to concentrate. In this following chapter the most important findings on how to create such an environment is explored.

School size

Moore and Lackney (1993) have studied the relation between academic performance and the size of the school. In their study they found that the smaller schools with 100-200 students scored higher on both verbal and math tests compared to bigger schools with 4000-5000 students. They also found that the student satisfaction and attendance was greater in the small schools.

Moore and Lackney also looked at the school results of students in regular sized classes of 22-25 students compared to small classes of 13-17 students. The students in the small classes scored higher on tests in all subjects, especially in reading and mathematics. Two years after the students from the small classes went back to regular sized classes, they were tested again. Surprisingly the students still scored significantly higher at the tests compared to those students who never went to a small class, even two years after being back in a normal sized class. This means that the class sizes have consequential long term effects on the students' performance.

Classroom size

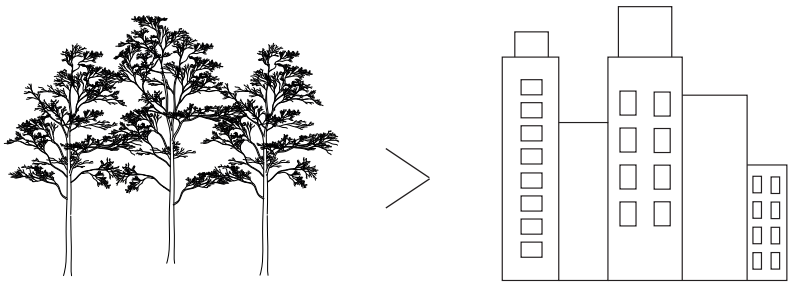
Not only the class size, but the relation between the classroom size and amount of students has great effects on the performance of the students according to their teachers. Olsson (2015) writes that the standard classroom of 60 square meters is often too small for the large student groups. When the room is too crowded the air quality gets poor, which can lead to headaches and concentration difficulties.
Too little space between the students' seats has also shown to increase the risk of conflicts and unwanted behavior (Hejlskov-Elfvén, 2015).

Location

Placement of the school building has historically been a way to show educations' prestige. In the 1800s the school buildings were mindfully placed in the center of the community with the same value as the church, the bank and the courthouse (Selander, 2003). But how does the location of a school impact its students?

Moore and Lackney (1993) writes that the location of the school impacts the ability for students to concentrate. Students exposed to traffic noise had higher blood pressure, more concentration difficulties and gave up faster than students at schools that were not located in noisy areas.

Sanoff and Walden (2012) adds that not only does nature surrounding the school affect the students academic performance, it also makes them more cooperative with each other. The more varied and rich the surrounding nature is, the more creative and cooperative the student gets.



Avoiding bullying using design

According to Pålsson (2020) most of the bullying happens in hidden places where the teachers aren't present or can overlook. The students listed the areas where they felt the most insecure: the school yard, restrooms with closeable anterooms, changingrooms, locker rooms and hang-out spaces.

Hejlskov-Elfvén (2015) on the other hand believes that restrooms need an anteroom to feel safe. Perhaps a good balance would be an anteroom that is still visible, without a door, or to place the toilets in a way that they don't feel too exposed to high flow areas such as corridors.

Conclusively the areas that students point out as unsafe are the most crucial spaces for teachers to be present in. These spaces might benefit from being close to spaces where staff frequently walk by. The school yard can be shaped in a way so that it is easily overlooked by the staff from both inside and outside the school.

Corridors

According to Hejlskov-Elfvén (2015), the layout of a room highly influences the students' movement and behavior. A long high ceiling corridor will promote running. If running isn't eligible then the layout of the room should be designed accordingly. Two parallel walls in a corridor promotes fast speed. To promote slower walking at least one of the walls should go in and out.

Classroom Layout

Personal workspace

Tufvesson and Tufvesson (2009) found in their study that children with Down's syndrome, autism and ADHD all benefited from having their personal seat in the classroom. Having their own designated workspace increased their concentration span compared to choosing a seat every time they entered the classroom.

Activity pockets

Moore and Lackney (1993) suggests that the classrooms should be designed into different zones with specific purposes. They stress the value of having secluded spaces within the classrooms where students can study without too much visual and auditory stimulation. They mention that specific reading places in the classroom notably increased the amount of reading. Moore and Lackney calls the concept *Activity Pockets*. The activity pockets could be created by sound absorbing partition walls or by the classroom layout itself, creating different nooks.

Barrett et al. (2015) advise that the layout of the room should be so that the students sit close to the teacher in order to properly hear, to achieve this, long rooms should be avoided.

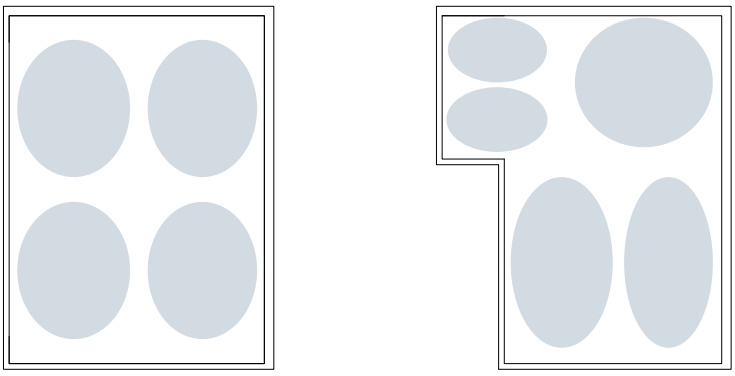


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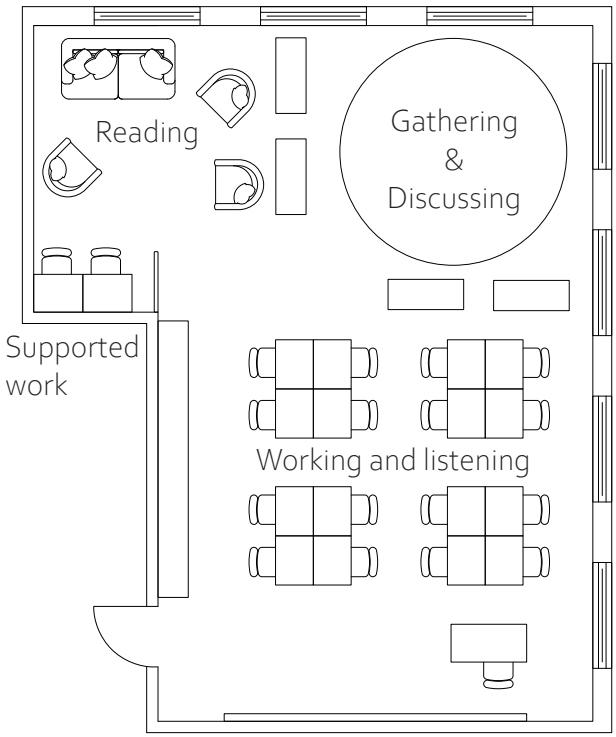
Diagram showing simple ways of zoning in a sqare versus an L-shaped classroom.

The L-shape

Pålsson (2020) agrees with Moore and Lackney, and describes how different class-room shapes make it easier to create good zones. Humans tend to prefer being in corners of a room, therefore a room with many corners is easier to divide into zones that feel comfortable.

Moore and Lackney (1993) , points out that too many corners in a room could instead make it hard to fit a traditional lecture, where all the students can see the board. The L-shaped classroom might be a good alternative since it is easy to divide into zones and still fit traditional lectures.

Pålsson (2020) argues that the L-shape is good for individual adaptation for the student. It is easy to create calm enclosed work environments in the corners for the students who are sensitive for visual stimulation, while some students prefer to sit where they can get a good overview over the room.



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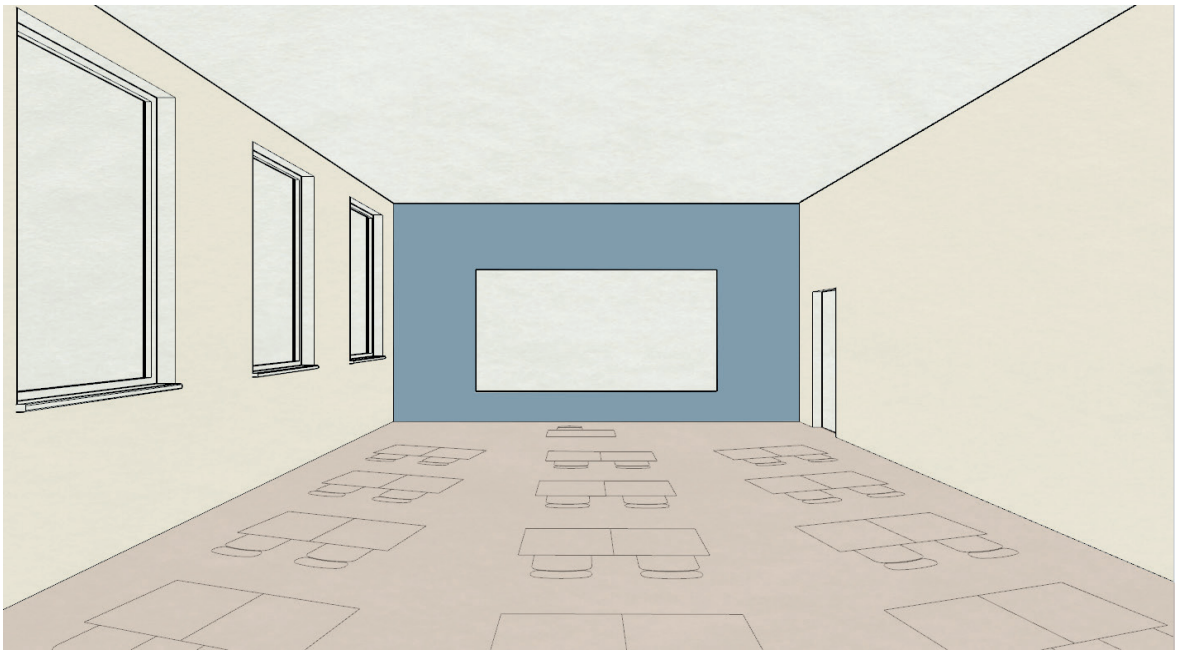
L-shaped classroom with four zones. The zones are divided by the L-shape itself, bookshelves and sound absorbing partition walls.

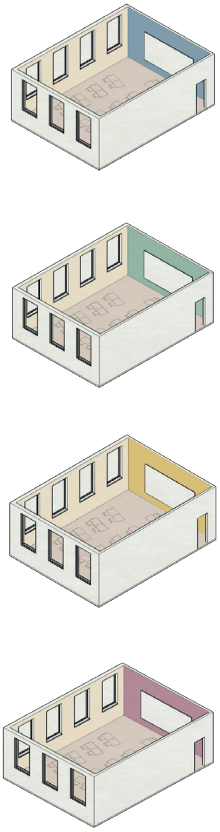


Color

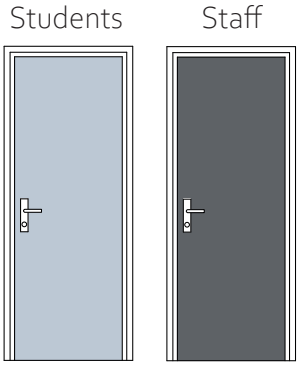
In order to get the perfect balance between overwhelming and blunt Barrett (2009) means that a room needs the right amount of diversity and contrast. In order to get the students' attention in the right direction he suggests painting the wall behind the board and the teacher in a different color than the rest of the walls that should be painted in more neutral colors. Then the board and the teacher will be a natural focal point for the eyes, without making the room too overwhelming.

Different colors give us different feelings. Red increases the stress hormone cortisol (Pålsson, 2020). Red colors should therefore be avoided in school environments. Yellow and orange makes you more awake whereas blue and green lowers the blood pressure and makes you calm.

Hejlskov-Elfvén (2015) writes that children with autism usually prefer pastell or earthy tones. He also mentions that humans prefer opening light colored doors over dark ones. This could be used to differentiate the doors that are allowed for the students to open compared to doors that are only for staff such as staff room and storage spaces.



Examples of medium toned colors for clearer focal point.



Example of how to use color on doors.

Complexity

Hejlskov-Elfvén (2015) explains that children with neuropsychological difficulties struggle to organize and sift information. Therefore a messy and cluttered environment can be highly stressful. He proposes that the interior is clutter free with unnecessary information hidden away. He emphasizes that patterns should be avoided and that a simple solution to reduce the feeling of clutter is to add doors to all shelves and storage units.

Wood as a material

According to Pålsson (2020), exposed wood inside the classroom has a stress reducing effect on the students. Wood tables were also preferred by the students because of the balanced amount of contrast between the table and the paper.

Lighting

Window placement

In his text about optimal learning spaces, Barrett (2009) highlights the importance of sufficient daylight in the classroom. Preferably you want a room with a lot of natural lightning as well as having an even distribution of the light. Harsh shadows should be avoided for better comfort for the eyes. In order to achieve this, north facing windows are preferred over south facing windows since it casts softer shadows and avoids disturbing glare.

Barrett et al. (2015) advocates external shading, such as outriggers and overhangs if south facing windows are needed. According to Barrett (2009) the glazing of the classroom should be around 40 percent for south, east and west facing facades and 55 percent for north facing ones. He suggests that the room should, if possible, have windows in several directions to even out the illumination.

Windows that are placed closer to the ceiling allows the light to come further into the classroom which also contributes to a more uniform distribution of the light. However, Barrett et al. (2015) mentions that the window placement should be at eye level for the children, giving them important views of the seasonal changes of the nature outside.

Hejlskov-Elfvén (2015) points out that some children with neuropsychological difficulties are extra sensitive to harsh lighting. He suggests that the lighting should be possible to regulate depending on the student's individual needs. In order to do so, thin curtains, blinds and a variety of spread lighting sources are important. Preferably all lights would be dimmable.

Hejlskov-Elfvén (2015) agrees with Barrett (2009), that the windows should if possible be in more than one direction, but also adds that the windows shouldn't sit opposite each other. Especially good are those rooms with indirect overhead light from a skylight.

Artificial lighting

Artificial lighting can never replace the natural lighting from a window. Instead artificial lighting should work as a compliment to natural light. The lighting in a room has a great effect on behavior. Dimly warm lit rooms lower the frequency of the voice and create a calmer atmosphere, it even makes us less prone to conflicts and better at working together. Whereas directed blue toned light is better for focusing on the task. The classroom should therefore have a variety of light sources of different tones depending on the activity (Pålsson, 2020).

Focus Collaboration

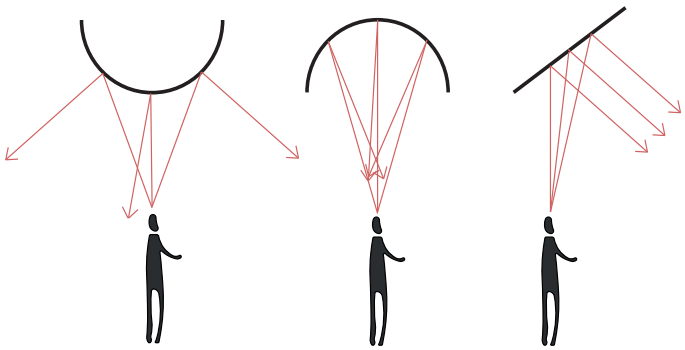
Acoustics

Too much unwanted noise in Swedish schools is common and has been identified as a work environment problem. Impaired hearing, vocal problems and stress is a huge issue amongst teachers, probably caused by the constant high noise levels. High noise under a longer period of time has been linked to stress, lower memory capacity, concentration difficulties and lower language skills in students (Pålsson, 2020). The sound environment in schools should therefore be of highest priority.

Ceiling and room shape

Dudek (2007) mentions that sound absorbers and soft materials often are added in the end as the only acoustic design element. He clarifies that the acoustic design is far more complex than adding sound absorbers in the last design phase. Instead the acoustics should be considered throughout the entire design process starting already with the spatial configuration. He points out that the biggest acoustic problems in schools are due to noise transfers between rooms or excessive reverberation within a room, which is especially common in open plan schools.

Dudek (2007) continues by explaining that niches and narrow angles can cause sound accumulation in a room. Concave surfaces concentrate the sound while convex surfaces diffuse it. He means that the room could be shaped to direct or diffuse the sound to your advantage.

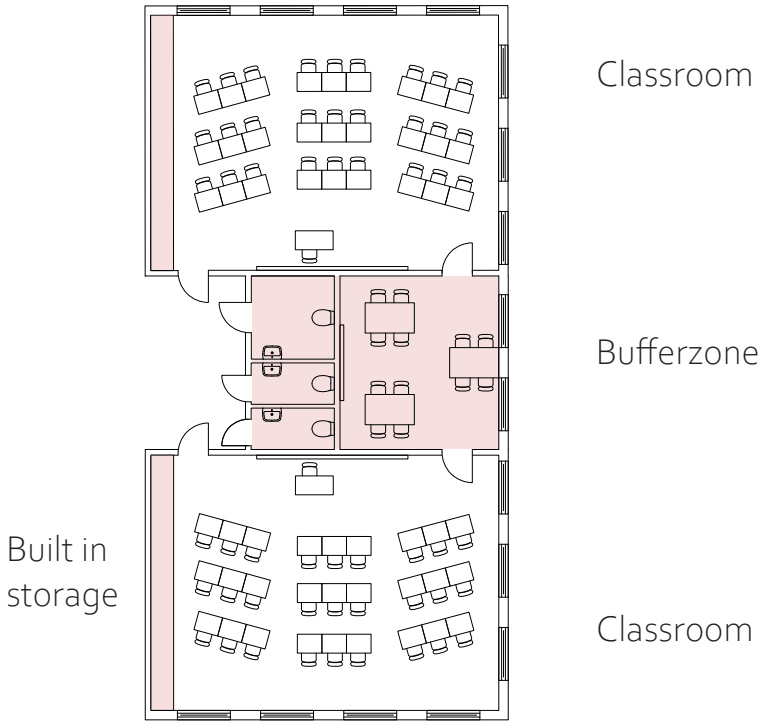


Materials

Carpets, cushioned furniture and fabrics can be used as sound absorbers (Pålsson, 2020). Textured areas that have raised and recessed areas like, for example wood panels decrease reverberation (Dudek, 2007). Barrett et al. (2015) suggests putting rubber feet on all movable furniture, to avoid disturbance.

Buffer zones

Barrett (2009) suggests that classrooms and other concentration demanding areas could benefit by placing support functions such as storage spaces and toilets in between as a buffer zone for better sound privacy inside the rooms. Another suggestion would be to place two classrooms with a shared activity room in between. This room could then be used by both classes in order to divide the class into smaller groups and work as an extension of the classroom when needed. Barrett et al. (2015) also agrees with the idea of having an activity or group room in connection to the classroom. In their suggestion they have a layout with both toilets and a group room as a sound barrier in between the classrooms. Olsson (2015) means that there is generally a lack of group rooms and suggests that each classroom should be connected to an additional workspace, preferably with a glazing in order for the teacher to get a good overview.



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Two classrooms with shared group room. The group room allows for half class division. Toilets and group room works as a sound barrier between the two classrooms.

Conclusion

There is strong evidence that the physical school environment has an effect on the students academic performance. The Swedish law ensures all children a calm study environment but does not specify further what that demands from a building perspective. In order to fulfill the law, I believe that the amount of students within a room should be regulated. The research suggests that the classroom needs to be bigger, however, it does not specify what that means in terms of square footage. What can be said about the classroom size is that the standard classroom size of 60 square meters is probably too small for an average sized class.

The smaller classes perform better than the large ones even in a long term perspective, but splitting the classes in two would be very expensive. However, some schools today have a two teacher system, meaning that each class has two teachers working together. Therefore it might be beneficial to divide the class in two as often as possible. This creates a higher demand on group rooms, which is already too few according to the research.

Lighting, color, material and room shape has a great impact on students' behavior. Knowing how the students are affected by our design choices can be an asset when creating the right environment for the right task.

3

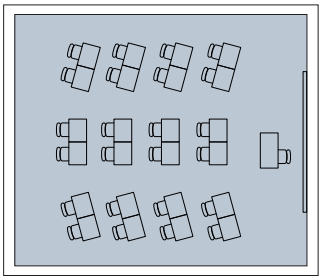
The history of the school building

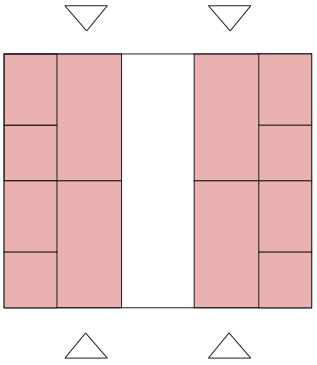
Layouts

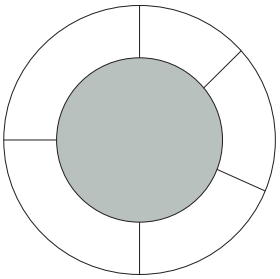
The architecture of the school building can be seen as a mirror of our pedagogical thoughts and by that also mirroring our desired future. In this chapter an historical evaluation of Swedish school buildings is done, in order to understand what has been done previously and what effects that had on the students' performance. History can help us better understand the needs of the schools in the future. Without evaluating what has been done already, we might repeat previous mistakes over and over again, or miss out on great already found solutions to a problem.

Some of the different school typologies have been overlapping, therefore the timeline isn't linear, instead they are organized after starting point.

I have identified three categories for the historical school layouts: the traditional, the home room and the open plan. To get a better overview of the eras, the most present layout concept is being displayed by the icons below.







Traditional

Traditional classroom layout with rows of tables facing the teachers desk.

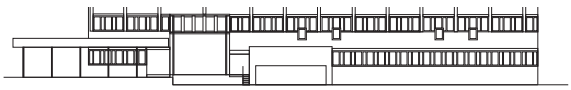
Home room

The school building is divided into departments with various workspaces inside. Each unit has its own entrance.

Open plan/ study hall

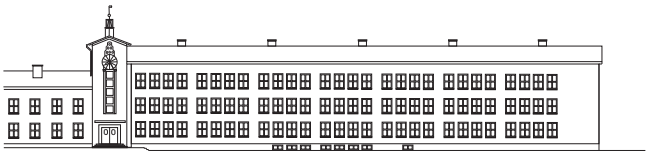
One large central study area with surrounding support functions.

Swedish school timeline



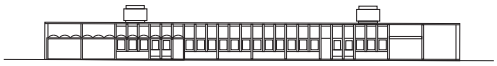
The open plan school

The new pedagogical ideas of working in teams of different sized flexible groups, did not fit inside the traditional classrooms. The typical open plan school had a large study hall in the middle, with subject specific rooms surrounding it.



The subject room school

Previously the teacher moved from classroom to classroom, now the traditional classrooms disappeared, instead the students moved in between subject specific rooms. It was during the 1950s that the "classrooms" got paired with group rooms.



The integrated public functions school

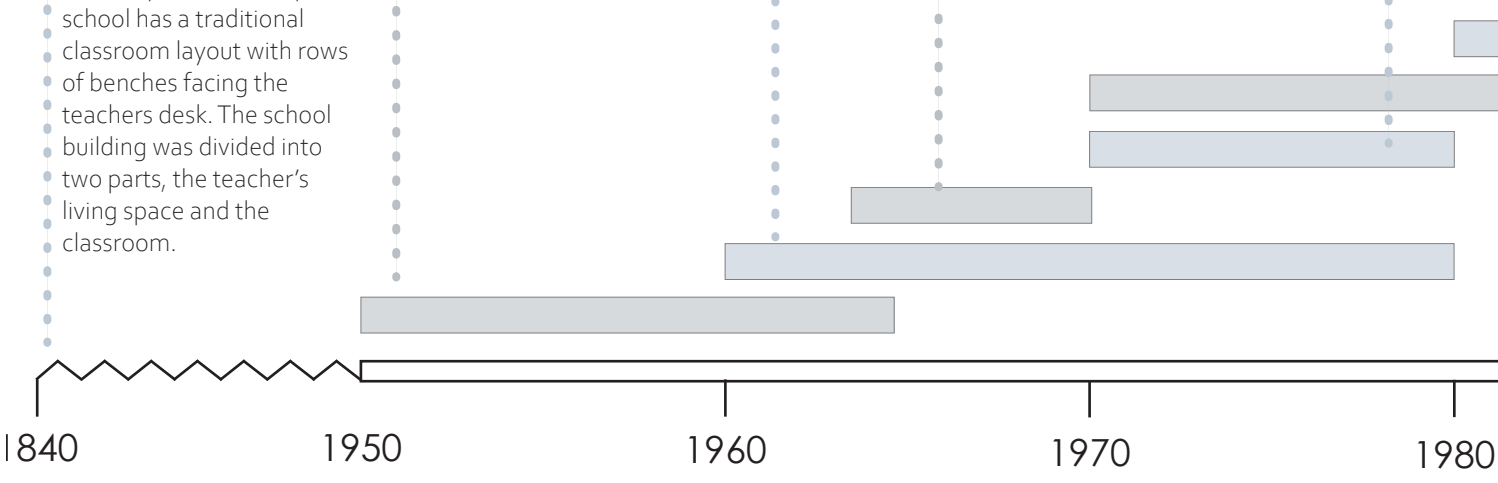
The schools were a central part of the city planning and were combined with other facilities such as libraries, leisure activities and sport arenas, dwellings, shops and health centers. The buildings were often very large.

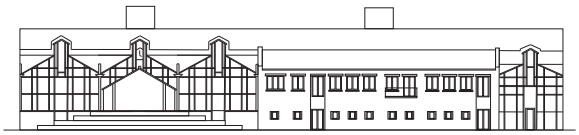
The institution school

The huge demand for new school buildings quickly resulted in low quality buildings that were only supposed to be temporary structures but were used for many years.

The public school

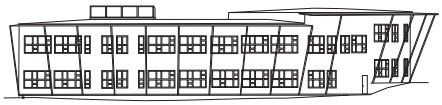
The public school was statutory in 1842. The public school has a traditional classroom layout with rows of benches facing the teachers desk. The school building was divided into two parts, the teacher's living space and the classroom.





The home room school

The school was divided into three to four departments and teams with their own entrances and support functions. This was done to create the feeling of a small school within the large one, making the students less anonymous.



The school 2000

Similar to the Open plan school from the 1960s, with study halls with surrounding support rooms. The age integration and home room from the SAMLA and SAMPHOL school is still present.

The SAMLA/SAMPHOL School

The SAMLA or SAMPHOL was a continuation of the homeroom idea. The subject rooms were toned down to give space for social activities and flexible usage. The teachers' education was redone to promote age integrated learning.

1990 2000 2010 2020

The public school
Folkskolan
1842

The public school became statutory in 1842. This meant that all children had the right to go to school. Every parish needed to have a school with at least one educated teacher. Some small parishes got exemptions to go together and shared one single school among them (Jönsson, 1992).

The schools were run by the church and the classroom did in many ways resemble the church halls.The location of the school was often next to the church (Krupinska, 2022). The aim was to host the education in a specific stationery school, but this was not always the case, a lot of the education was itinerant or held in someone's private home (Jönsson, 1992).

During the 1850s the discussions about pedagogical ideals and school buildings started to arise. One of the most influential Swedish school debaters during the time was Per Adam Siljeström. Siljeström claimed that education should be held in school buildings only. Therefore he designed programs for what a Swedish school should look like. The programs had a clear division between the classroom and the teachers living space, by placing them in two separated but adjacent buildings. Siljeström suggested gender separation in the schools according to some French examples. The idea of gender separation got only a minor influence on the Swedish school buildings since it was seen as unnecessary to separate small children according to gender (Jönsson, 1992).

700 new school building were built in Swden during the 1860s (Jönsson, 1992). The buildings were often small with the classroom in the south and the teacher's living space in the north. As previously mentioned, Barrett (2009) advocates a classroom with even lighting but at the same time avoiding windows facing south since it can cause overheating and glare. The public school buildings generally have windows towards several directions which evens the lighting in the room. Preferably, the teachers home and the classroom could have switched positions to avoid having south facing windows.

To guarantee the quality of the education and the school buildings, school inspectors were hired. They looked at aspects such as class size, building standard and personal hygiene. A lot of schools got marked for having too large classes (around 100 students) with varying ages of the students, which was seen as problematic. Reversing it, Krupinska (2022) describes how large age integrated classes would be desirable from the SAMLA school and onwards. With the research from the previous chapter we now know that too large classes and mixing students of different ages has a negative effect on the academic performance of the students.

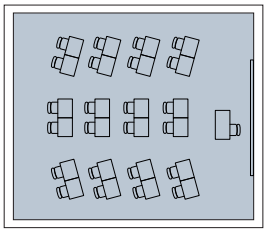
Moore and Lackney (1993) described how small schools perform better than larger schools. The public schools had only room for one class which is the smallest school typology.

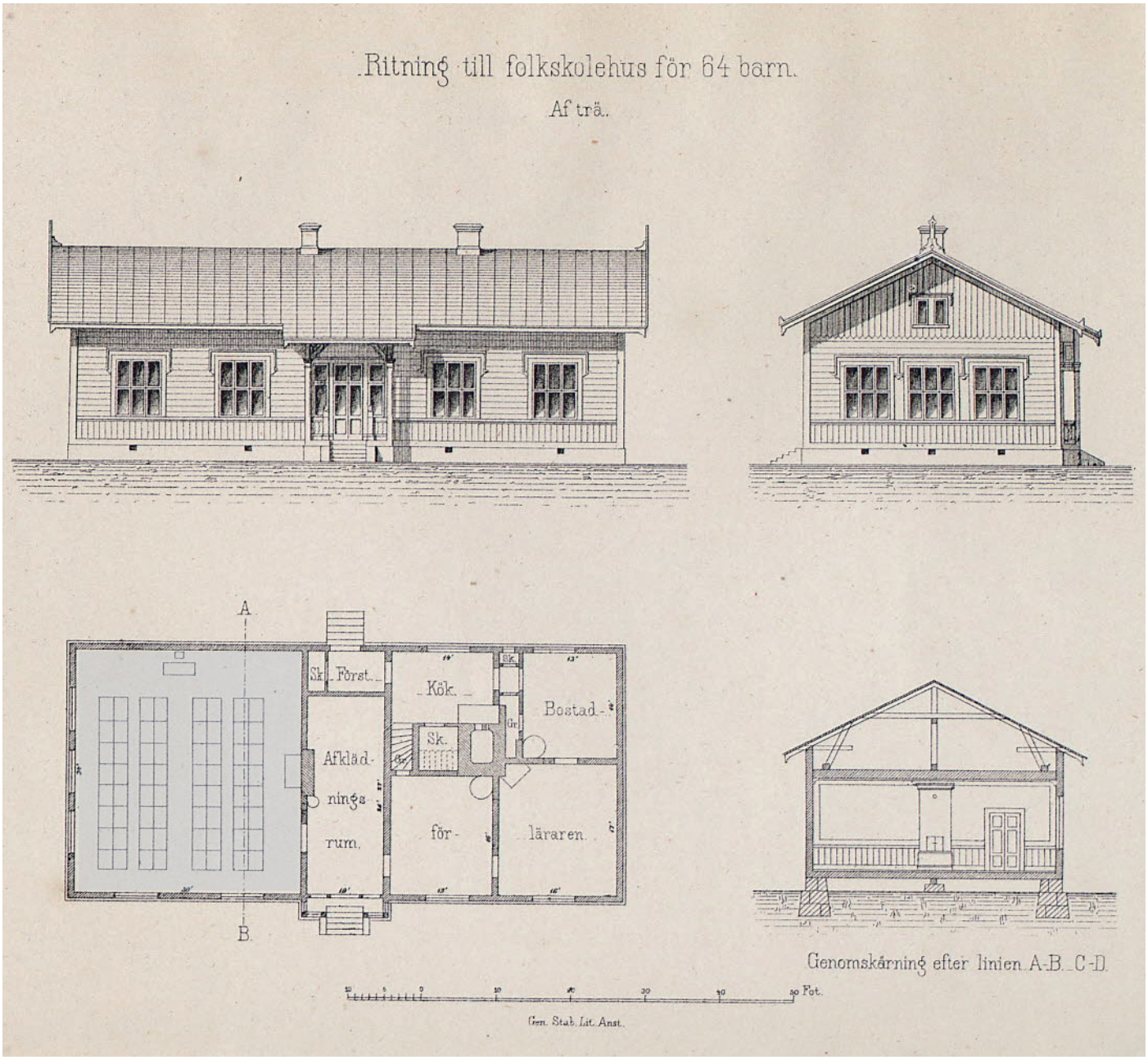
Jönsson (1992) describes that in 1865 new standard drawings for school buildings were made to guarantee the building standard. They were similar to Siljeströms drawings but with less gender separation. The teacher's living space was instead placed inside the school building but with clear division of the floorplan.

The Public school has later been described as hierarchical where the teacher had too much autonomy and power. The traditional education was with clear rights and wrongs, without seeing the child as an individual.

Traditional layout

The Public school has a traditional classroom layout with rows of benches facing the teachers desk.





1865 standard drawings for 64 students
(Boverket, 2021)

The subject room school

Ämnesrumsskolan

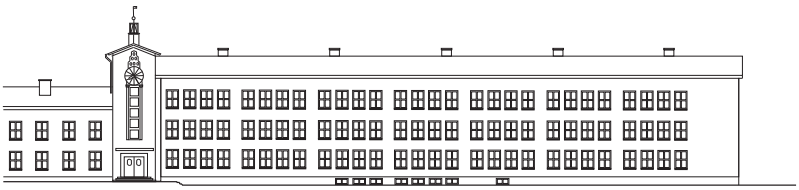
1950-1965

The demand on education increased after the world war. Larsson et al. (2007) describes it as "schools being industrialized". His point was that the industries and businesses for the first time got involved and interested in the Swedish schools. They realized the importance of an educated population both for practical and theoretical professions. Previously, it had been the teachers who moved in between the different classrooms, but this hindered education to have laboratory parts since it would be impossible to carry all the necessary materials from room to room. Krupinska (2022) describes how the traditional classrooms disappeared, instead the students moved in between subject specific rooms. In the 1950s the budget for schools was very low and the design was mainly focused on minimizing unnecessary space. Jönsson (1992) explains how the standardized school building plans disappeared.

The small public schools were replaced by centralized schools in the bigger cities. The small public schools had no ability to fulfill the demands of the subject specific rooms with so few students. Some students now needed to travel very far to get to school. Both location and size of the Subject room school can have had a negative effect on the students performance. Both Sanoff and Walden (2012) and Moore and Lackney (1993), suggest placing the schools close to nature rather than in the middle of the city, where there is more noise pollution. As previously mentioned, Moore and Lackney (1993) advocates for smaller schools.

Instead of having standardized school building plans, architects (who mainly lived in the cities and where now available) got a larger freedom in the design. The classrooms were often placed in a row along a corridor, giving a narrow building with good lighting. The long corridors can however, according to Hejlskov-Elfvén (2015) have contributed to excessive running in the corridor. The classrooms could have benefitted from being L-shaped and bigger in order to create better zoning for the various activities (Pålsson, 2020).

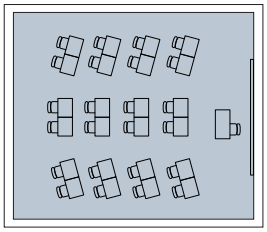
According to Bjurström (2003), it was during the 1950s that the classrooms were paired with additional group rooms. Olsson (2015) means that the group room provides privacy and a better sound environment within the classroom.

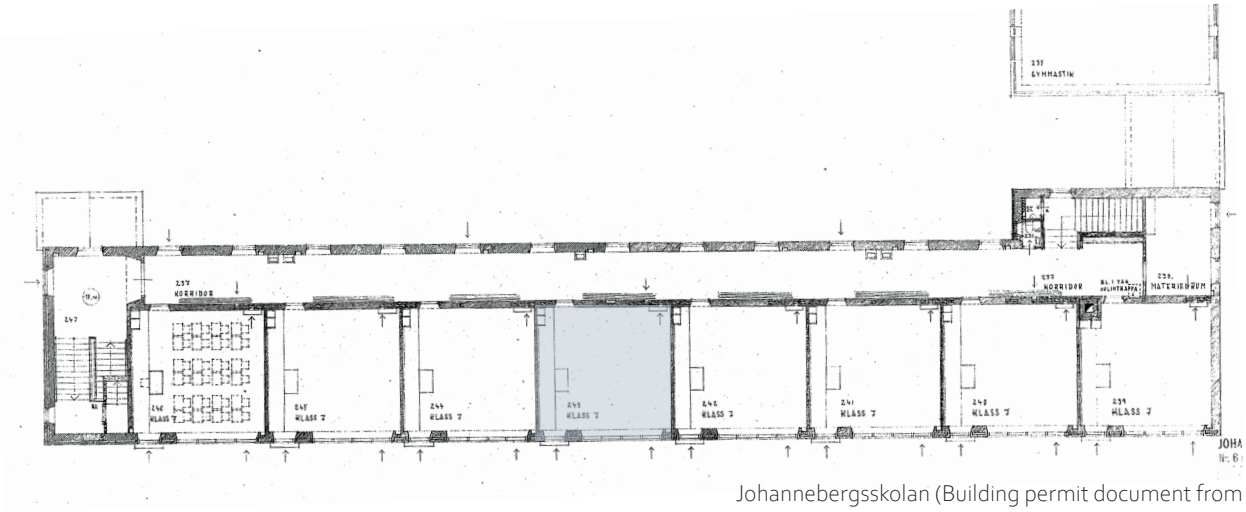


Own drawing of the facade of Johannebergskolan, Gothenburg.

Traditional layout

The Subject room school has a traditional classroom layout with rows of benches facing the teachers desk. The classrooms were often placed in a row along a corridor, giving a narrow building with good lighting.





Johannebergsskolan (Building permit document from Göteborgs stad, 1950).

Traditional classroom

Plan showing Johannebergsskolan. The school is a typical 1950s school building with its monumental look and architectural detailing. The school has built in artwork in the form of casted reliefs in the facade. The entrances have granite around them. The building is narrow with traditional classrooms along one side of the corridor to maximize the natural light (Jonsson & Lindman, 2021).

The institution school

Instutionskolan

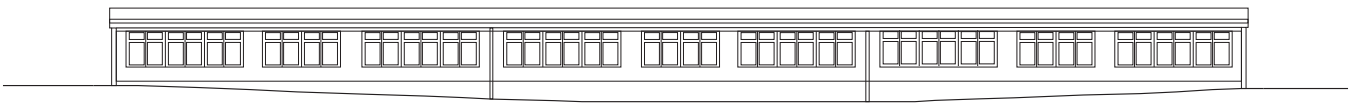
1960-1980

In 1962, the Swedish parliament decided that it would be obligatory for all children to go to school for nine years. The right and accessability to education would thereby be the same in the whole country - in the cities as well as in the countryside. This created a huge demand for new school buildings quickly. Krupinska (2022) writes that the building speed was hurried with very low budgets. She continues: "Construction, technical quality, pedagogical and architectural holistic thinking became thereafter" (ibid, p.38).

According to Bjurström (2003), the acute shortage of school buildings was solved with what was planned to be provisional structures, with lower quality demands.

But what was planned to be a short term solution unfortunately became temporary school buildings that were used for many years.

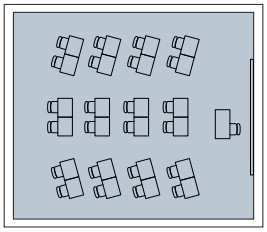
The subject room school has similar pros as the subject room school with closed classrooms paired with group rooms. Just as the subject room, the classrooms of the institution schools were very square and quite small and could have benefitted from having a larger L-shaped classroom (Pålsson, 2020). The bad materiality and quality can have affected the students academic results negatively.

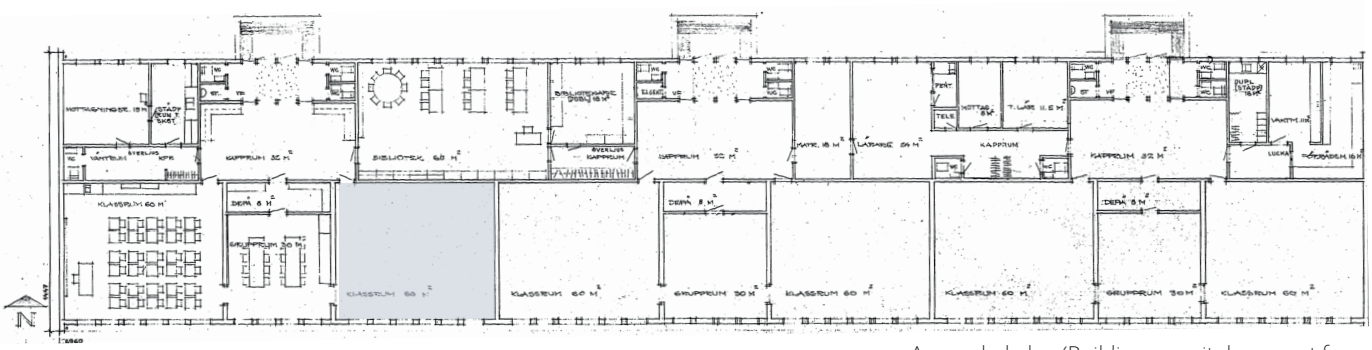


Own drawing of the facade of Assaredsskolan , Gothenburg

Traditional layout

The institution school has a traditional classroom layout with rows of benches facing the teachers desk.





Assaredsskolan (Building permit document from Göteborgs stad, 1963).

Traditional classroom

Plan showing the middle school building of Assaredsskolan. Assaredsskolan is a typical school building from the 60s. The building is divided into six pavilions, one middle school pavilion, four elementary school buildings and one for shared functions such as the canteen and the sports hall.

The middle school building has six classrooms of 60 square meters paired with three group rooms/ half class rooms of 30 square meters. The building has three entrances meaning that only two classes need to share the same cloak room.

The open plan school
Öppenplanskolan
1963-1970

The founder of the Open plan school was the American educator Lloyd Trump (Sanoff & Walden, 2012). He observed that too few of the American teachers had a proper education. To solve this issue, Trump suggested a school where the teachers worked together in teams to better spread their knowledge. The students were also spread into three different sized flexible groups, depending on activity, such as: large groups for lectures, small groups for discussions and individual work. This new way of working did not seem suitable in the traditional classroom configuration. Instead the leading words for the upcoming design was openness and flexibility. The pedagogical ideas were very important for the shift but it was also a way to save money. If each class didn't demand their own classroom, the square footage could be highly reduced.

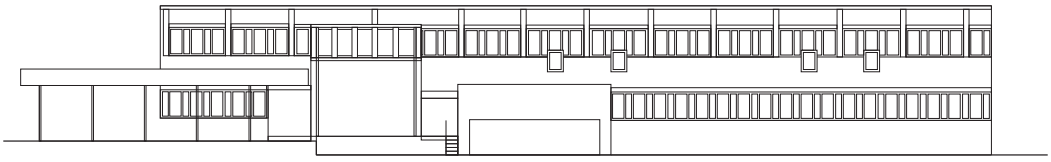
The rooms were configured with as few walls as possible, to promote large groups of around a hundred students to come together. The typical layout had a large study hall in the middle, with subject specific rooms surrounding it. Some architects tried to solve the issue with the study hall becoming the only passage to get around in the building by adding corridors in the facade. In order to get light into the subject rooms they added skylights and windows along the ceiling. A lot of the skylights were poorly built and quickly got covered to prevent leakage. This became in reality, deep buildings without any sufficient daylight or natural ventilation.

The idea of the teachers working in teams was not implemented the way it was intended. Krupinska (2022) means that there was a naive translation of the notion of openness. The hopes were to get an open society with open minded people, but that can't be equated with an open layout and a school without sound privacy. A lot of the open plan schools were demolished or rebuilt just a few years after they were built.

Larsson et al. (2007) describes the open plan school debate as bitter. The supporters of the typology states that it is beneficial for the students to have several teachers to go to. They argue that education gets richer when the students can take part in several teachers' varied knowledge. The teachers can seek support from each other and are not left alone to solve problems. The opponents on the other hand describe a situation where the students hang out in the study halls during breaks, making the sound environment unbearable and unfitting for subjects such as language and math. They are especially concerned for the students with concentration difficulties and claim that the layout punishes the weaker students the most.

That the open plan layout worked poorly for concentration is just what the research from the previous chapter suggested. With poor natural light, bad air quality, too many students in one room and inadequate acoustics it is not surprising that they got demolished or rebuilt quickly.

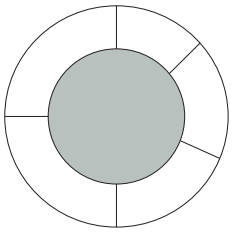
The ideas of the open plan were implemented again in the School 2000 (Kurpinska, 2022), which is discribed later in this chapter.

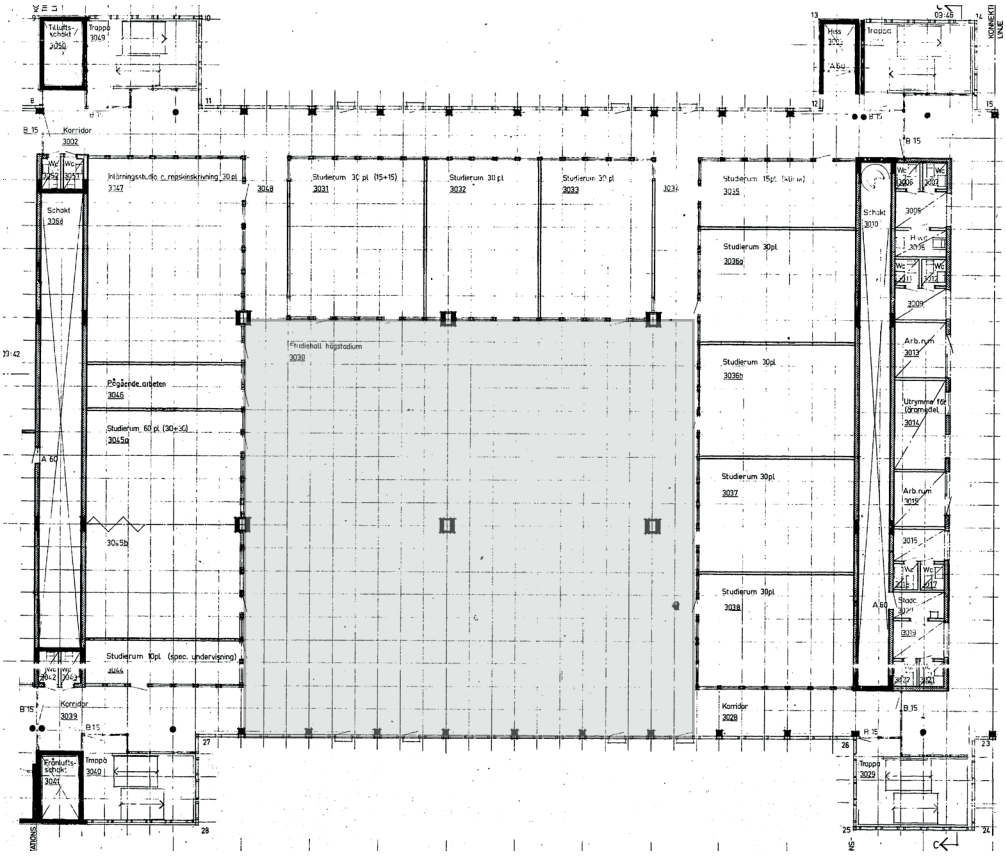


Own drawing of the facade of Skälltorpskolan , Gothenburg

Open plan layout

The open plan school has, just as the name suggests an open plan layout with one big study hall in the center with support functions around it.





Skälltorpskolan (Building permit document from Göteborgs stad, 1971).

Study hall

Plan showing the middle part of Skälltorpsskolans third floor. The school has a central study hall with surrounding group rooms. The group rooms do not have access to natural light. The inner walls were made demountable as a way to future proof the building. In 1993 the study halls were rebuilt (Jonsson & Lindman, 2021).

The integrated public functions school

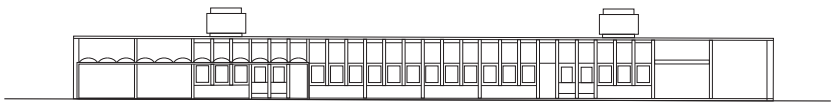
Integreringsskolan

1970-1980

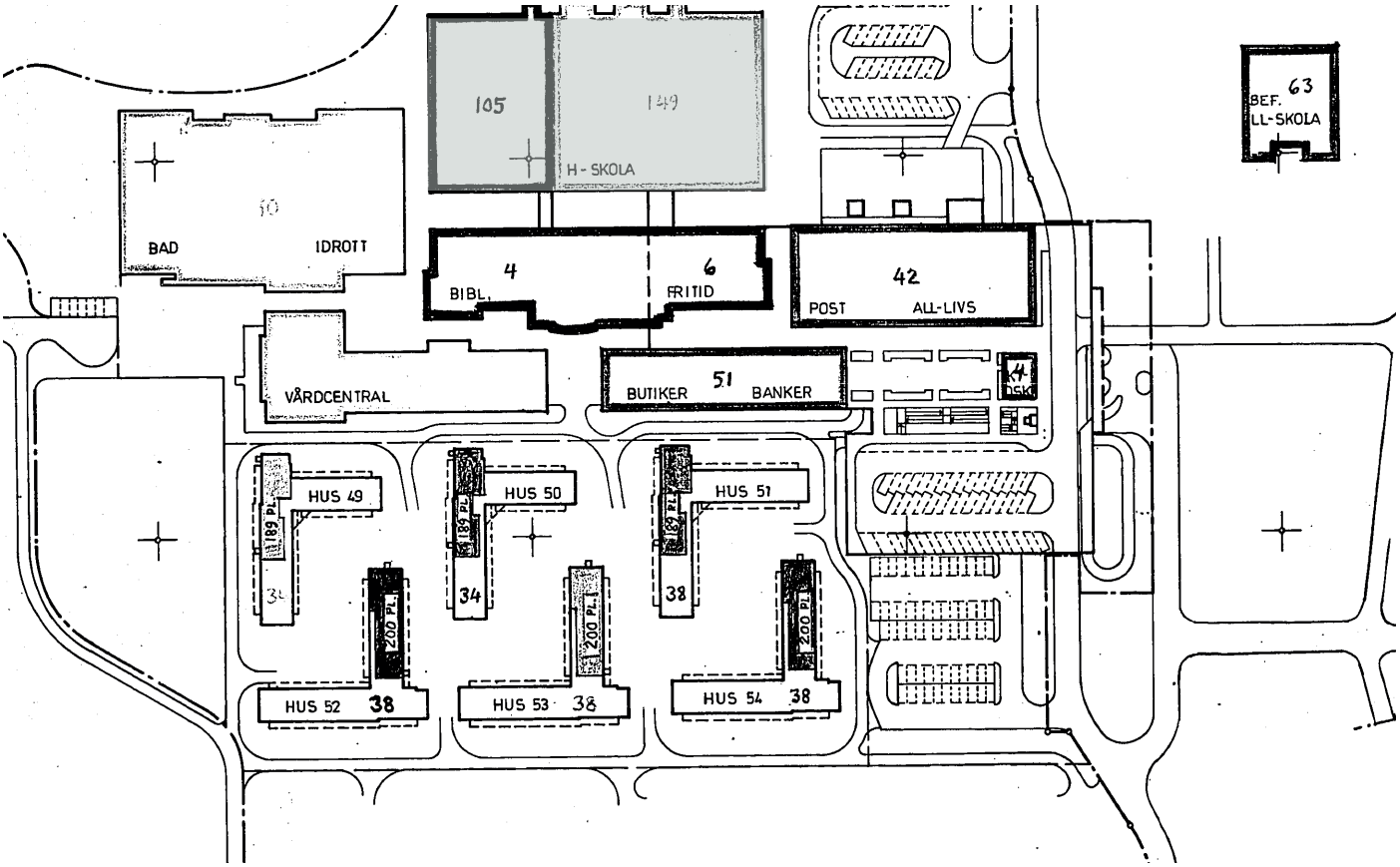
After the war in the 1940s, new ideals of city planning emerged in the USA and Great Britain. The idea was to create stronger communities by placing certain things together and separating the different areas by roads, nature or railroads. Today these are our suburbs. These ideas highly influenced Swedish city planning until the end of the million program in the middle of the 1970s. The schools had a central role in the community center, it was not only used for traditional education but also as an important meeting point for the community to gather, discuss and host leisure activities (Larsson et al., 2007). The suburb city plan could be discussed as a reason for the segregation, increasing the gap between the schools results in high performing schools compared to low performing schools.

In 1967, a new plan for Gothenburgs' suburb Angered was presented. The plan included a school for 6500 students integrated in a large cultural center. The plan for the school was to integrate it with sport facilities, services and associations. The ideas were that the massive school integrated in society would bring different people together, referring to some english studies that had proven so. However, the scale of the school got highly criticized. The critique was also that the schools did not benefit from being integrated with commercial functions but should rather have been placed near dwellings and nature instead (Larsson et al., 2007).

Since smaller schools have shown to perform better than larger, it is reliving that the massive school in Angered didn't get built. Contradictory to the intention of the proposal, smaller schools create stronger communities (Moore and Lackney, 1993). As the criticism suggested, the school would most likely benefit more from being close to nature rather than integrated to noisy public functions.



Own drawing of the facade of Bäckebolskolan from 1971, Gothenburg



Kärra centrum with Klarebergskolan, 1977
(Building permit document from Göteborgs stad, 1977).

The school building

Masterplan showing Kärra centrum, in Gothenburg, with Klarebergsskolan in the top. Klarebergsskolan was designed together with the new centrum of Kärra. The school was made to blend in architecturally and be an integrated part of the center. The school has an indoor connection to the library as well as an assembly hall. The school is then surrounded by a sportshall and swimming pool, shops, a bank, a health care center and dwellings. The layout of Klarrebergsskolan was designed as an open plan school with study halls but has been rebuilt to have a traditional classroom layout. (Jonsson & Lindman, 2021).

The homeroom school

Hemrumsskolan

1970-1990

In the late 1980s and during the beginning of 1990s, an interest in school size emerged globally. Several new studies showed that the smaller schools both were more efficient, had higher performing students and had less vandalism, theft and violence compared to larger schools. These new findings started a discussion about how to minimize the impression of the schools (Sanoff & Walden, 2012).

The home room school can be seen as a reaction towards the Institution school and the Open plan school. The idea was to create a school where the students felt like they were a part of a community. The institution schools were described as making the students anonymous. Instead of letting the students go between different rooms with new teachers and new student group configurations, the Home room school would allow the students more stability and recognition. Simply explained, the closable classrooms were back (Larsson et al. 2007).

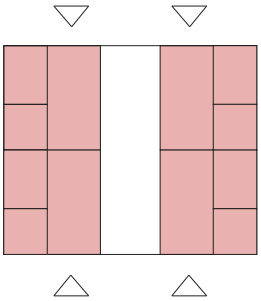
The classrooms were then divided into groups of three or four with shared additional spaces in the middle. This was to create the feeling of a small school within the large one.The central cloakrooms were divided into several small ones to take down the scale. The canteens were also divided into the different "home departments". They were designed to host around 60 students each, making the noise level and queing time more desirable. The smaller units took up more space than the previous open plan, therefore additional spaces such as libraries and study halls were rejected to keep the same square footage. What potential consequences this had was never evaluated according to Krupinska (2022).

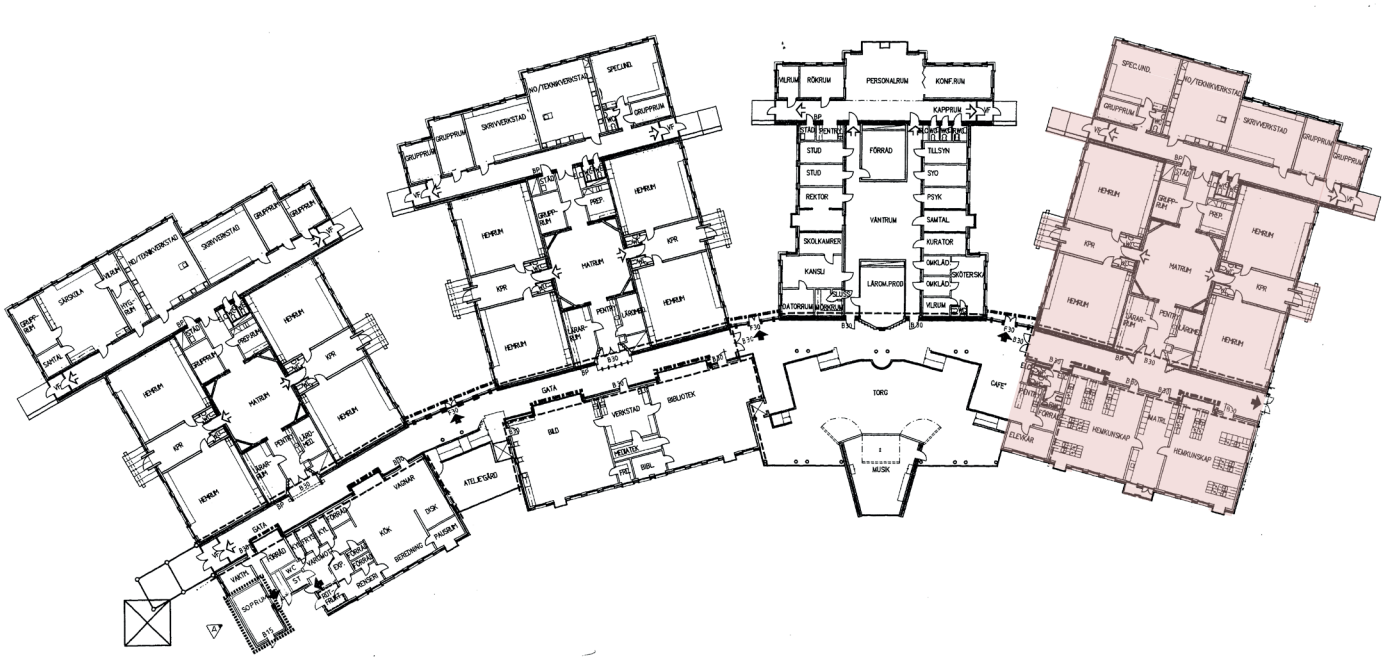
The home room school was designed with strong research backing the suggestion of small schools performing better. As written in the previous chapter, letting the students have their own personal desk increases their concentration. It is therefore likely that letting each class have their own classroom will have a similar effect. Reducing the noise level in the canteens will have a positive effect on the students behavior and performance. Generally the home room school goes in line with the research on school design from the previous chapter.

Own drawing of the facade of Vättleskolan , Gothenburg

Home room layout

The home room school has a home room layout where the school is divided into departments and work teams with their own entrances.





Vättleskolan
(Building permit document from Göteborgs stad, 1988).

One home department

Plan showing Vättleskolan. The school is divided into three home departments in their own wing connected with an indoor "street". The last wing is for shared support functions. Each department consists of four home rooms, three group rooms, a dining room and a staff room.

The SAMLA or SAMPHOL school

1980-1990

In 1979, the Swedish public authority *Skolöverstyrelsen*, which had the responsibility for the questions concerning the Swedish school, presented a new idea of a school building and pedagogy. The ideas called SAMLA or SAMPHOL schools were a continuation of the Home room ideas. The goal was to create stronger relationships between teachers and students. Just as in the Home room school, the schools were divided into smaller units to create the impression of a smaller school within the large one.

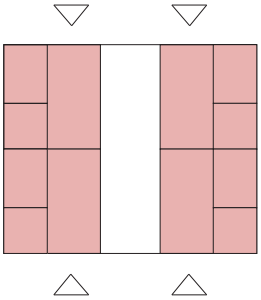
What was new about the SAMLA or SAMPHOL schools was that the subject rooms were toned down to give space for social activities and flexible usage. The teacher education was changed to promote age integrated education where several ages were educated together in the same room. The rooms were generally between 150-200 sqm and made room for around 60 students (Krupinska, 2022). The layout of the SAMLA and SAMPHOL idea was with as few communication areas as possible. The focus was on maximizing space for social activities, this was to create strong relationships between the teachers and the students. Krupinska (2022) describes how the SAMLA and SSAMPHOL ideas never got evaluated, probably because Skolöverstyrelsen, who came up with the idea, was closed down shortly after presenting the ideas.

The integrated learning had a negative effect on the school result (Kornhall 2013). Kornhall means that it was impossible to hold lectures for children of various ages at the same time, resulting in no lecture at all. The research from the previous chapter indicates that the class sizes were way too big with 60 students in each class, instead Moore and Lackney (1993) advocates for 13-17 students per class. Kornhall (2013) means that the age integration together with the large student groups with no real lectures was a big part of why the school results, a couple of years later, had a massive drop.

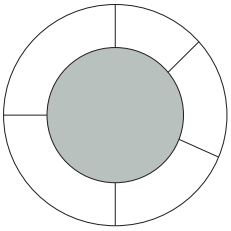
Few schools were built during the 1980s (Krupinska, 2022). When searching for schools that were designed with the SAMLA or SAMPHOL idea, it was evident that the school typology didn't get widely spread. Due to the low building rate the ideas were implemented larger in a pedagogical way then affecting the physical buildings.

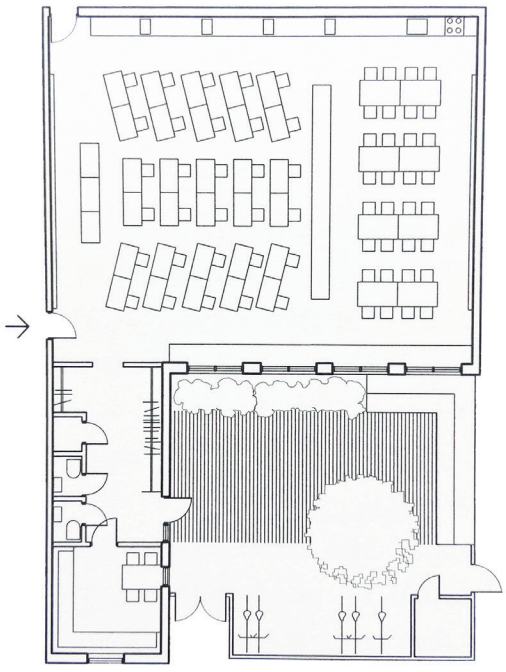
Home room and open plan layout

Just as the home room school, the SAMLA school has a home room layout where the school is divided into departments and work teams with their own entrances.



You could advocate that the SAMLA school has somewhat of an open plan. The rooms were generally between 150-200 sqm and made room for around 60 students.





Plan showing a SAMPHOL classroom of 200 square meters, with room for 60 students (Krupinska, 2022).

The school 2000

Skola 2000

1990-2020

Jean Piaget (1896-1980) was a biologist from Switzerland, whose thoughts about knowledge became highly influential for many years to come. He claimed that knowledge was something you have inside, not something you can find around you. He believed that telling a child what was right and wrong would disturb the childs' inner learning (Säljö, 2003).

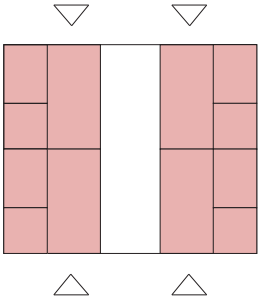
In the 1990s new pedagogical ideas emerged, imspired by Piaget. Kornhall (2013) describes that the role of the teacher was rewritten. A teacher should no longer be telling the students what was right or wrong. Teachers and students were seen as equals and the role of the teacher was primarily to support the childs' own curiosity and will to learn. Kornhall (2013, p.88) cites the 1999 years teachers education investigation: "Historically, the teacher's role has been to speak to students and direct the education. The students have then been listening and obeying. Today the teacher's right to talk from a superior position is being challenged. When the teacher's right to, on one's own, decide the agenda - to pursue superior right of interpretation - is being questioned, then this entails new contours of professional identity. Thus, the central question becomes how you appropriate authority. Authority is something you become with a democratic process." Kornhall (2013) problematize this teacher role since it, according to him, puts all the responsibility on the students themselves. The slogan for the 1990s pedagogy was Learning to learn. The slogan originated from the idea that with the internet all information could be searched for, diminishing the need for memorizing facts. The only skill that would be needed in the future would be social skills and curiosity to search for information. The common belief was that knowledge couldn't be transferred and therefore the education was without lectures. The only way to learn was to find information on your own. When later evaluating this education system, we see that it has had tremendous effects especially on the already low performing students, increasing the gap between motivated and unmotivated students even more.

Krupinska (2022) writes that the School 2000 buildings were uncannily similar in typology to the highly criticized and problematic Open plan schools from the 1960s. The School 2000 did, once again discharge the traditional classroom layout. Instead the plan had centralized study halls for student groups of around 60-100 students to work individually without the traditional lectures. The age integrated learning from the SAMLA schools were still promoted. When looking at the School 2000 with the research gathered from the previous chapter, it is evident that the school 2000 was problematic. The open plan is, as previously stated, unsatisfactory for acoustics and the student groups were too big. Once again the school promoted age integrated learning which according to Kornhall (2013) came with severe side effects.

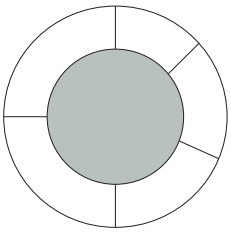
Own drawing of the facade of Landamäreskolan , Gothenburg

Home room and open plan layout

The school 2000 has a home room layout where the school is divided into departments and work teams with their own entrances. The home room layout have been present since the 1970s.



Not only does the school 2000 have the home room layout, it also have the open plan layout that was introduced in the 1960s.



Färila skolan

Färilaskolan was one of the first Skola 2000 schools in Sweden, built in 1995. The school was praised globally for its innovative classroomless design. The aim was to create the most modern school in the world, with focus on digitalization. The ambitions were grand and each student was given their own macbook for 27000 sek. Instead of traditional lectures the school implemented age integrated learning within open study areas, where the children were encouraged to take own responsibility for their learning. The praises stopped abruptly when the school results dropped significantly. Färilaskolan suddenly had one of the lowest school results in Sweden with only 72 percent of the graduating students being allowed to start the gymnasium. Teachers at Färilaskolan testified that the building made concentration and teaching impossible. The teacher Tord Jefssen described the working conditions as: "When I had a test, I counted that over 70 people passed through the big working space, which also worked as a corridor, it was time to quit." The school got rebuilt just a few years after completion to go back to regular classrooms again (Vi Lärare, 2021).

Kvibergsskolan

The school was finished in 2019 and has room for 700 students from grade four to grade nine. Just as Färilaskolan, Kvibergsskolan had digitalisation as a concept. Each student had an Ipad to increase their digital learning. The principal of the school, Mikael Parknäs, announced that the new school would be without classrooms. He explained that katederundervisning (teacher holding the lecture while students listen) was now in the past to give room for digitalization. The students' parents demonstrated loudly against putting their children in classroomless schools. Mikael Parnäs corrected himself by saying that the school did in fact have classrooms, they were just called baserooms. When the principal stated that they just called the classroom something else the protests stopped (Expressen, 2018).

Kvibergsskolan is divided into home units with age integrated learning where several ages share the same rooms.

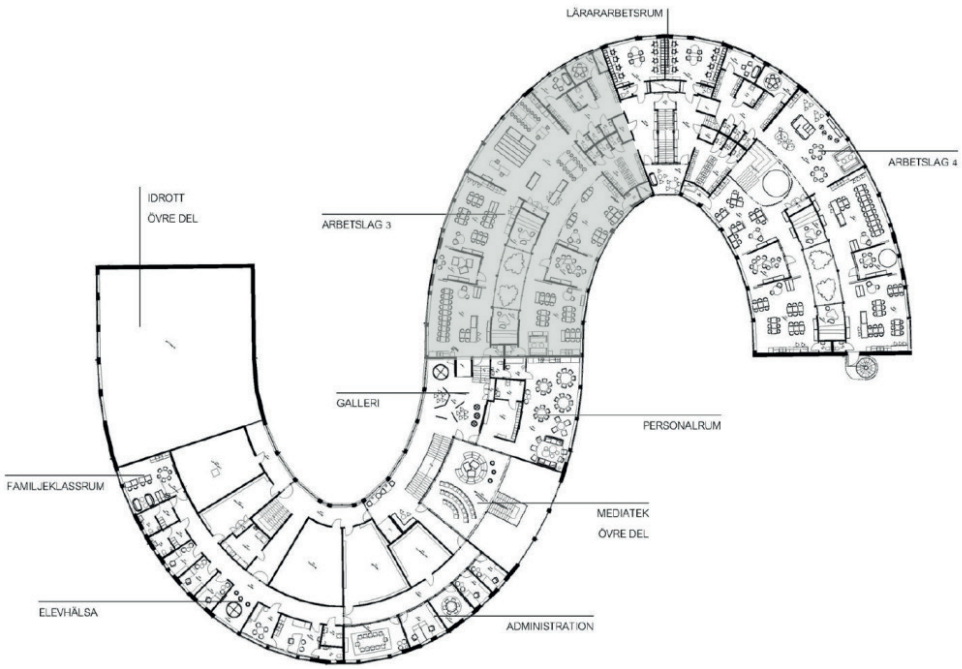
One home department

Floor plan over two home departments, Kvibergsskolan , Gothenburg
(Spaces Created For Learning, 2017)

Landamäreskolan

Landamäreskolan is located in Biskopsgården, one of Gothenburgs' suburbs. It was built in 2016 and was planned to fit 400 students. Landamäreskolan has a unique expression with high levels of detailing and thought through materiality and coloring. The aesthetics of the school is in my opinion successful. The school has the concept of an open learning environment. Instead of closed classrooms, the school is divided into four home departments with around 90 students in each unit. The rooms inside each unit vary in size and openness. According to Boverket (2021), the teachers of Landamäreskolan have split opinions about the open plan. Some of the teachers say that the open plan has created more work since it needs precise planning for the different activities to not clash. There have been complaints about the sound in the building, which according to the teachers has made it harder, especially for the students with neuropsychological difficulties to concentrate.

One home department with open plan



Floor plan, Landamäreskolan, Gothenburg (Boverket, 2017)

Conclusion

What did we learn?

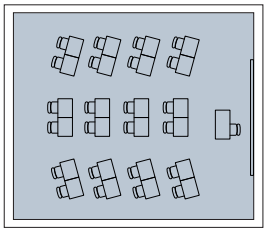
The Swedish schools have been described as experimental. Both reforms in the Swedish school system and the building process have been rushed. When there has been a demand for many new school buildings quickly, the quality of the buildings has been poor. It is evident that there has been a lack of understanding childrens' needs when designing schools. We can see repeating trends in the school design. More than once, schools have been built that aren´t adequate learning spaces. It seems like architects and stakeholders haven't learned from the previous mistakes that were made. Both Krupinska (2022) and Larsson et al. (2007) describe a lack of research within the field of school buildings. I believe that if the history of school buildings would have been properly evaluated, the open plan wouldn't have had its comeback in the 1990s. Naive thoughts about equating words literally into architecture has been a pattern, for example believing that an open plan creates open minded people. It is overall a field that has been given way to little research and evaluation.

Teachers don't automatically use the spaces as the architects have intended. Teachers should not have to change their education style after the room, instead the room should be shaped for the activities planned by the teacher.

The findings in this chapter can be a useful insight for all architects, specialized in designing schools or not. Evaluation and reflection of what has been built already is a great method for predicting the results of a design.

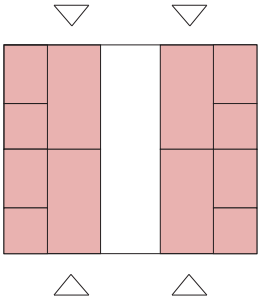
Traditional

The traditional classroom layout has generally worked well. A lot of the traditional schools have been in use for a long time without being demolished or rebuilt. The traditional layout could however be optimized by enlarging the classrooms. The classrooms are commonly square and could benefit from having a shape that is more adapted to the various activities and create better zoning within the classroom. The traditional classroom is preferably paired with group rooms. Historically, the traditional classroom layout has been ranging from very small one class schools to huge complexes. Research shows that the size of a school should be relatively small to avoid anonymity. Placing the classrooms on a long row connected to a parallel corridor could lead to running inside.



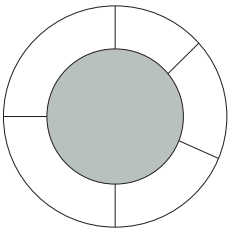
Home room

The smaller schools have proven to be more successful than the large ones. It seems therefore like the home unit layout with division of a larger school into feeling like a smaller one could have a positive effect on the childrens' ability to learn. It seems that the home unit idea is one of the few reforms that were implemented based upon research and knowledge rather than beliefs and it is therefore not shocking that the home room worked quite well. The home room idea has historically been combined with both age integration and the open plan.The age integrated learning as well as the open plan has shown to have a negative effect on academic outcomes. Conclusively, the home room layout on its own or combined with the traditional layout can have a positive effect on students' performance.



Open plan/ study hall

The open plan has been a reappearing trend that has been coming and going since the Open plan schools in the 1960s. The open plan layout has historically proven to be hard to concentrate in, especially for children who are already struggling to keep focus. Several of the schools with an open plan concept have been demolished or rebuilt shortly after completion. The open plan generally means more planning to properly function and could potentially give the teachers an even higher workload. Especially dysfunctional are the open plans that work both as a classroom, a corridor and hang-out spaces for the students at the same time. The open plan contributes to too much auditory and visual stimulation, especially for students with neurodevelopmental disorders. From the open plan school in the 1960s we saw examples of study halls with no or very little access to natural daylight, which goes against what the researchers say about the importance of daylight for academic performance. Conclusively, the open plan layout is not suitable as a learning space.



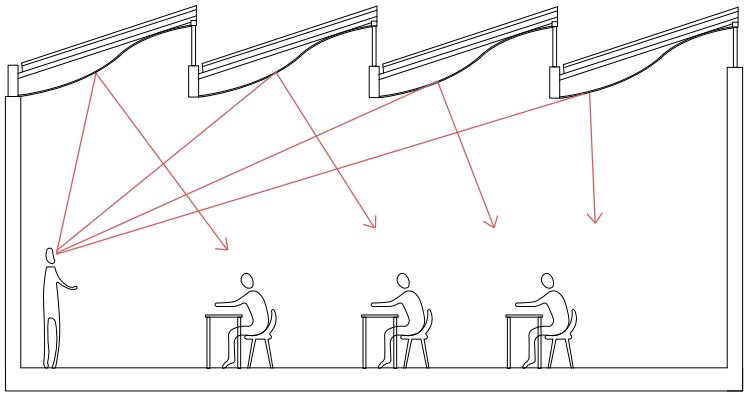
4 Design test

What could an evidence based classroom look like?

In this chapter I have made a design test, implementing as much of the research from the first chapter as possible. The design test is constrained to two classrooms paired with group rooms and does not have a specific site or program. The test is done to get a better understanding of what an evidence based school environment could look like. The design test is a way to showcase how research could be translated into design and to see if and how the research can be combined. I have designed all drawings and pictures in this chapter.

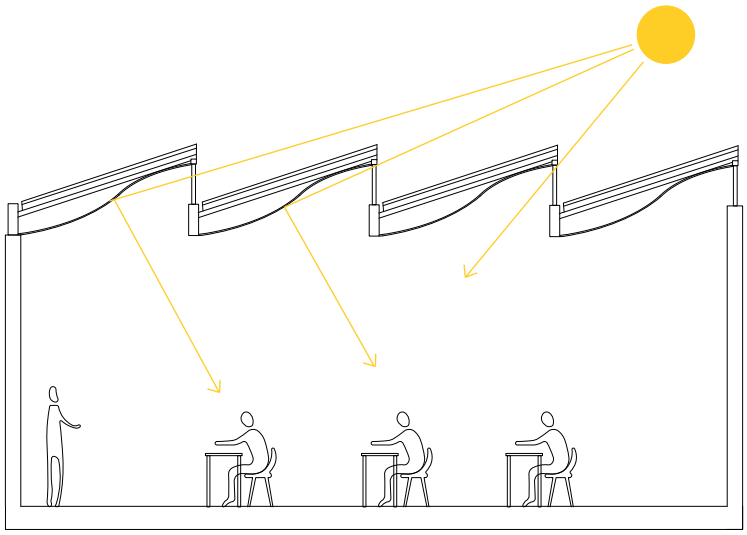
Sound reflection

The ceiling is shaped in order to reflect the sound from the person presenting in front of the whiteboard throughout the room. This is done to make sure that even the students sitting in the back can hear properly. If you sit underneath the concave parts of the ceiling the sound is instead concentrated and reflected back to the persons having the conversation.



Light reflection

From the research chapter we learned that the light should preferably be as even as possible and that skylights are good for an evenly spread light. The glazing is faced away from the students to avoid glare. The light hits the convex surface and spreads the light in the room.



L-shape

The classrooms have an L-shape to provide enough corners for several zones within the classroom. From the whiteboard, the teacher has a good overview over the room as well as on the door. The door is hidden from sight from the students to minimize the risk of too much visual stimulation.

Reading nook

The classroom have a wall with built in seatings for reading. The reading wall also works as a buffer zone towards the corridor.

Group room

Each classroom has a group room in direct connection. The group room makes it possible to divde the class. The group room works as a buffer zone between the classrooms.

Storage

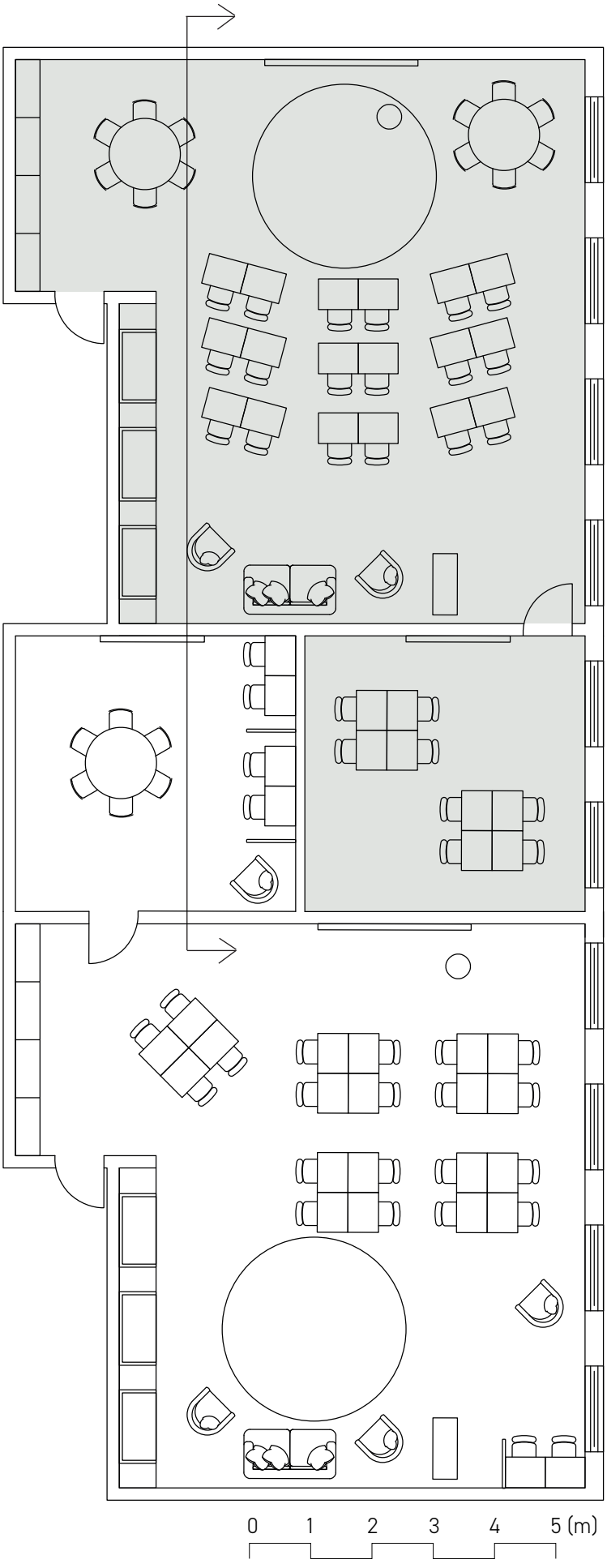
Built in storage to avoid clutter. Acts as a bufferzone towards the corridor.

Corridor

Due to the shape of the classroom the corridor outside of the classrooms are not straight. This avoids the urge to run in the corridor.

Flexibility

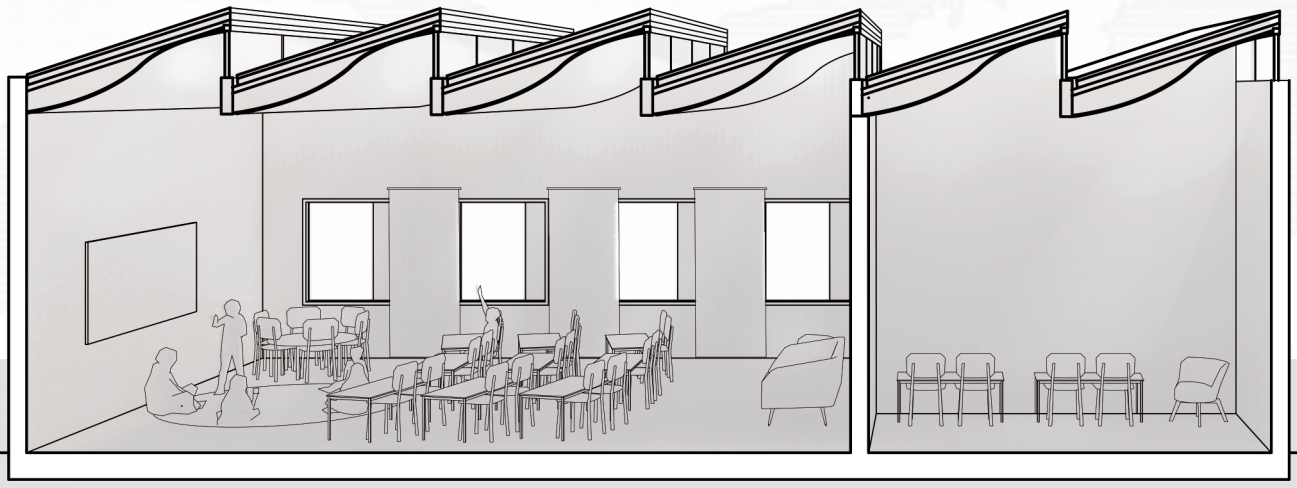
The classroom can be furnished in several ways, giving freedom and authority to the teacher to adapt the environment to the specific student and task.



Colors and materials

The color behind the whiteboard is a meduim toned pastell blue. It gives the perfect amount of contrast and makes the white board a nautral focal point. The blue tone gives a calm feeling. The carpet in front of the whiteboard is a natural gathering place and works as a sound absorber. Some of the walls have sound absorbing wood panels both for the acoustic and to bring in more wood elements due to their stress preventing effects. The desks and tables are also in wood to create good contrast to the paper. The yellow on the chairs is chosen to keep the students more alert in order to create a good balance between awakening and calming colors.

Section



Reading nooks

The reading nooks gives the students a more private and secluded area to sit in for individual, focus demanding work. The research shows that having designated reading areas in the classroom notably increases the amount of reading. In the reading nooks you have an overview of the classroom but can still feel embraced by the soft walls around you. Each nook has its own lamp, with cold light to make sure that the thing you read becomes the focal point.

Alternative design options

The classroom could have been done without the ceiling shape. The suggestion then would have been to give at least two of the walls windows. One of the group rooms would then have to be moved so that each classroom had one group room on each side, with natural lighting.

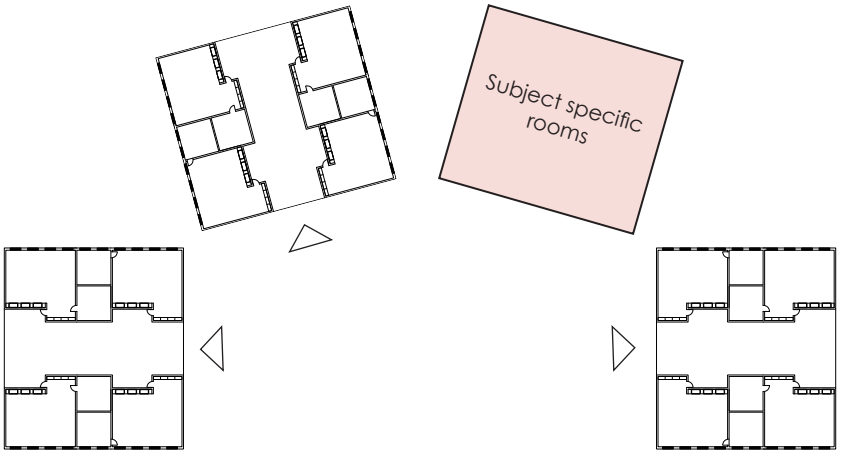
The door could be placed more in the middle of the L to make the leg of the L more calm, that would have made the door less visible for the teacher and could possibly become a distraction for the students sitting close by, meaning that both options have pros and cons.

If I would´not have limited myself to only design two classrooms with adjacent group rooms, making an entire school, I would have implemented the home room idea. I would have placed the classrooms four by four, sharing one canteen and two entrances to take down the scale. Subject specific rooms such as Physical education and health, Home and consumer studies, Music and Crafts could be shared amongst the home departments.

What should be placed right outside of the classroom highly affects the feeling within the classroom. What functions that should be placed right outside the classroom for increased academic results of the students is not yet answered by the research and would probably be different depending on the ages of the students.

The shape of the building must be suitable for the specific site. However, I would preferably design a school building that wraps around the schoolyard as a natural boundary for the students, and at the same time making the schoolyard easily overlooked both from the inside and the outside. The school building itself can protect the schoolyard from noise by blocking the sound.

Conceptual diagram



Conclusion

It was fairly easy to combine the different research, they did not work against each other. On the contrary some of the research was dependent on the other. The L-shape demands a larger square footage to enable the class to be grouped in front of the whiteboard compared to a square classroom. A larger classroom is however what the research suggests. The L-shaped classrooms placed together created niches making the corridor less straight. However, the L-shape could contribute to sound accumulation meaning that the placement of sound absorbers is very important and should be placed in the created niches.

The ceiling shape and the wall color is making the classroom less flexible since the placement of the whiteboard is fixed. Due to the roof the classrooms could not be mirrored but had to be facing the same direction. This was not an issue in this design test but is something to be aware of when choosing this kind of strategy.

The design test showed the importance of implementing the research from the beginning of the first design phase. By letting the research guide the design it increased the creativity rather than limit it, as I think it would have been if the research would have been an added layer in the end. Only sound absorbing materials and wall color is something that is easily added to an existing design.

The design test could have been done in innumerable ways and still have implemented the research. The architectural freedom is, according to me, not limited by the evidence but instead contributed to design with a more interesting atmosphere.

5 Design strategies

Most important things to think about when designing a school

This chapter can be seen as a guidance for architects and stakeholders to use when designing schools. The Design strategies are based upon the research and the historical evaluation. This chapter aims to summarize and answer the thesis question: How should we design schools to promote learning according to research and evaluation of historical building typologies?

School size

- Design smaller schools instead of a large one, preferebly for around 100-200 students.
- Each class should preferably not have more than 17 students, alternatively great possibilities to divide the class in half.

Classroom size

- The classroom size should be appropriate to the number of students and should most likely be bigger than the standard classroom of 60 sqm to be optimal for learning with a class of around 25-30 students. The exact square footage of the optimal classroom for learning does currently lack enough evidence to specify.

Location

- The school should be placed close to nature rather than close in busy cities or close to high traffic roads.
- From a city planning perspective, it is better to have small local schools rather than one big in the city.

Typology

- Both the traditional school layout and the home room layout are good options. The open plan should be strictly avoided.

Avoiding bullying by design

- Avoid closeable anterooms.
- Place changing rooms, locker rooms and hang-out spaces close to where teacher frequently walk by.
- Shape the school building so that the schoolyard is easily overlooked both from inside and outside.

Corridors

- Avoid long corridors with two parallel walls if running is not promoted.

Classroom layout

- The classroom can preferably have an L-shape to provide an appropriate amount of safe corners to create good zoning.
- The students should have their own designated working space.
- The classroom should have designated reading areas.
- The classroom should have plenty of closable storage to avoid clutter and overstimulation.

Color

- Colors have a great impact on our mood and should therefore be carefully chosen depending on the usage of the room.
- Choose a medium toned color behind the whiteboard to create a focal point with a good amount of contrast.
- Avoid red since it can be overstimulating, choose instead colors such as green or blue for areas where you want the students to be calm. Yellow or orange is good for areas where you want the students to be more awake and active.
- Keep the tones of the colors pastel or muted to avoid overstimulation.
- Bring in wood elements, especially on the student's desks to create a calmer environment and good contrast to the paper.

Windows

- The light should be as even as possible, without glare. To achieve this:
- Have windows from at least two sides.
- Avoid south facing windows.
- Choose skylights when possible.

Artificial lighting

- All lamps should be dimmable.
- There should be several light sources, spread out for an even lighting.
- Blue toned lamps should be placed where students need to focus on a task.
- Warm light should be placed where students work together in teams.

Acoustics

- The shape of the room highly influences the sound. Choose a room layout that creates the appropriate sound environment.
- Choose concave or convex shapes to direct or diffuse the sound.
- Add sound absorbing materials, such as fabrics, acoustic wood panels and carpets.
- Create buffer zones between rooms.
- Put rubber feet on all movable furniture.

Final conclusion

The academic results of a student in childhood highly predicts its future. There is strong evidence that the physical school environment has an effect on the students ability to learn. School buildings are arguably one of our most important typologies and should be given more attention and research.

The Swedish law ensures all children the right to a calm study environment but does not further describe how that is achieved. Children are sensitive to auditory and visual stimulation when trying to concentrate. A lot of the research advocates that the most important thing about school design is helping the students to focus on the right thing and avoiding distractors.

Historically the school building has been shaped after the prevailing pedagogical ideas. The pedagogical ideas have rarely been based on evidence on how students actually learn. The school buildings have also been highly influenced by cutbacks and the economical assets. Some of the design strategies would be expensive, such as having smaller classes and bigger classrooms. However, it is important to identify what is the ideal school environment regardless of the price tag. Only then is it possible to avoid designing the opposite, motivated by financial savings. The findings in this thesis shows the importance of the school building, motivating why more money should be invested on making adequate learning spaces.

The school environment has been given too little evaluation and reflection. Only by reflecting on what has already been done, can we avoid repeating the already made mistakes and take advantage of what we see has been successful. Reflecting and analyzing existing designs would be a beneficial method for all architects to use.

A school designed based on evidence for improved learning could be designed in innumerable ways. It does not, according to me, limit the architectural freedom, but helps you create the right environment for the right task. In order to design a school that optimizes learning, it is important to implement the design strategies and the research in the first design step, since it is difficult to add them to an existing design.

Visual references

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