Architecture as a Teacher

Exploring the merger of cultural heritage and scientific theory in a learning environment

Author Andreas Pehrson Examiner Mikael Ekegren Supervisor Björn Gross



CHALMERS

Master's Thesis Chalmers School of Architecture MPARC - Architecture & Urban Design Building Design Autumn 2017

Title Architecture as a Teacher Exploring the merger of cultural heritage and scientific theory in a learning environment

Author Andreas Pehrson Supervisor Björn Gross Examiner Mikael Ekegren

Abstract

During the next ten years Sweden needs to build a thousand new schools due to increased childbirth and the increasing number of refugees coming to Sweden (Skanska 2016). In addition to new schools needing to be built many of Sweden's schools are in dire need of renovation and at the current rate it will take seventeen years to renovate all the schools built before 2015 in Sweden (Byggfakta 2017).

The purpose of this thesis is to investigate how the physical environment of schools influences students and their ability to learn. Most schools and classrooms today look the same as they did a hundred years ago but what we know about how we learn and the way we teach has changed drastically, so why has the physical environment in schools not changed during this time?

This thesis also aims to raise a discussion about what good architecture in schools is, how can we build great schools that work and that enhances the students ability to learn. The result of this thesis is a new secondary school in my hometown Kinna.

The proposal will show that the physical environment can aid students in their learning. It will explore how the physical shape of a classroom can enhance interaction between the students themselves and the interaction between student and teacher.

It will show that depending on the layout of the classrooms and the communication between them one can create a place where students can feel safe and confident in their ability to learn.

The thesis is based on a research by design process, with the support of scientific reports and papers written on the subject of the physical environments effects on learning.

The program for the new school is a result of a close collaboration with the municipality and the principals and teachers of the secondary school in Kinna.

Content

| 1 Introduction | |
|---------------------------|-------|
| 1.1 Abstract | 3 |
| 1.2 Content | 4 |
| 1.3 Background | 5 |
| 1.4 Design | |
| Aim | 6 |
| Method | 6 |
| Questions | 6 |
| 1.5 Aim, delimitations | 7 |
| 1.6 Method, results | 8 |
| 2 Analysis | |
| 2.1 Scientific reference | 9-13 |
| 2.2 Program | 14-21 |
| 2.3 Iterative design | 22-23 |
| 2.4 Local context | 24-27 |
| 3 Proposal main building | |
| 3.1 Materials | 28-33 |
| 3.2 Exterior Illustration | 34 |
| 3.3 Construction | 35 |
| 4 Drawings main building | |
| 4.1 Site plan | |
| 4.2 Entrance | |

| 4.3 Interior illustration | 38 |
|-------------------------------|--------|
| 4.4 First floor | 39 |
| 4.5 Second floor | 40 |
| 4.6 Third Floor | 41 |
| 4.7 Sections | 42-43 |
| 4.8 Detail | 44-45 |
| 4.9 Fasades | 46-47 |
| 5 Proposal homestead building | |
| 5.1 Materials | 48-51 |
| 5.2 Interior illustration | 52 |
| 6 Drawings homestead building | |
| 6.1 Entrance | 53 |
| 6.2 First, second floor | 54 |
| 6.3 Sections | 55 |
| 6.4 Facade | 56-57 |
| 7 Conclusion | |
| 7.1 Reflection | 58 |
| 8 Reference | |
| 8.1 Litrature, streaming med | lia 59 |
| 8.2 Images | 60 |
| | |

Background

At the end of summer 2016 the secondary school in my hometown Kinna had to close due to dangerous amounts of mold in the structure and particles in the air. Instead of returning to their old school after summer vacation the students where scattered and had to continue their studies in a number of locals spread out across the town center.

The town of Kinna is a small rural locality in the municipality Mark located sixty kilometres east of Gothenburg with a population of about 14.000 people.

The region has a long history of textile manufacturing beginning in the 18th century and continuing on to this day. During a period in the middle of the 19th century 80% of all the cotton fabric sold in Sweden were made by hand in the region.(Hembygd, u.å.)

Located in a rural area the region also has a long history of agriculture and forestry.

Drawing inspiration from the cultural heritage of the region and scientific research within the field of pedagogy this thesis will result in a design proposal for a new secondary school in Kinna.

Design

Aim

The aim of the thesis is to explore the school as a typology using scientific reports, papers, references, local context and cultural heritage.

Method

By using a research by design approach the thesis will explore how to use the knowledge of today's learning to create a proposal in which students can feel safe and inspired. Through sketches and 3d models, the designs will be evaluated and narrowed down to a final proposal.

Questions

Can architecture influence student's ability to learn? How do we design a school that is safe, inspiring and aids students in their pursuit of knowledge?

Aim

The proposal will show that by combining local cultural heritage and scientific research one can create a physical environment that can aid students in their learning. Furthermore it will show that by merging these two aspects the school will ground itself on the site and in the community. The thesis explores how the physical shape of a classroom in a homestead environment can enhance interaction between the students themselves and the interaction between student and teacher thru peripheral engadgment. Furthermore the typology of the school itself should make the students feel safe, counteract bullying, encourage exploration and communication.

Delimitations

A program was decided early on in the process by the municipality, principals and the representatives of teachers and other disciplines within the school. Using the program the focus has been to design a school that accommodates to an extent the wishes of the previously mentioned groups together with the findings of the research by design formula.

Method

By applying a research by design process to the design proposal it will naturally evolve through the continuing iterations combining elements of cultural heritage and scientific research. Iterations of the design proposal will be evaluated in 3d models and sketches.

Results

The thesis will result in a proposal for a new secondary school in Kinna. The school will combine local cultural context, research and user input into a school where students feel safe, inspired and inquisitive.

Clever Classrooms

A summary report of the HEAD project (Holistic Evidence and Design) at the University of Salford in Manchester.

In the report the research presents clear evidence that the overall design of the physical learning space does have an effect on its users.

Researchers spent three years collecting performance statistics and doing detailed surveys of 153 classrooms from 27 very diverse schools in the United kingdom.

"Surprisingly, whole-school factors (eg size, navigation routes, specialist facilities, play facilities) do not seem to be anywhere near as important as the design of theindividual classrooms"



The L-Shaped Classroom:

A Pattern for Promoting Learning Peter C. Lippman

The architect Peter C. Lippman re-examine the "Fat L" classroom that was previously proposed by James A. Dyck in the article "A Case for the L-Shape Classroom: Does the shape of a classroom affect the quality of the learning that goes inside it?".

Lippman gives a in-depth look at the interactions that take place between student and teatcher in the classroom and how this is affected by its physical shape.

"the environmental qualities of classrooms—high/low, open/closed, big/little, vertical/horizontal—do indeed affect the learning process in young children" James A. Dyck



Lärande och fysisk miljö En kunskapsöversikt om samspelet mellan

lärande och fysisk miljö i förskola och skola Pia Björklid

In this research overview Pia Björklid, professor emerita of pedagogy explores the connections between the physical environment and children's learning. The report use and summarizes research done within Scandinavia from the 1990s and onwards

> Lärande och fysisk miljö En kunskapsöversikt om samspelet mellan lärande och fysisk miljö i förskola och skola

> > PIA BJÖRKLID



Forskning i fokus, nr. 25

9

Better spaces for learning *RIBA*

A report from RIBA (Royal Institute of British Architects) that investigates how good design can help students and teachers within the current British school system. It focuses on how the British government school buildings programme can evaluate their current system and improve it so that good design can help ensure that the capital funding can deliver schools that have a better value for the money they spend.

Through their evaluation they discover that the current programme delivers school buildings to a varying degree of quality where on the lower part of the scale it is likely to have a higher running and maintenance cost, worse student performance and behavior, and lower staff productivity.



Better spaces for learning

2.1 Analysis Scientific reference

Framtidens lärande 2012: Studio Lärmiljö

A series of video lectures and panel discussions about how we can build flexible learning spaces that are tailored for the increasing need of adaptable spaces and the use of digital tools in schools today.

The Programme

The school is divided into three grades ranging from 7-9 each with four classes with the option of an additional four classes per grade. The students are between 12 -15 years old. The total sum of users are 360 students, 50 teachers and other administrative personnel. 2.2 Analysis Program

Homestead

| Classroom | Group room | Classroom | Group room |
|--------------------------|------------------|-----------|------------------|
| 60 sqm | 12 sqm | 60 sqm | 12 sqm |
| Classroom | Group room | Classroom | Group room |
| 60 sqm | 12 sqm | 60 sqm | 12 sqm |
| Teacher worksp 18 sqm | ace Recreation | on area | WC 8 x 12 sqm |
| HWC 5 sqm | Storage 8 sqm | | |

Homestead x 3

| Premises | <u>Quantity</u> | <u>Sqm</u> | Total sqm |
|-------------------|-----------------|------------|-----------|
| Classroom | 12 | 60 | 180 |
| Group room | 12 | 12 | 36 |
| Teacher workspace | 3 | 18 | 54 |
| Recreation area | 3 | 100 | 300 |
| WC | 24 | 1,5 | 36 |
| HWC | 3 | 5 | 15 |
| Storage | 3 | 8 | 24 |

Subject specific classrooms



Instrument storage in classroom 10 sqm

Subject specific classrooms



Subject specific classrooms



Lecture hall

Lecture hall 150 sqm



Kitchen/ Food court

| CaféStudy hall/library80 sqm80 sqm | Food court 200 sqm | | | |
|------------------------------------|-----------------------|----------------|------|--------------------|
| | | | | |
| Serving area | Kitchen | | | Kitchen staff room |
| 90 sqm | 140 sqm | | | 20 sqm |
| | | | | |
| Kitchen laundry roc | um Cha | anging room /M | | anging room /MC |
| 15 sqm | 15 . | sqm | 15 I | 5 sqm |
| | | | | |

Administration

| Administrators office | Administrators office | Principals office |
|-----------------------|-----------------------|-------------------|
| 10 sqm | 10 sqm | 15 sqm |
| Vice rincipals office | Copy room | Storage/file room |
| 15 sqm | 15sqm | 12 sqm |
| Conference room | Staff room | Changing room/WC |
| 30 sqm | 60 sqm | 15 sqm |
| Changing room/WC | WC | HWC |
| 15 sqm | 1.5 sqm | 5 sqm |



Iterative design process

Once the building programme was established an iterative design process began. Using a set number of criteria ranging from student safety, easy accessibility, transparency and building footprint on the site the designs where analyzed tested and refined. Slowly but surely the design of the building fell in to place further anchored by the initial inspirations of the cultural heritage of the region. 2.3 Analysis Iterative design





















Local context

The site of the school is the small rural town of Kinna in the western part of Sweden. Kinna is located near three of the largest cities of that region, Gothenburg, Borås and Varberg. This makes it an attractive place to live for anyone wanting to get away from the busy city life but still have easy access to the possibilities the larger cities provide.



The school will be the first thing one sees approaching Kinna from the neighbouring town of Skene and in extension, Gothenburg. It is the first point in a sequence of social hubs that run through the city center. The other ones being a town square, an outdoor theater and the town library and concert hall.



The location of the old school is near the new location keeping the tradition of the area and at the same time rejuvenating it.



The placement of the buildings take into account the sun's path during the hours of the day, accessibility for the students be it by car, buss, bicycle or walking. The placement also allows for easy delivery of material and goods.



3.1 Proposal main building

Materials

Exterior materials

Drawing inspiration from the traditional textile weaving traditions of the area the main structure is inspired by a loom weaving a delicate fabric that wraps around the building. The curtain wall is covered with a wood laminate panel.

The panel draws it's colors from the natural surroundings of the area and connects the building to the history and context of the site. Red, orange and yellow inspired by the fields and agricultural heritage, various shades of green taken from the forest and represents the forestry that has taken place here for centuries. The blue colors come from the lakes and rivers that made much of the textile fabrication possible in Kinna and the neighbouring community's.



Traditional loom.



The Lake Öresjön



Rye field

Laminate panel cladding color



Interior materials

In the entrance of the building you are greeted by the two Ornäs birches, Knowledge and Values, growing in between the main staircase. Moving further into the building the colors and the textile qualities of the exterior continue to accompany their respective floor but here they lend their colors to the woven vinyl floors and the stair balusters.



The finnish pavilion, Hannover



Bollon wing carpet





3.2 Proposal main building Exterior Illustration



laminate panel cladding of different glossinesses rang-ing from full matt to a piano finish to create a variation The exterior shell is coverd with a 0.6 x 0.6 m off white in the otherwise monocrome shell fasade. Pre fabricated curtain wall exterior with window openings in two variations; 2.4 x 2.4 m and 1.2 x 2.4 m.

Hollow core slabs resting on concealed steel beams.

support of two elevator shafts. In the classrooms some Vertical pillar construction in a 4,8 x 4,8 m grid with pillars are removed inorder to fully utilize the space.

Glas facade divided into 2.4 m sections.

0.3 x 0.3 m Laminate panel cladding in a variation of

colors.



4.1 Drawings main building Site plan





4.4 Drawings main building First floor 1. Study/ recreation area7. |2. Natural science8. \3. Prep. room9. |4. Staff room10. |5. Conference room11. |6. File storage12. |

7. Principal's office
8. Vice principal's office
9. Dressing room/WC/ Shower
10. Administration
11. Copy/ post room
12. WC/HWC

School counselor
Special pedagog
Waiting room
Nurse administration
Student rest room
School nurse

19. Prep. room 20. Biology 21. Lecture hall





1. Study/ recreation area5. Dyeing space2. Textile craft6. Woodworking3. Weaving room7. Metalworking room4. Storage8. Machine room

Surface treatment
Storage
Wood storage

12. Material room13. Techology/ mechanics14. Lecture hall



4.6 Drawings main building

1. Study/ recreation area5. Storage2. Domestic science6. Music3. Special needs kitchen7. Grouproom4. Laundry room8. Instrument storage

9. Grouproom 10. Storage 11. Art 12. Ceramic studio

13. Photo studio 14. Exhibition area







Scale: 1:350

4.7 Drawings main building Sections



4.7 Drawings main building Sections

4.8 Drawings main building Detail



| | | r& | | | |
|----------------------------|-------------------------------|---|------------------------------|--|--|
| 4.8 Drawings main building | | | | | |
| D | etail | | \mathcal{V} | | |
| | | | | | |
| | | | | | |
| | | | <u> </u> | | |
| | | | | | |
| | | | | | |
| 3 | Tar paper | | | | |
| 335 | Insulation | | | | |
| 300 | Concrete | | | | |
| 12 | Plasterboard | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| 50 | Funda da da se estada en esta | | | | |
| 50 | Expanded metal mesh | | | | |
| 8 | Laminate panel | | | | |
| 50 | Fasade panel | | | | |
| | water proofing memorane | | | | |
| 145 | Mond post c 600 | | | | |
| 145 00 | Insulation | | | | |
| 00 1 | | | | | |
| 1 70 | Insulation | | | | |
| 70 | Wood post c 600 | | | | |
| 13 | Plasterhoard | | | | |
| 13 | Plasterboard | | <u> </u> | | |
| 10 | | | | | |
| | | | ==== | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| 30 | Screed flooring | | | | |
| 300 | Hollow core slab | | | | |
| 12 | Plasterboard | | | | |
| 12 | Plasterboard | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| 50 | Torrazzo | | | | |
| 270 | Concrete | | | | |
| 550 | Insulation | | | | |
| 550 | Gravel | | | | |
| | | | | | |
| | | | | | |
| | | | ا = در این مراجع این م | | |
| | | | | | |
| | | | ŇŇ | | |
| | | | ///t | | |
| Scale: 1:3 | 5 | $\bigcirc \qquad \qquad$ | <u>v v v</u> | | |
| | | 45 | | | |
| | | | | | |





South fasade





North fasade

Exterior materials

The forest and forestry heritage of the region is where the inspiration for the homestead building originates from. The smaller, lower and more organic shape of the homestead building reminiscent of a tree stump is clad with wood slats that will fade to gray over time.



Tree stump



Forest

Interior materials

Inside wooden slabs and slats continue to clad the interior walls along with random slats colored in the same colors as was used within the main building. From the interior ceiling wood hexagons are suspended to improve the sound environment and to further enhance the overall hexagonal spaces of the homestead building. Carpets are used in the classrooms to give them a more homely feeling.



Apartment at Bow Quarter



Les Dada East hair salon







6.1 Drawings homestead building Entrance











Homestead north fasade Scale: 1:350





Homestead south fasade Scale: 1:350

Reflection

Why a school? Because this is something I believe in and have a passion for, I believe that the physical environment can help students in there learning and I want to make people aware that this is the case.

I believe that if we use the research being done within this field we can plan and build schools that are healthy, have architectural quality and that actually aid student in there learning.

Learning is something I've always found very interesting, how we learn, what drives us as a species to learn more, to discover and experience. During this project I discovered that I still have a lot to learn.

When one thinks of a school the typology seems quite obvious there's classrooms, corridors, some larger areas for recreation, maybe a library, that can't be too hard to design, but as I discovered the more you learn about schools and the factors that play in too how we learn the harder it gets. With my project I feel that I answer the question that prompted the thesis to begin with "Can the physical environment of a school building aid students in their learning?" In it I feel that my school is a place where students can feel safe, find inspiration and where they are allowed to be inquisitive about their surroundings.

While doing the research and working through the design iterations and trying to fit the program while at the same time taking the staffs wants and requests into account I was happy that I it still felt that this is what I want to do, this is something I could do for the rest of my life.

This was a massive project and I may have been a bit naïve and a little bit overconfident when all of this began it was a very humbling experience but I'm glad that I endured and finished the project.

8.1 REFERENCES

Litrature, streaming media

Litrature

Clever Classrooms. Barrett, P., Zhang, Y., Davies , F., & Barrett, L.,(15). Clever Classrooms Summary report of the HEAD Project. Manchester:University of salford, Manchester. Available at: http://www.salford.ac.uk/cleverclassrooms/1503-Salford-Uni-Report-DIGI-TAL.pdf[Accessed 2016-10-11]

The L-Shaped Classroom: *A Pattern for Promoting Learning. Lippman, P., C.(04).* The L-Shaped Classroom: *A Pattern for Promoting Learning.* Minneapolis:Design Share, Minneapolis, MN. Available at: https://eric.ed.gov/?id=ED497662[Accessed 2016-09-29] Design Share, Minneapolis, MN.

Lärande och fysisk miljö

En kunskapsöversikt om samspelet mellan lärande och fysisk miljö i förskola och skola. Björklid, P.(05). Lärande och fysisk miljö En kunskapsöversikt om samspelet mellan lärande och fysisk miljö i förskola och skola. Stockholm:liber distribution

Better spaces for learning Plotka, E.,(16). Better spaces for learning. Available at: https://www.architecture.com/-/media/gathercontent/better-spaces-for-learning/additional-documents/ribabetterspacesforlearningpdf.pdf[Accessed 2017-03-15]

Streaming media

Framtidens lärande 2012: Studio Lärmiljö diu redaktion, Available at: https://vimeo.com/user1797694[Accessed 2017-02-18]

Images

Traditional loom

Wikimedia Commons user Damast, (04). Väv,_Vävstol.jpg [photography]. Available from: https://commons.wikimedia.org/wiki/File:V%C3%A4v,_V%C3%A4vstol.jpg

The Lake Öresjön

Schweden-angler, (14). ö16-768x511.jpg [photography]. Available from: https://schweden-angler.de/oeresjoen/

Rye field

unknown, (17). rye_cereals_nature_grain_ear_field_plant_golden_yellow-490178.jpg [photography]. Available from: https://pxhere.com/es/photo/490178

The finnish pavilion, Hannover

SARC Architects (00). finland_birchgrove4-edit-1500x650.jpg [photography]. Available from: https://sarc.fi/wp-content/uploads/2015/11/finland_birchgrove4-edit-1500x650.jpg

Bollon wing carpet

Bollon, (13). Wing-flooring-tile-by-Bolon-07.jpg [photography]. Available from: http://re-taildesignblog.net/2013/06/27/wing-flooring-tile-by-bolon/

Tree stump

unknown, (17). wood_wood_background_stump_tree_stump_tree_forest_summer_annual_rings-343297.jpg [photography]. Available from: https://pxhere.com/ko/photo/343297

Forest

Wikimedia Commons user Petritap (2008). "Iso Helvetinjärvi Lake in the Helvetinjärvi National Park in Ruovesi, Finland. [photography]. Available from: https://commons.wikimedia.org/wiki/File:Iso_Helvetinjarvi.jpg

Apartment at Bow Quarter

Luke White(12). 1335186625_apartment_at_bow_quarter_studio_verve_architectes_1334712313_view_to_bedrooms_0095_1a.jpg [photography]. Available from: https://www.archdaily.com.br/br/01-44981/apartmento-em-bow-quarter-studio-verve-architects/44981_44995

Les Dada East hair salon

Matteo Rossi(16). les-dada-east-joshua-florquin-paris-france-_dezeen_936_11.jpg [photography]. Available from: https://www.dezeen.com/2016/01/31/joshua-florquinles-dada-east-paris-hair-salon-hexagonal-ceiling/to-em-bow-quarter-studio-verve-architects/44981_44995

Master's Thesis Chalmers School of Architecture MPARC - Architecture & Urban Design Building Design Autumn 2017

Title Architecture as a Teacher Exploring the merger of cultural heritage and scientific theory in a learning environment

Author Andreas Pehrson Supervisor Björn Gross Examiner Mikael Ekegren