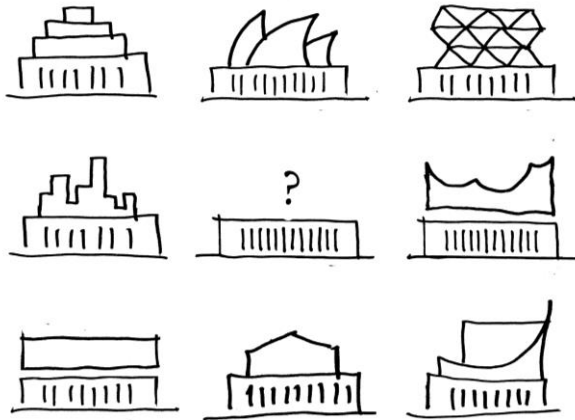


Demystifying Abstraction

In the Context of Architectural Education

A Student's guide to understanding and deriving abstract-general architectural concepts through the use of abstraction.



Deyan Saev

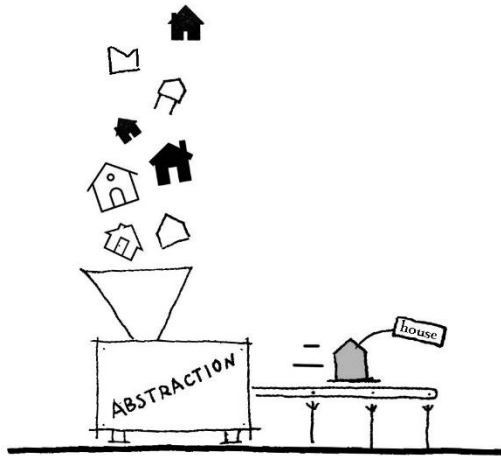
D.S.Saev@student.tudelft.nl

Student ID: 4503112

AR3EX320

07.04.2017

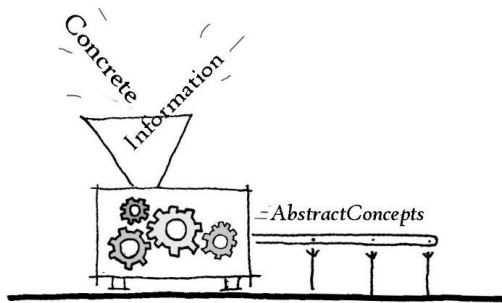
Research Tutor: Elise van Dooren



Abstract:

The following research examines the role abstraction plays in architectural design & education. In this context, the term abstraction refers to the mental process of generalizing attributes of concrete examples, in order to derive new abstract concepts. Serving as a way of dealing with a lot of information, architects often rely on abstraction as a tool to both define and solve complex design challenges. [1] However, the steps behind the process of abstraction itself are rarely explicitly taught or discussed in the field of architecture. As a result, unexperienced students often do not have a clear idea of how best to apply this process in their own design work. The aim of this research is to put forward an outline for a teaching model that would help and guide beginner architects to better understand and use abstraction as a method of generating effective concepts. The proposed framework consists of four distinct phases (Familiarity with the Concrete, Differences & Similarities , Reification through Diagrams, Application) translated from an existing educational model, explicitly designed to promote abstract-general learning in mathematics.

Key Words: abstract, abstraction, reflection, concept, learning, education, model, design process, familiarity, similarity, reification, application,

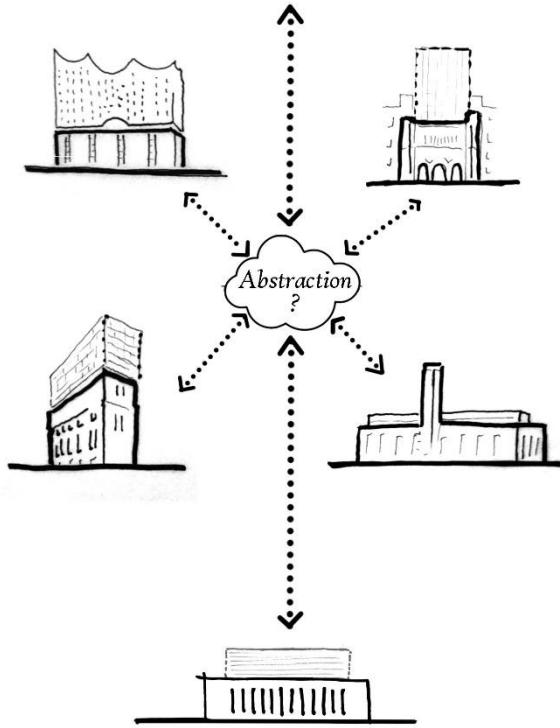


Contents

Abstract:	3
Introduction.....	7
Problem Identification.....	9
Theoretical Framework & Methodology	11
Abstraction as a Process - Overview and Context.....	12
Between the Concrete and the Abstract.....	14
Abstract Apart and Abstract-General Concepts	16
Literature Review – Locke, Piaget and Kolb	18
Teaching for Abstraction: A model in Mathematics.....	22
ABC - Abstract before Concrete.....	24
CBA - Concrete before Abstract	26
Evaluation of the method and its phases	28
Familiarity	30
Similarity.....	32
Reification.....	34
Application.....	36
Demystifying Abstraction: a Model	38
Design Task & Application:	50
Collect.....	52
Compare	54
Diagram	56
Adapt	58
Recombine & Experiment.....	60
Going Forward & Conclusions	62
References.....	63

*“Abstraction is one of the greatest visionary tools ever invented by human beings to
magine, decipher, and depict the world.” - Jerry Saltz [2]*

Concrete Examples:



Abstract Concept

Introduction

Architecture, similar to other creative disciplines, is traditionally taught through design practice.[3] Such form of education puts emphasis on facilitating tacit, rather than formal knowledge - or in other words, it encourages learning by doing.[4] However, in order to achieve deeper understanding of the subject of architecture students must also actively reflect on both their actions and experiences, seeking to gain further information from them.[5] One element, which strongly influences this process of reflection and learning, and yet is rarely explicitly investigated on its own terms in architectural academia, is the process of *abstraction*.^[6]

Originating from Latin, when used as a verb, the word “abstract” historically means, “to draw away from”.^[7] Thus “Abstraction” is the “process through which new ideas or conceptions are formed by considering several objects or notions and omitting the features that distinguish them.”^[8] In other words, the operation through which we derive abstract ideas from a range of specific examples is abstraction and the end results of this process is an abstract concept.

What is essential to consider is that abstraction is a process. Therefore, as an identifiable process, it should either have some specific structure or follow a series of particular steps. Understanding these steps can be greatly beneficial to our grasp of the design process as a whole. Despite this, the process of abstraction is rarely explicitly investigated in architecture. The following research sets out to address this problem by proposing a simple, yet comprehensive teaching model that would aid beginner architects in their understanding and use of abstraction as a method of deriving concepts.

Problems with understanding and using
abstraction

Concrete
Examples



Abstract
Concepts



Having the food or the ingredients
but not the recipe

Problem Identification

”Abstract entities are abstractions from concrete entities” [9]. This is to say that there is a strong, often direct link between abstract concepts and concrete examples. The phenomenon and process of abstraction and its relationship to the concrete is present in the discussion and study of nearly every subject - from mathematics and computer science to linguistics and art.

In the field of architecture, we can identify two problems inexperienced designers face in their first encounters with abstraction as a tool for design. Firstly, when faced with the challenge of studying buildings, beginner designers struggle draw away the abstract concepts that underline the studied project. Secondly, when it comes to applying abstraction themselves in order to generate concepts as part of the design process, many students lack any structure for dealing with the amounts of options and information that design opens up to them. All of this raises the question of how can the process of abstraction be more explicitly taught in architecture in order to aid design?

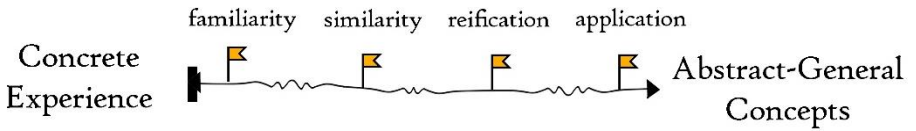
Proposing a general structure for the process of abstraction addresses these challenges by demystifying the relationship between the concrete context and the abstract concepts in buildings. At the same time the model provides an outline for the thought process architects and in general designers often engage in. This added clarity about the process should be beneficial to students when they come to define, explore and resolve convoluted problems across all levels of design.

“The educational process must stimulate interpretation; it is a process which should perpetuate process. Education as a device is purely a communicative operation. It cannot create or describe what the thinking should be; it can only exchange operations of thinking.” [10]

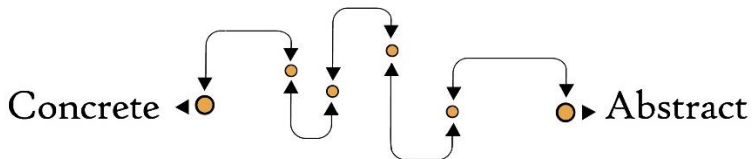
The abstraction process in architecture



Teaching for Abstraction: A Model in Mathematics



Demystifying Abstraction



Theoretical Framework & Methodology

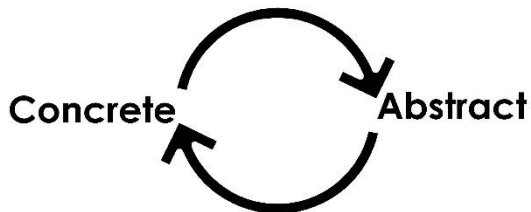
The framework of the research is constructed around several existing teaching models and learning theories from non-architectural subjects, that have recognised the important role of abstraction in learning. The question of how to more explicitly teach abstraction in architecture is going to be answered by studying, translating and combining established educational models from other fields and applying them to the subject of architecture. Existing models for subjects such as mathematics, which directly address the challenges students face with abstraction can be hugely beneficial when it comes to establishing an initial framework which architectural education can adapt and build upon for its specific needs and contexts.

We will begin with a general look in to abstraction and will continue with a brief discussion on the works of John Locke, Jean Piaget and David Kolb on the subject of acquiring new knowledge and concepts. In this research, a teaching model by P.White and M. Mitchelmore for mathematics, called “Teaching for Abstraction: A Model” will serve as the primary reference. Their educational framework will provide the overall structure of the proposed new model for understanding abstraction in the context of architecture. The focus will be on mainly deriving and explaining the general outlines of this new for architecture education model. Combined with personal observation of the academic architectural field the research method employed is predominantly literature-based, qualitative analysis.

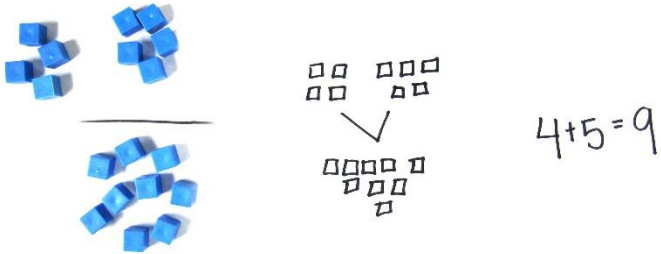
“The ability to simplify means to eliminate the unnecessary so that the necessary may speak.” - Hans Hofmann. [11]

Abstraction as a Process - Overview and Context

This is where we will briefly discuss the background, definition and theories behind abstraction as a process and its role in education and learning, in order to provide somewhat general but also multifaceted understanding of the topic. When the abstraction process takes place, it becomes an object itself, resulting from the switch from a concrete (contextual) to an abstract (conceptual) way of thinking about a subject. The outcome of this process is new knowledge - a new abstract concept.[12] Abstraction is central to learning because it helps us with categorizing, understanding and applying information.[13] For architects it serves as a tool to both define and solve complex design problems by abstracting them to more a easily comprehensible size. [14]



“This is called Abstraction, whereby ideas taken from particular beings become general representations of all the same kind; and their names general names, applicable to whatever exists conformable to such abstract ideas.” John Lock [15]



Concrete ←————→ Abstract



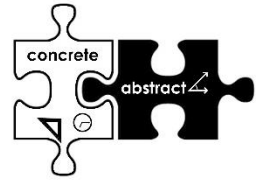
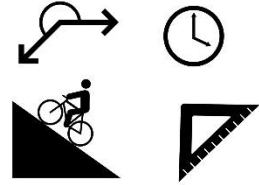
Between the Concrete and the Abstract

Everything can be categorized in two ways - as either “concrete” or “abstract”.[16] “Concrete” things have physical presence and causal powers, such as objects or matter that can be physically observed. In contrast, “Abstract” entities do not exist in space and time and are “causally inert”.[17] Such distinction between things that are concrete and those that are abstract is central in the discussions on epistemology and the wider theories on knowledge.[18]

In a very similar way, we can distinguish between the two different kinds of thinking people mentally engage in - once again categorized as concrete and abstract.[19] In this case, concrete thinking is very specific and focuses on facts and descriptions of everyday reality - it mostly deals with particular objects or scenarios in a set context. In comparison, abstract thinking is a mental process, which works more with ideas, relationships and general assumptions.

While these two modes of operation are very different, it is important to consider that they nevertheless strongly influence each other - our abstract thinking effects our concrete experiences and the other way around. This makes it crucial to be aware of the relationship between the two. [20] Considering this, we can say that teachers aim, among many other things, to help students establish a link between abstract ideas and concrete examples.[21] One way to achieve this in architecture is by teaching students how to use and understand abstraction as a process, rather than just a classification or an end product.

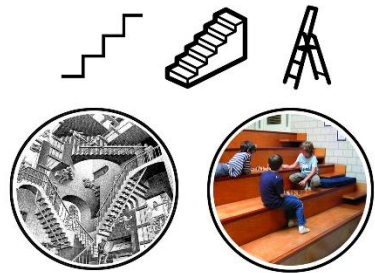
*“The knowledge we gain by human understanding must be by means of concepts”-
Immanuel Kant [22]*



Abstract-Apart

vs

Abstract-General Concepts



Abstract Apart and Abstract-General Concepts

Concepts are the general notions, ideas or knowledge we hold.[23] They play a crucial part in many of our fundamental psychological activities such as decision-making, learning, categorization and memory.[24] Each concept or piece of knowledge has a level of abstractness, which refers “to the degree to which a unit of knowledge (or a relationship) is tied to a specific context.”[25] Deep understanding takes place when a certain concept is freed from the specific context in which it was thought, and becomes general and applicable to many different and new situations. [26] Concepts such as these are referred to as “Abstract-General”.

Opposed to those, there are also “abstract-apart concepts”. Abstract-apart concepts are obtained independently, without going through the process of abstraction, and thus do not have strong links to concrete examples, nor are easily applicable to unfamiliar or divers contexts. In the world of architecture, students that obtain abstract-apart concepts have a more fixed and narrow view of the architectural challenges and problems they face. In contrast, students with abstract-general concepts have knowledge, which is more malleable and applicable to a variety of scenarios due to the high level of abstractness their ideas have.

The Process of Learning



John Locke
Essays on Human
Understanding



Jean Piaget
Qualitative development
of knowledge



David A. Kolb
Experiential Learning
Theories



Abstract & Particular
Ideas
John Locke



Empirical & Reflective
Abstraction
Jean Piaget

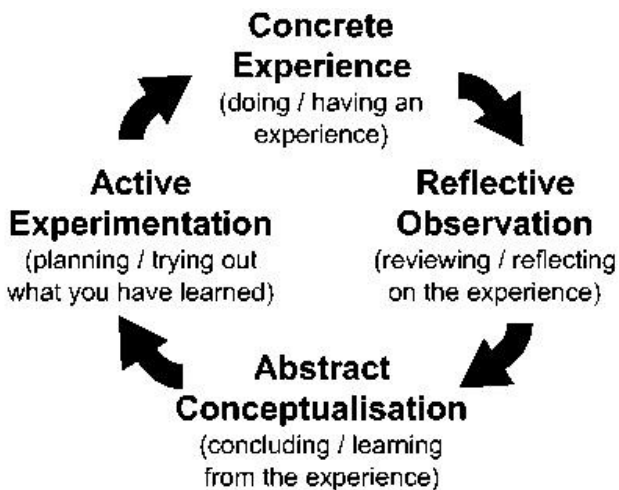


Abstract
Conceptualisation
David A. Kolb

Literature Review – Locke, Piaget and Kolb

The first popular theories on abstraction as part of learning come from English philosopher John Locke, who is considered to be one of the most influential thinkers on the subject of empiricism. For Locke, while sensory experience is the primary source of knowledge, reflection still plays a crucial role in the learning process. In his writing on human understanding and language, Locke distinguishes between particular ideas and abstract-general ideas. He goes on to explain how particular ideas are limited in their application in new scenarios, while abstract general ideas are not specific to a time or place and thus can be more easily tested in similar contexts. [27] Locke draws attention to the importance of obtaining abstract general ideas in the process of learning by omitting context from a wide selection of examples, thus forming a concept. [28]

In the 20th century, by building upon some of the ideas of Locke, the famous French psychologist Jean Piaget developed his own approach to abstraction as part of his wider theories on “genetic epistemology”. [29] He differentiated between “empirical”, “pseudo-empirical” and “reflective” abstraction and sought to explain the important relationship between the three and the role each one played in learning. While Piaget’s focus of study has mostly been on the development of knowledge in early age, up until adolescences, many of his concepts are thought to be relevant to the subject of teaching and learning as a whole. Piaget argued that cognitive development should be considered as a life-long process. [30]

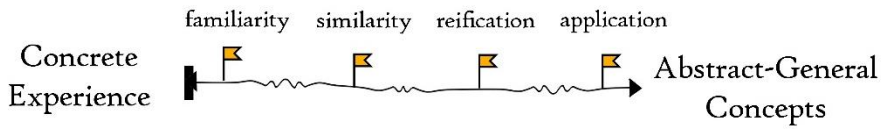


Partially drawing from the work of Piaget, the most popular modern theory and model on experiential learning is by David Kolb.[31] Kolb describes four stages an individual, not necessarily with the help of a teacher, needs to progress through, in order to learn effectively and gain genuine knowledge. These four stages describe a recursive process that combines immediate experience, reflection, abstract conceptualisation and action. In this context Abstract Conceptualisation is the process by which the learner, through the use of evidence, comes to a new abstract idea, or changes an existing concept they have. This new abstract concept must be separate from the specific concrete example from which it was first observed.[32]

Some researchers suggest that the process of Abstract Conceptualization described by Kolb is in fact a natural result of the brain's structure and method of processing information. [33] Furthermore, while all four stages are necessary for effective learning Kolb puts forward the notion that people have individual learning styles. Each learning style described by Kolb corresponds with one of the four stages he puts forward. For example, students that have abstract-conceptualization as their core learning ability are better at understanding a wide range of information and putting it in reduced, logical order. [34] However, While Kolb's model is generally applicable to architecture it does not address in enough detail the above posed question of exactly how this process of abstract conceptualization should take place.

Teaching for Abstraction: A model

4 phases



Teaching for Abstraction: A model in Mathematics

Using similar base assumptions, “Teaching for Abstraction: A Model”. is by Paul White and Michael C Mitchelmore deals with the problem of how students should derive meaningful abstract-general concepts through the process of abstraction. In their paper, White and Mitchelmore put forward a teaching model constructed out of four distinct phases (Familiarity, Similarity, Reification and Application) that is explicitly designed to help students acquire abstract-general concepts.[35] Because Mathematics is considered to be an inherently abstract subject, the field has had a long preoccupation with how to better teach students about the subject’s inseparable connection to concrete reality. [36]

By implementing this model, students have been shown to develop a stronger connection between the abstract knowledge they acquire in mathematics and the real-world concrete applications of those concepts. While “Teaching for Abstraction” is designed for a particular subject, it is nevertheless based, and relies on the similar fundamental assumptions about learning and abstraction, which Locke, Piaget and David Kolb base their works on. For this reason, it acts as a valuable example of how a framework can be constructed around general theories to address a particular challenge in a certain subject. The next chapter will look at this research and its four-phase model in more detail, before going on to demonstrate how the process and findings of this research can be translated in the context of abstraction in architecture.

ABC - Abstract before Concrete

What students often forget when learning mathematics is that Despite its highly abstract language, the basic elements and building blocks of the whole subject are nevertheless based on models of experience.[37] The problem “Teaching for Abstraction” seeks to address is how students often learn abstract mathematical concepts in isolation, without going through the necessary process of abstraction, resulting in Abstract-apart concepts. As previously mentioned, abstract-apart concepts are pieces of knowledge, which have not been derived from observing or studying a variety of contexts, but instead are obtained ready-made in separation, detached from any concrete examples or experiences. These kind of abstract-apart concepts are most often the result of what the researchers have called “Abstract before Concrete” or “ABC” learning methods.

The assumption this “ABC” approach relies on is that, if students are presented with a context free abstract idea, they can later more easily reapply it themselves to a new scenario when necessary. However, this has been concluded to be problematic. As it turns out it can be very challenging for students, especially beginners in a subject, to put such abstract-apart concepts in context without knowing how the abstract idea was derived in the first place. To address this issue some teachers have made a switch from teaching fundamental mathematics as a closed system, to mathematizing everyday experiences. This process of going from real world concrete examples to abstract symbols and concepts is what has become the basis of the Realistic Mathematical Education (RME) movement in the Netherlands. [38] By first establishing a link between familiar contexts and then moving on to mathematical concepts the “ Abstract Before Concrete” teaching method is reversed , becoming a “Concrete Before Abstract” approach, at the centre of which is the process of abstraction.

The phases described in the existing teaching for abstraction model are: [39]

Familiarity: Students explore a variety of contexts where a concept arises, in order to form generalizations about individual contexts and thus become familiar with the underlying structure of each context.

Similarity: Teaching then focuses on helping students recognise the similarities and differences between the underlying structures of these contexts.

Reification: The general principles underpinning the identified similarities are drawn out, and students are supported to abstract the desired concept into a mental object that can be operated on in its own right.

Application: Students are then directed to new situations where they can use the concept.

CBA - Concrete before Abstract

The idea that is at the center of the Concrete before Abstract (CBA) teaching method is that, if students are capable of first understanding and deriving a concept related to a specific concrete context, over time that context will become more general, allowing for the same, or similar way of thinking to be applied to a new abstract scenario.[40] As a result students should be better at recognising similarities between superficially different contexts in which the same concept occurs. When this is the case, they can be said to have an Abstract-General type of concept. [41] In order for this CBA method to be effective however, students must be capable of understanding and going through the process of abstraction. This is where the four phases previously mentioned become crucial for the model's application in education, as they outline the process students must go through.

By guiding students through these four stages of abstraction, teachers can explicitly promote abstract-general kind of learning and at the same time help their students practice the process through which such concepts can be generated and later on re-applied. Instead of a single jump to abstraction students are introduced to a more coherent and understandable process which they can follow along in order to reach an abstract concept. The next paragraphs will look at and consider the overall conclusion of the "Teaching for Abstraction: A model" paper after it was tested as an educational model in mathematics classes. Following this the research will move on to describe how these principles can be applied in architecture.

Evaluation of the method and its phases

The conclusion of the research team that tested the above described educational model for mathematics is that “Teaching for Abstraction” is indeed effective in guiding students towards obtaining abstract-general concept in a variety of different topics. The fact that it was tested on several different mathematical concepts, which are common part of the school curriculum, demonstrates that the model is adaptable to existing teaching methods and can be integrated and combined with traditional ways of teaching. At the same time, the research casts light on some of the challenges of implementing this model in practice.

Familiarity



Similarity



Reification



Application



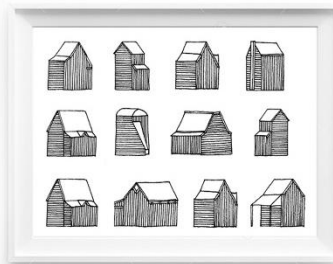
“...explore a variety of contexts where a concept arises in order to form generalizations about individual contexts...”

Familiarity

Similarity

Reification

Application



Familiarity

Overall, this phase has shown to be helpful at familiarizing students with a number of different contexts, before they can draw out similarities and differences between them. However, teachers have noted that depending on the starting ability of the students the number of examples that could be discussed may vary. [42] Lower ability students find it more difficult to recognize the mathematical concepts present in all of the concrete examples and thus require more time to study each context in additional detail. This suggests that for some, it would be more beneficial to look at fewer examples, but in greater detail, while for others the large number of case studies helped them to more quickly begin to draw away the concept from its context. Nevertheless, this phase provides great opportunity for fruitful discussions and increased enthusiasm about engaging with new unfamiliar contexts.

“...recognize the similarities and differences between the underlying structures of these contexts...”

Familiarity

Similarity

Reification

Application



Similarity

“The power of the model lies in this phase”.[43] This is to say that the comparative study of contexts, in terms of structural and not just superficial similarities is a crucial step in the development of abstract concepts and critical thinking. In the case of teaching basic mathematics, this was most often achieved through the use of physical models (manipulatives) or pictorial aids (diagrams). This in a way foreshadows the next stage of Reification and the important role diagrams play in the abstraction of information.

However, a second study that tested the teaching model draws attention to how there were some difficulties when teachers tried to implement this step in practice. Even though students gain a lot from reaching their own conclusions, in some cases their observations and concepts were evaluated to be lacking in depth. The main challenge resulted from the inverted traditional approach of starting by teaching a clear concept and directly trying to show students how to use and manipulate it. In Teaching for Abstraction, both students and teachers need to start from a blurred concept that is present in a series of particular contexts, and slowly reveal it through the use of Similarity and Reification. [44] This problem is somewhat explained by the fact that the teachers in the research had not been given sufficient time to fully adapt to the new Concrete before Abstract method.

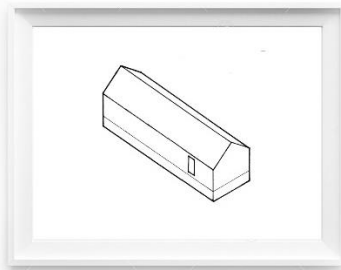
“...abstract the desired concept into a mental object that can be operated on in its own right...”

Familiarity

Similarity

Reification

Application



Reification

Reification focuses on the student's ability to work with a new concept as a mental object of its own. It is about understanding that certain concepts can be manipulated and applied in similar ways, despite the different contexts in which they appear. In the subject of mathematics the researchers tested this by examining the student's ability to use and explain a concept in their own words, through appropriate generalizations. The outcomes of this stage should be the ability to:

- Define the meaning of the concept
- Give contextual examples of the concept
- Operate on the concept in its abstract form
- Give a contextual analogy to a given abstract operation
- Explain abstract operations relatively
- Express Generalizations involving operations on the concept
- Show understanding of how the concept is applied

The result of the conducted research suggest that reification is not a single “aha” moment but rather a steady ongoing process. This process starts with the recognition of a similarity, advances by reaching the above listed outcomes and does not have a definitive end. As time goes on acquired concepts get more generalized in order to cover more and more contexts. [45]

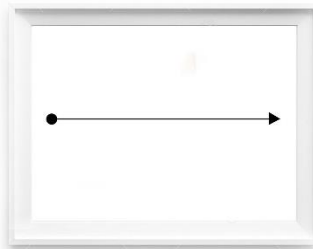
“...directed to new situations where they can use the concept....”

Familiarity

Similarity

Reification

Application



Application

Upon reaching an abstract-general concept students are guided towards its application in new unfamiliar situations. However, this phase, despite being listed last, should not be considered to be the final step in the process. Application in particular “feeds back into and strengthens the first three phases”.⁴⁶ The act of application in this case is synonymous with experimentation. In order to detect and challenge any pre-existing biases student must engage in experimentation throughout the process of abstraction.

One research which has tackled a similar problem of pre-existing biases but directly in the context of architecture is by Joo-Hwa in his “Cognitive Biases in Design, the of tropical architecture”. He points out the dangers of biases and illusions when it comes to using concrete examples as a starting point of abstract concepts. The solution he puts forward to is the introduction of regular “rebuttals” which aim to challenge, and test the concepts while it is developing. Rebuttals can be in the form of counter-arguments or the exploration of alternative solutions and interpretations.

“The urge to abstraction stands at the beginning of every art ” - Wilhelm Worringer [47]

Example

Collect

Compare

Diagram

Adapt

Recombine

Apply / Experiment

Demystifying Abstraction: a Model

The following pages are the result of a research, which began with the fascination of how we learn about architecture, and consequently how we teach architecture. In the process of investigating the act of learning what became evident was that the process of acquiring new knowledge, ideas or concepts is to a very large extent affected (if not driven) by our ability to understand and use abstraction. By being aware of the main aspects of this process students can have better control and grasp of what and how they are learning.

Because the process of abstraction can vary greatly depending on context, subject or the individual who engages in it this framework is far from universal. Nevertheless there does seem to be a large set of underlying rules to abstraction, which these pages help to outline and uncover. Demystifying this mechanism does not necessarily mean the same as automating it. The below described phases aim to simply give shape to a process which otherwise appears chaotic and difficult to navigate through, especially for beginners in the subject of architecture.

What lies at the heart of this model is the notion that “good” (which we have so far referred to as abstract-general) concepts are not the result of an “aha” moment, or a sudden stroke of genius, nor can simply be directly obtained from another source. They are rather the outcome of a continuous mental process shaped and guided by abstraction. By proposing this general structure, the subjective and seemingly random process of abstraction can hopefully be more easily understood, taught and applied.[48]

Instruction Manual.

- Abstraction is the process that connects the concrete and the abstract in a line (rarely a straight one)
- Every architectural concept can be placed along that line from concrete to abstract.
- The most concrete a concept can be is “example”. The most abstract version of a concept is a “diagram”.
- No concept is ever entirely abstract, nor entirely concrete.

- Concepts can move in either direction along that line.
- There are two possible ways of moving – from the concrete to the abstract and from the abstract to the concrete.
- The move from the concrete to the abstract is about deriving new concepts through abstraction
- The move from the abstract to the concrete is about applying abstraction in to new concrete situations

- A concept which is set along that line, and has remained on the same spot we call abstract-apart concept. Abstract-apart concepts are static and only rarely applicable
- Concepts which can move smoothly along that line are abstract-general. Abstract-general concepts are good because they can be adapted according to the specific conditions in which they are used
- A diagram of an example is more representational and thus closer to concrete. Diagram of a pattern is more abstract and closer to a concept

- The development of a concept from a concrete to an abstract state (from an example to a diagram) can be split in 4 conditions:

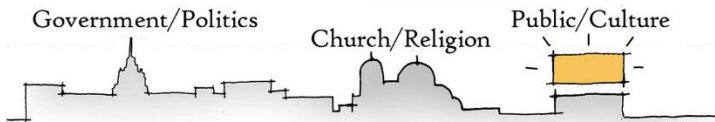
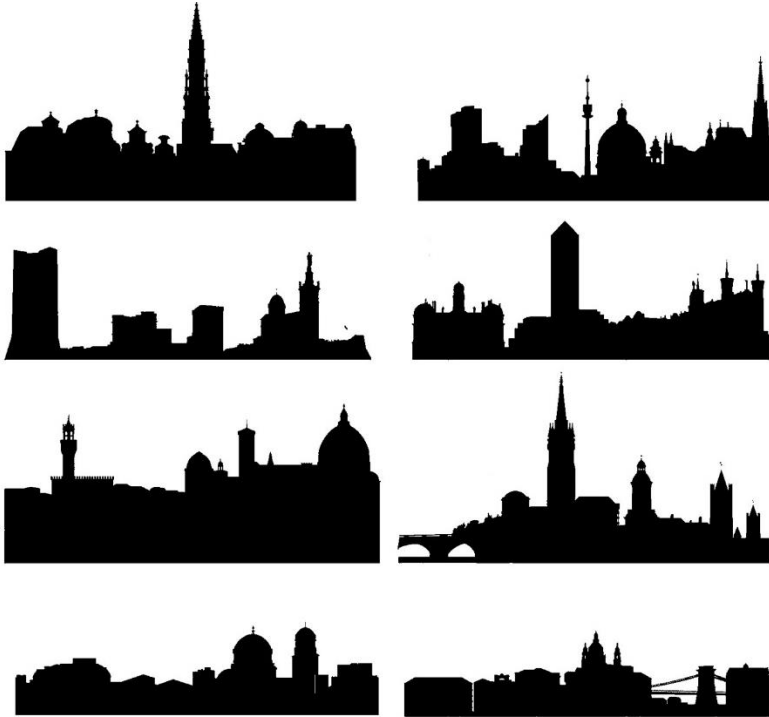
1. Precedent: (an abstract-apart concept)

2. Collect: number of similar examples (A set of examples is more abstract than a single instance.)

3. Comparison: What are the unique and shared qualities? Is there a pattern?

4. Diagram: The Reification of those identified qualities and patterns.

- The application of a concept from an abstract diagram to a concrete example (from an example to a diagram) can be split in 4 conditions:
 1. -Diagram of the concept. The most abstract state in which the concept is still recognisable.
 2. -Adaptation of the diagram due to the influence of external factors.
 3. Recombination with existing conditions
 4. Application



How do you put a new building on top of an existing one?

Design Task & Application:

Similar to the research method used in “Teaching For Abstraction” the ideas and application of the model will be demonstrated and explained in two ways. First we introduce a step in the process, and then that step is demonstrated on a specific design project. In this case the design task is part of a larger brief for the extension of The Bulgarian National Library in Sofia. Through the course of the initial analysis it was concluded that the extension should be constructed on top of the existing neo-classical building. This has created an interesting condition with one very clear design question: How do you put a new building on top of an old one?

This question, while unique for the particular project, structurally is no different than any other design question architects often face along the design process- “Where should the entrance be?” “What material is most appropriate” “How do you navigate the space” “What is the Structure”. While all design challenges have a particular nature, the process through which we approach them is often similar.

Different version and configurations of the following proposed steps have to some extent been studied in a number of research projects dealing with the nature of design precedents. [49] As we have seen, precedents and existing examples are what give start to the process of abstraction. In this sense, we can think of the abstraction process as a general method of approaching information, or more specifically in architecture as an explicit tool for analysing and learning from precedents and buildings.



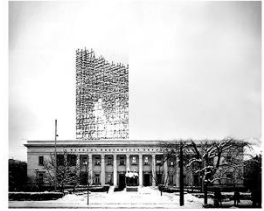
Architecture Hats & Tops

Collect

In order to derive an abstract concept we begin by collecting intuitively similar concrete examples. "Abstract entities are abstractions from concrete entities"[50]. Abstract thought cannot fully flourish in isolation from reality - any abstract-general concept, while seemingly far removed from a specific context is, regardless whether intentionally or not, inevitably related or connected to some aspects of an existing concrete example.

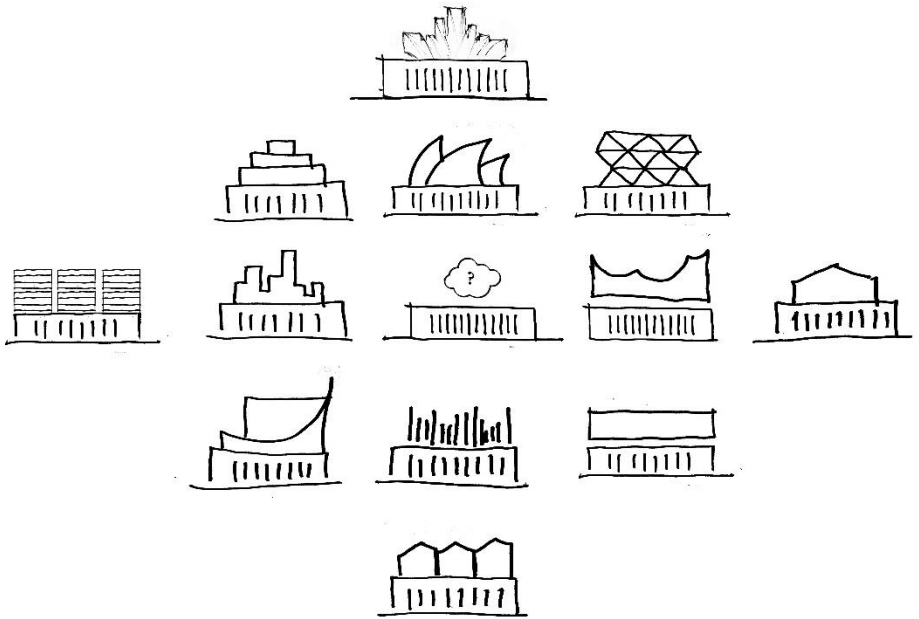
When collecting examples designers will isolate a part of a precedent or abstract some of its particular features. The capacity to recognize precedents is to a large degree dependent on our ability to re-organize and re-frame them in a new matter, relevant to our particular case. [51] As for the nature of the precedents, in order to arrive at a true abstract-general concept ideally the precedents branch outside the immediate realm of built architecture and expand to include other frames of reference.

Through the collection of examples patterns will almost always begin to occur in some particular aspects such as form, structure, materials, circulation etc. These patterns can be made more pronounced and visible when the selected examples are arranged and categorized in groups. This activity becomes more important in the next stage of comparison.



Compare

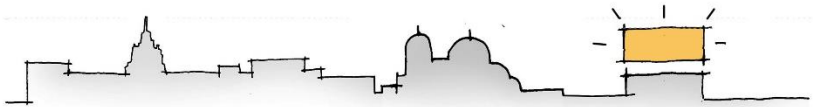
In order to evaluate and understand the qualities of the selected examples we must first compare them. In this phase students have to begin to work with a more abstract language while reducing or removing the unnecessary specific information from the collected precedents. Certain kind of diagrams can be used to isolate the studied characteristics of these case studies. At this point the diagrams are often at a low level of abstractness, due to their highly representational nature. The stage begins with the recognition of co-existing unique, and general qualities in each examples, and concludes when these qualities can be reduced to a more general abstract concept or pattern.



Diagram

This is the point where concepts reach their highest level of abstractness. When we use the word diagram, it does single out a particular visual style or language. In this case diagrams can be any visual or concrete representation of the identified relationship, patterns or qualities. Patterns diagrams are different from example diagrams because they are less representative of a single condition. A pattern should be replicable to adaptable o a number of scenarios without losing its distinctive logic.

No pattern is an isolated entity. After this process has been carried out several times , with a variety of different examples, we can begin to see that most patterns, are connected. This is wonderfully illustrated in the work of Francois Blanciak entitled “Siteless” and in the highly influential book by C. Alexander “A pattern language”.⁵² Both works seek to achieve similar results - identify or derive an observable pattern or general rules, which can be reapplied in to a specific design scenario. On the one A Pattern Language has a clear “concrete before abstract” approach to abstraction. On the other hand diagrams from the book “Siteless” originate from concrete examples, but are quickly transformed in to their maxim abstract form.



Adapt

While in the abstract end of the process, concepts can be pure if we wish to bring a diagram closer to being a concrete example, outside factors and conditions will quickly begin to have an influence. A design is never the complete entirely pure manifestation of a concept. Patterns imply simplicity, while concrete conditions often possess that simplicity, but under a layer of unavoidable complexity. Any design is the balance between those two aspects.

In the adaptation of diagrams to fit a particular case there are two problems that beginner students most often stumble on. If successful at deriving a pattern beginner architecture students often attempt to transform that pattern directly into a complete design, without going through adaptation or recombination. Another just as common fault is the over-adaptation of a diagram or concept which results in a diluted result, with no clear intent or priorities.

Ideally a diagram can be gradually adapted in order to simultaneously refer to a specific concrete context, while distinctly keeping in line with the identified abstract concept. Another method of achieving this is through the combination, and recombination of concepts, patterns and diagrams in order to fulfil a variety of conceptual needs or to generate previously unconsidered options.

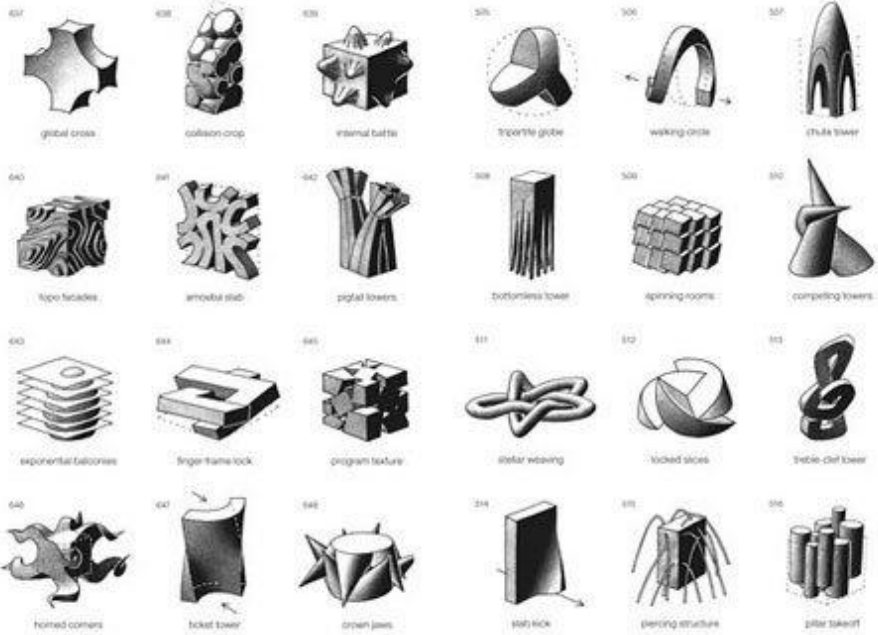


Fig.x - Siteless by Francois BLnciak

Recombine & Experiment

Demystifying the process of abstraction mostly deals with describing how we derive concepts and how we then move those concepts from the concrete to the abstract or from the abstract to concrete. However, it does not say anything about what those concepts should be or how we come to choose them. In order to avoid, or counter any existing preconceptions a designer has to engage in persistent experimentation with different concepts. The attempt at re-applying abstract concepts in to concrete contexts reveals the compatibility between an idea and its compatibility with the given conditions.

At the same time, through the process of experiment and further adaptation, in certain cases a combination or overlap of patterns or concept occurs, creating a new, sometimes original combination. When this process occurs mindfully, a designer can further elaborate on it, recreating it several times, similar to an experiment, paying closer attention each time it happens. Experimentation is what allows for familiar and predictable steps, to create a new unfamiliar condition.



Abstraction does not tell us what to think, it tells us how to think about it.



Going Forward & Conclusions

Following on from this initial research the next step in this investigation would be testing how applicable, relatable or intuitive these outlined ideas are to beginner students in architecture. It would be interesting to observe what happens when unexperienced designers attempt to follow a more structured method of conceptual thinking in regards to the process of abstraction. Through an experiment like that the model can gather a large amount of examples to draw from, and can become even more fine-tuned for particular activates as part of the design process.

Demystifying abstraction would not reduce design to a straight path that is clear from the beginning. On the contrary - adding a degree of structure to the seemingly chaotic process of abstraction would liberate the design process and open up numerous different patterns, configurations and concepts to explore - all derived and building upon what has come before. Rather than ignore the process that is persistently going on in the background of design, we can observe, study and aim to improve it.

References

-
- 1 Erinerin Bradner, Francesco Iorio, Mark Davis, *Parameters Tell the Design Story: Ideation and Abstraction in Design Optimization*, p.3 Symposium on Simulation for Architecture and Urban Design, (Tampa, Florida, USA 2014)
 - 2 Jerry Saltz is a renowned american art critic and columnist for New York Magazine Seeing Out Loud: The Village Voice Art Columns, fall 1998 – winter 2003, Jerry Saltz (small press distribution 1999)
 - 3 Bryan Lawson, *How Designers Think: The Design Process Demystified* (Biddles: Great Britain 1980), P. 6. While design practice is still in the focus of learning, architectural training has shifted places from the work studios, and real world practice, to formal college and university higher educational systems. This however has resulted in some professional criticisms that students are removed from the context in which they will be working.
 - 4 Tovey Mike, *Design Pedagogy*, (Taylor and Francis 2015) p.2. Tacit knowledge is difficult to describe in words, or formalize by another person. The opposite of formal or explicit knowledge.
 - 5 Schön, D.A. *Educating The Reflective Practitioner: Toward A New Design For Teaching And Learning In The Profession* (San Francisco: Jossey-Bass 1987)
 - 6 David Kolb - *Experiential Learning: Experience As The Source Of Learning And Development*. (Prentice-Hall International London 1984) Abstraction appears as an important step in the process of effective learning in both in the general theories of kant and kolb, as well as a number of specialised ones which discussed abstract before concrete(abc) or concrete before abstract(cba) teaching models.
 - 7 Dictionary Definition of the word “abstraction”, *Oxford Dictionary of English*, (Oxford University Press 2015)
 - 8 Rosen, Gideon, "*Abstract Objects*", The Stanford Encyclopedia Of Philosophy (spring 2017 edition), Edward N. Zalta (ed.), available at <https://plato.stanford.edu/archives/spr2017/entries/abstract-objects/> [accessed December 2016]
 - 9 Lewis David, *The Plurality of Worlds*. (Oxford: Blackwell) p.84.

-
- 10 Claude Levi-Strauss. *Structural Anthropology*. Doubleday New York, 19. Journal abstraction, transformation, integration author(s): Belinda C. Reeder source: Journal of Architectural Education (1947-1974), vol. 28, no. 1/2, part 2. <http://www.jstor.org/stable/1424079> [accessed: February 2017]
- 11 Hans Hofmann was an influential abstract expressionist painter. he argued that abstraction was a method through which reality can be stripped back in order to expose the most important aspects of it.
- 12 Paul White, Michael C. Mithchelmores, Teaching for Abstraction:A Model, Mathematical Thinking and Learning Journal[<http://www.tandfonline.com/loi/hmtl20>] p.207
- 13 David Kolb - *Experiential Learning: Experience As The Source Of Learning* p.
- 14 Erinerin Bradner, Francesco Iorio, p.2
- 15 L.P. Steffe , *Epistemological Foundations of Mathematical Experience*, Abstraction, Re-presentation, and Reflection: an Interpretation of Experience and of Piaget's Approach (Springer-Verlag New York 1991) (p. 3, 106)
- 16 Rosen, Gideon, "Abstract Objects", [accessed 13 september 2016].
- 17 Locke, John, 1690, *An Essay Concerning Human Understanding*, Peter H. Nidditch (ed.), (Oxford: Clarendon Press, 1975)
- 18 Fine, Kit, *Essence And Modality, Philosophical Perspectives* 8, 1-16. "Our Knowledge Of Mathematical Objects" Oxford Studies In Epistemology 1, 2006 : pp. 89-110.
- 19 Piaget, Jean , *The Psychology of Intelligence* (Totowa, Littlefield. 1972)
- 20 Claude, M.J. Braun, *The Marxist Categories Of The "Abstract" And "Concrete" And The Cultural Historical School Of Psychology*, p. 1. <http://www.ich-sciences.de/media/pdf/Braun.pdf> [accessed January 2017] An underlying idea of the work of Karl Marx is that our understanding of the abstract aspects of a phenomena changes and can heavily influence our perception and experience of the concrete entity which it is linked to. He applies this thinking to his ideas about concrete and abstract labour.
- 21 Penina Kamina, *From Concrete to Abstract: Teaching for Transfer of Learning when Using Manipulatives*, (NERA Conference Proceedings 2009) paper 6.

http://digitalcommons.uconn.edu/nera_2009/6 [accessed December 2016]

- 22 Immanuel Kant, *The Cambridge edition of the works of Immanuel Kant, Critique of Pure Reason, (1724)* (Cambridge 1998)
- 23 Oxford Dictionary of English, (Oxford University Press 2015). Dictionary definition of concepts.
- 24 Margolis, Eric and Laurence, Stephen, "Concepts", *The Stanford Encyclopedia of Philosophy* (Spring 2014 Edition), Edward N. Zalta (ed.), <https://plato.stanford.edu/archives/spr2014/entries/concepts/> , [accessed 12 October 2016].
- 25 White, Paul, Mitchelmore, Michael C , Teaching for Abstraction : A Model p.206
- 26 *Ibid.* p.207
- 27 John Linnell, *Locke's Abstract Ideas* , Philosophy and Phenomenological Research, Vol. 16, No. 3 (Mar., 1956), pp. 400-405
- 28 Uzgalis, William, "John Locke", *The Stanford Encyclopedia of Philosophy* (Spring 2016 Edition),
- 29 Leslie P.Steffe, *Abstraction, Re-Presentation, and Reflection: An Interpretation of Experience and Piaget's Approach* (Springer New York 1991) p .8
- 30 Tracy S.Craig, *Reflective Abstraction and Mathematics Education: The genetic Decomposition of Induction and Compactness.* *The journal of Mathematical Behaviour* 5 (55-92). p. 2
- 31 David A Kolb. *Experiential Learning: Experience as the Source of Learning and Development*
- 32 *Ibid.*
- 33 Alice Y. Kolb and David A. Kolb, *Experiential Learning Theory: A Dynamic, Holistic Approach to Management* (Learning, Education and Development Weatherhead School of Management Case Western Reserve University)
- 34 Richard E. Boyatzis Charalampos Mainemelis , *Experiential Learning Theory: Previous Research and New Directions David A. Kolb* (Department of Organizational Behavior Weatherhead School of Management Case Western Reserve University) p.6
- 35 Paul White & Michael C. Mitchelmore (2010) *Teaching for Abstraction: A Model,*

- 36 Teaching for abstraction: A model . p.206
- 37 Penelope Maddy, *Realism in Mathematics* , (Clarendon Press, 1992) Weather mathematics is something humans have invented, or discovered, to this day is a very heated ongoing debate in the world of mathematical philosophy. In this particular instance all the research discussed subscribes to the theory of mathematical realism, which views the subject as fundamentally tied to concrete reality and our experience of it.
- 38 Gravemeijer, K. (1994). *Developing realistic mathematics education*. Utrecht, The Netherlands: Freudenthal Institute
- 39 Teaching for abstraction: A model. P . 209
- 40 Van den Heuvel-Panhuizen, M. (2001). Realistic mathematics education as work in progress. In F. L. Lin (Ed.), *Common sense in mathematics education (Proceedings of The Netherlands and Taiwan Conference on Mathematics Education, Taiwan, pp. 1-43)*. Retrieved February 19, 2010, from <http://www.fi.uu.nl/publicaties/literatuur/4966.pdf> Van den Heuvel-Panhuizen (2001) p.11
- 41 Teaching for abstraction: a model p. 6 . Abstract-general concept are the ones previously described in the first chapter as more applicable to new contexts and more beneficial for students to have.
- 42 Ibid. p221
- 43 Teaching for abstraction: A model. p. 222
- 44 White, Paul Wilson, Sue Mitchelmore, Michael, *Teaching for Astraction: Collaborative Teacher Learning*, p. 767
- 45 Teaching for abstraction a model: p.223
- 46 Ibid.
- 47 Worringer, Wilhelm, *Abstraction and empathy - a contribution to the psychology of style*, (Ivan R. Dee, Chicago1997) p 15. Wilhelm makes an incredibly important point about the state of aesthetic appreciation at which we are now. While abstraction is currently at the height of its popularity as an aesthetic form, it reveals a large degree

of uncertainty towards the work of art in general. Abstraction is rooted with the current human unrest about humanity's place in the external world. "Whereas the precondition for the urge to empathy is a happy pantheistic relationship of confidence between man and the phenomena of the external world, the urge to abstraction is the outcome of a great inner unrest inspired in man by the phenomena of the outside world."

48 Matthew Frederick , *101 Thing I learned in architecture school*, (MIT Press 2007) p.1

"Architecture is, after all, a creative field, and it is understandably difficult for instructors of design to concretize lesson plans out of fear of imposing unnecessary limits on the creative process. The aim is to firm up the foundation of the architecture studio by providing rallying points upon which the design process may thrive."

49 K. Moraes Zarzar, *Use and Adaptation of Precedents in Architectural Design: Toward an Evolutionary Design Model*, (Delft University Press, Delft 2003) p. 5

50 Lewis David, *The Plurality of Worlds*. (Oxford: Blackwell) p.84.

51 K. Moraes Zarzar, *Use and Adaptation of Precedents in Architectural Design: Toward an Evolutionary Design Model* p. 5

51 Alexander C., *A Pattern Language* (California 1977)p. xiii

52 Blanciak, Francois, *Siteless* (MIT Press 2008)



Bibliography

- Abstraction, Total, (2013) *'Nature of Abstract Art , Meyer Shapiro'*, 2013, 13-24
- Alexander, C, S Ishikawa, and M Silverstein, (1977) *'A Pattern Language'*
- Bradner, Erin and Francesco Iorio, *Parameters Tell the Design Story: Ideation and Abstraction in Design Optimization*, Symposium on Simulation for Architecture and Urban Design, (Tampa, Florida, USA 2014)
- Brookhart, Susan M, (2014) *'Buckingham Questions and Tasks: How to Design Questions And Taks to Assess Student Thinking'*
- Clark, Roger H. Pause, Michael, (2005) *Precedents In Architecture*
- Dubinsky, Ed, 'Reflective Abstraction in Advanced Mathematical Thinking', *Advanced Mathematical Thinking*, 1991, 95-121 http://dx.doi.org/10.1007/0-306-47203-1_7
- Eisenman, Peter D (1970), *'Notes on Conceptual Architecture'*, 1970, 319-23
- Facey, Paul W., 'The Oxford Conference', *Thought*, 14 (1939), 159-62
- Faste, T, and H Faste, 'Demystifying "Design Research": Design Is Not Research, Research Is Design', *Proc IDSA Education Symposium*, 2012
- Hall, Walton Keynes, Milton (1981) *Design method and scientific method*
- Hall, Walton, and Milton Keynes, *'Design Method and Scientific Method'*, 2 (1981), 195-201
- Heuvel-Panhuizen, M Van Den, 'Mathematics Education in the Netherlands: A Guided Tour', *Freudenthal Institute CD-Rom for ...*, 2 (2000), 26-27
- Hickam, Richard (2005), *Critical Studies in Art & Design*
- Hickman , Richard, (2005) *Readings in Art and Design Education Series Critical Studies in Art & Design*
- Kamina, P Iyer, N (2009) *From Concrete to Abstract: Teaching for Transfer of Learning when Using Manipulatives*

-
- Kamina, P, and N Iyer, 'From Concrete to Abstract: Teaching for Transfer of Learning When Using Manipulatives', *NERA Conference Proceedings 2009*, 2009
- Kolb David A, (1984) *Experiential Learning, Experience as the Source of Learning and Development*
- Kolb, David A., '*Experiential Learning: Experience as The Source of Learning and Development*', Prentice Hall, Inc., 1984, 20-38
- Lawso , Bryan (2006) *How Designers Think, The Design Process Demystified*
- Moraes , K. Zarzar,(2003) *Use and Adaptation of Precedents in Architectural Design: Toward an Evolutionary Design Model*
- Nesbitt, Kate (1995) *The Sublime and Modern Architecture:Unmasking (an Aesthetic of) Abstraction*
- Nicol , David, Simon Pillng (2005) *Changing Architectural Education: Towards a New Professionalism*
- Roth , Manuela, (2010) *Masterpieces: Library Architecture + Design*
- Blanciak, Francois, (2008), **Siteless**
- Tovey, Mike ,(2014) *Design Pedagogy: Developments in Art and Design Education*
- Utaberta, Nangkula, (2013) *A Comprehensive Learning of Architecture Education: Understanding Critique Session as Learning Process and Criteria-based Assessment in the Architecture Design Studio*
- Utaberta, Nangkula, Badiossadat Hassanpour, Mohd. Arsyad Bahar, and Adi Irfan Che Ani, 'A Comprehensive Learning of Architecture Education: Understanding Critique Session as Learning Process and Criteria-Based Assessment in the Architecture Design Studio', *Procedia - Social and Behavioral Sciences*, 102 (2013), 21-32
- Vidler , Anthony (200) *Diagrams of Diagrams: Architectural Abstraction and Modern Representation*
- Von Glasersfeld, Ernst, (1991) *Abstraction, Re-Presentation, and Reflection: An Interpretation of Experience and Piaget's Approach*
- White, Paul & Michael C. Mitchelmore (2010) *Teaching for Abstraction: A Model, Mathematical Thinking and Learning*

White, Paul Wilson, Sue Mitchelmore, Michael (2010) *Teaching for Abstraction : Collaborative Teacher Learning*

White, Paul, Sue Wilson, and Michael Mitchelmore, ' *Teaching for Abstraction : Collaborative Teacher Learning*', 2010

Worpol, Ken (2013) *Contemporary Library Architecture: a planning and design guide*

Worringer, Wilhelm, *Abstraction and Empathy: A Contribution to the Psychology of Style*, 1997