Furniture Design for
Pre-Primary School Children

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MD16MDES11008

Guided By

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भारतीय प्रौद्योगिकी संस्थान हैदराबाद
Indian Institute of Technology Hyderabad

The Department Of Design

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Declaration

I declare that this written submission represents my ideas in my own words, and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be a cause for disciplinary action by the Institute and can also evoke penal action from the sources that have thus not been properly cited, or from whom proper permission has not been taken when needed.

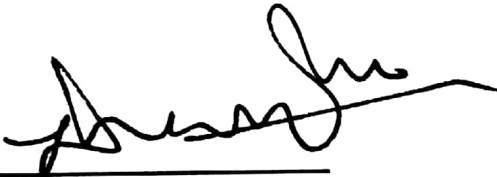Dnyaneshwar Purushottam Muley

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Supervisor's Certificate

This is to certify that the work entitled "**Furniture Design for Pre Primary School Children**" **i**s bonafide of thesis work by **Dnyaneshwar Purushottam Muley** under my supervision for his M. Design degree.

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Approval Sheet

This thesis entitled "Furniture Design for Pre Primary School Children"
by Dnyaneshwar Purushottam Muley is approved for the degree of Master of Design
from IIT Hyderabad.

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Delwyn Jude Remedia.

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Also, I would like to thank my all class mates and people in my Department for helping throughout to complete the semester and the learning successfully. I would like to thank my all Friends, who have supported me throughout entire process. I will be grateful forever for your love and support.

Dedication

School Children

Abstract

In the school education system, Classroom is most important space for children as they spend more than 80% time of their daily schedule. It is very essential to understand the importance of classroom in the children's school life.

Children are constantly engaged with classroom furniture. Sitting desks are most used furniture in the class by children. They do different activity on this desk like reading, writing and many more. Since children spend more time seated in classroom, the work space and ergonomically designed furniture are of great importance. It affects children's posture, comfort, health and ability to learn.

Project is consisting of designing classroom furniture for school children aged in between 2-7 years old. Pre-schooling ages are children's most crucial ages of children's development Cycle. Project involves furniture design considering three aspect as visually interesting, ergonomically comfortable and logically engaging. Furniture is able to help them to learn playful and fun way.

This furniture will also lead to a strong foundation for intellectual growth, creativity problem- solving and basic academic knowledge in the children.

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1. Introduction

1.1. Background

In Education system Infrastructure and quality of education is very important for child's social, cognitive, physical and emotional development. In the quality of education, it is essential to have best curriculum, courses, teachers and students. The infrastructure must include good school facilities, building and environment in the school.

A school is a place far from home where children go to be educated and also to be socialized for the need of the world. For fulfilling these purposes, they need to stay at their schools for a long time. The classrooms plays very significant role in the students' academic excellence and understanding the everyday concepts. Children's classroom is a space, which builds up a foundation for the future child.

Children are constantly engaged with furniture classroom. Sitting desks are most used furniture in the class. They do different activity on this desk like reading, writing and many more. Since, children spend a more than 6 hours of their day in school, and 80% of the time is spent doing their school work while seated, the children's work space and ergonomically designed furniture are of great importance. Classroom furniture affects children's posture, comfort, health and ability to learn.

School design must be accordimg with children's normal developmental stages. Children learn differently at different stages of development. For instance, younger children do not have the same skills, knowledge and ability to learn complex concepts as older children. Developmental differences are important not only in the design of child-friendly schools, but also in the selection of teaching/learning materials, the creation of learning/teaching spaces and the selection of school furniture.

Rudolf Steiner methodology of education explains that children should be actively, emotionally, and thoughtfully engaged in their learning. To satisfy this aspect school furniture plays very important role to engage children in their learning activity. It leads to a strong foundation for intellectual growth, creativity, problem-solving and basic academic knowledge in the children

Piaget's theory of cognitive development Piagets preoperational stage of cognitive development process occurs between 2 to 7 years. During the preoperational stage, children also become increasingly adept at using symbols, as evidenced by the increase in playing and pretending.

Educational authorities in many countries are becoming increasingly aware of the key role that school furniture can play in the achievement of educational objectives. It is evident that 'traditional' school furniture, designed for conditions that no longer exist, has become out-dated

For instance, the introduction of teaching in small groups in primary schools requires that individual chairs and small tables replace the heavy and inflexible desk-bench units which have been standard equipment for nearly a century. Again, the large increase in the number of students has completely changed the scale of furniture requirements.

1.2. Aim of Project

The goal of this project is the design classroom furniture for school children aged in between 2-7 years old that will help to the development in terms of child's social, cognitive, physical and emotional development. Furniture would able to help them to learn playful and fun way.

1.3. Structure of Thesis

The structure of the thesis is composed of nine chapters. In the first chapter, there is a brief introduction to the thesis with the explanation of the aim and structure. In the second chapter, primary research through field to school and observations are recorded. In the third chapter, characteristics of children are examined in order to get familiar with the behaviour and expectations of them. The motor, cognitive, and social development of children are studied. In the Fourth chapter, Existing furniture in the market is studied to point out the importance of ergonomically designed furniture in the preschool period of a child's life.

The Anthropomorphic study has been supported to understand school furniture. In the Fifth chapter, ideation and form explorations are done based on the field observations, children's psychological study and existing furniture. In the fifth chapter, standards, materials and finishes, safety factors, and the role of color related with the children furniture are discussed.

In the sixth chapter, three concept developments with requirements based on the research and field visit has been discussed on the functionality and form which is more engaging for children to learn in the classroom. In Seventh chapter, material analysis has been studied. Eight & ninth chapter includes 3D modelling and prototype making of the final concept form the selection. Tenth Chapter includes testing with children to get feedback on the designed furniture has been shown. Chapter Last two chapter include conclusion and future scope of furniture.

2. Field Visit to School : Primary Research

Primary research for furniture is very necessary to get know about existing furniture in the school. In the field visit, Observations of children and their interactions with school classroom and furniture are recorded through photography, field notes and video documents

In this visit, first standard children (age group 5-6 years old) were under observations. The main focus of field visit was to consider three aspects - engagement with space, use of existing furniture and posture study of children.
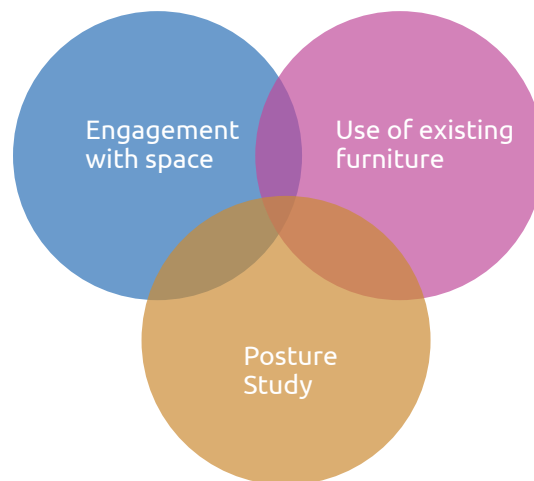
Fig. 1.1 - Focus areas of School field Visit

2.1. Engagement with Classroom Space

Children's learning experiences come from their interaction and engagement with their environment and the people around them. Similarly, the classroom is place where they most of time of day in the school. In the observation, Most of children are engaged with sitting materials, writing, reading materials, Storage materials and talking to batch mates.
They use also floor to write and to see board clearly in the class. So engagement with space of children is very material based which direct them to move in the space.

Fig.1.2 - Classroom space usages

This diagram shows the how childrens move throughtout the classroom activity in school day. These flow lines shows that there is very restricted movement while doing any task or activity on the class.
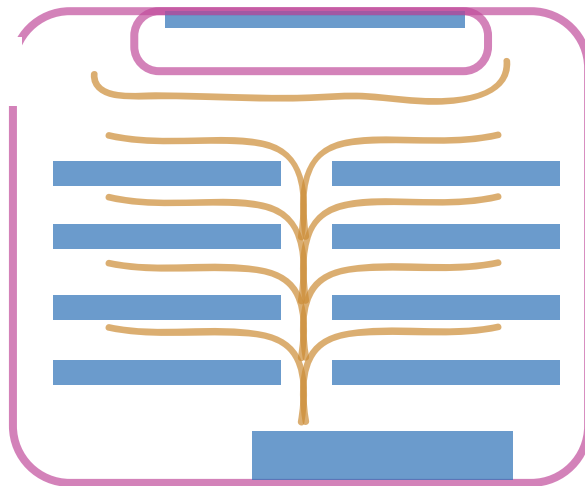
Fig. 1.3 - Children's movement flow in classroom

2.2. Use of Existing Furniture

Second aspect of observation towards field visit is how children use the existing furniture in their daily classroom activity. There are only two furniture elements one sitting desk and other is cupboard for storage. Children use the sitting desk for support to write and read. Secondly, they use it for lunch in the class. These two activities are only engaging for children with existing furniture

Fig. 1.4 - Use of existing furniture

Although, there are cupboards to keep the books and bags, children donot use the cupboards. School bags are kept on the desk by children for getting books. They also use it for back support.

2.3. Posture Study of Children

Third aspect of observation was posture study of children while they are in the classroom. After recording observation in the classroom children used to change their posture and orientation while doing work or any activity. These are the some of the posture studies of first standard children.

Fig.1.5 - Postures of Children in classroom

Most of the children rest their knees on the support surface of the Desk. Some of the children used writing pads to have support while writing in the notebook.They use whole body to rest on the desk while doing mostly writings.

These were important & common observations which shows discomfort for children while doing any activity with help of existing furniture in the classroom.

Bending of Knees

Bending whole Body

Use of Writing pad

Writing postures & body movement

Possible Rotations of furniture
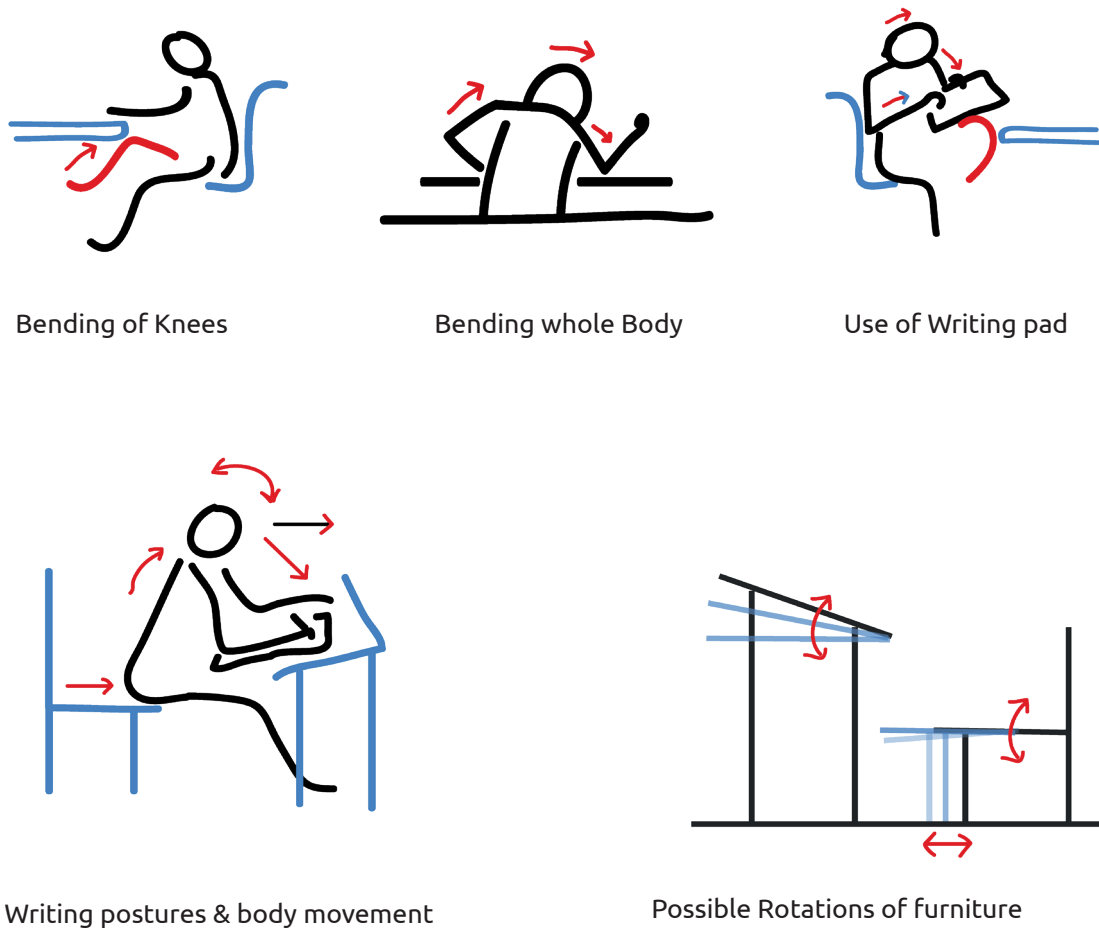
Fig.1.6 - Illustrations showing posture study

Observations of posture study

1. Constant Change in position & orientation of work

2. Adapts many postures while doing work

3. While writing apply force & need support

2.4. Conclusions of field visit
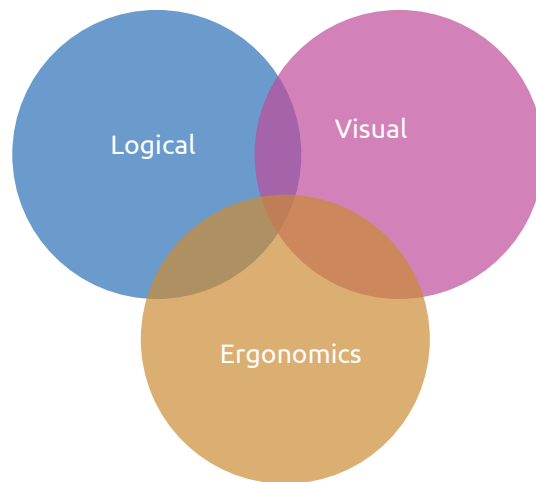
Fig. 1.7 - Conclusion diagram of field visit

Furniture must include must include following consideration while making

1.Play and fun with furniture to learn maths and science.

2.Color and shape can help to build better environment for learning

3.Comfort for seating which is build through anthropometric data of children

3. Child Development : Secondary Research

Rudolf Steiner methodology of education explains that children should be actively, emotionally, and thoughtfully engaged in their learning. To satisfy this aspect school furniture plays very important role to engage children in their learning activity. It leads to a strong foundation for intellectual growth, creativity, problem-solving and basic academic knowledge in the children

Piaget's theory of cognitive development Piagets preoperational stage of cognitive development process occurs between 2 to 7 years. During the preoperational stage, children also become increasingly adept at using symbols, as evidenced by the increase in playing and pretending. Play is a vital part of a child's social, cognitive, physical and emotional development.

3.1. Characteristics of Pre Primary School Children

According to childrens physical and psychological development children grow up. Their needs and expectations also changes with developments. Children have very distingushed performances, characteristics and pleasures in every stage of development . So it is important and essential to consider each development stage of their age and characteristics during stages when making inferences about the quality and property of their environment.

According to Piaget's theory children are ready to adapt and to learn the world by birth. They do not have to be taught deliberately to walk or that objects have to obey certain physical laws and people have to obey moral rules. In his opinion, children build up knowledge as they mentally organize information from the environment.

Children actively participate in their own development. They manipulate and explore their world, and they are guided by mental structures or mental representations of how things work.
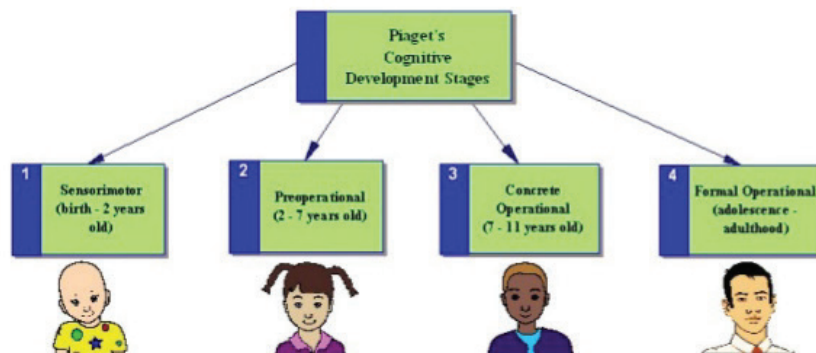
Fig. 1.8 - Piaget's Cognitive Development Stages theory

Stage Activities and Achievements Sensorimotor Birth to 2 years Infants discover aspects of the world through their sensory impressions, motor activities, and coordination of the two. Preoperational 2 to 7 years Child cannot yet think by operations, by manipulating and transforming information in basic and logical ways.

They can think in images, symbols and form mental representations of objects and events. Concrete Operational 7 to 11 years Children can understand logical principles that apply to concrete, external objects. Formal Operational over 11 year Adolescents and adults can think abstractly. Their thinking is no longer constrained by the given of the immediate situation but can work in probabilities and possibilities.

3.2. Motor Development Of Children

Motor coordination in young children develops along with muscular strength and speed. This refers to the skills involved in coordinating physical movements. Through active play, young children learn to channel strength and the speed into smooth, accurate movements. Children of this period are curious, energetic and eager and they love to climb, run, and jump. This vitality in movements enables the children to master the ability to regulate their behaviors. These gains in self-regulation in movement are part of a general trend toward greater self-control in all areas of development.

The major milestones of motor development from age two to six are summarized in table.

Age	Bahavior
2 years	• Walking rhythm stabilizes and becomes even • Jumps crudely with 60 cm takeoff • Will throw small ball 120-150 cm • True running appears • Can walk sideward and backward
3 years	• Can walk a line, heel to toe, 3m long • Can hop from two to three steps, on • preferred foot Will walk balance beam for • short distances • Can throw a ball about 3m
4 years	• Running with good form, leg-arm coordination • apparent, can walk around periphery of a cycle • Skilful jumping is apparent • Can walk balance beam
5 years	• Can broad-jump from 60-90 cm • Can hop 15 m in an about 11 seconds • Can balance on foot for 4-6 seconds • Can catch large playground ball bounced
6 years	• Girls are superior in movement accuracy • Boys are superior in forceful, less complex acts. • Skipping acquired. • Throwing with proper weight shift and step.

Table 1.1 - Milestones of motor development during early childhood
Age (Cratty and Bryant, 1979)

3.3. Motor Development Of Children

Children perceive the world in a different way. According to Fogel and Melson, for the children the world is as follow

• **Syncretic**: Children perceive everything in a global approach, mixing recollections, desires, dreams and reality.

• **Egocentric**: The world and the child are mixed. He/she thinks that other people think like him/her.

• **Magic**: Children confuse the signifier and the signified (e.g. Touching the moon's name means touching the moon itself.), the internal and the external (The humans think through the mouth.). Children think they can have an influence on the world with magic practices: to stop breathing to avoid something, to avoid walking on the lines etc.

• **Animist**: They perceive everything, even objects, as they are alive.

• **Finalist**: Everything has a function, and usefulness (Night is for sleeping, a mountain is for climbing, etc.)

• **Artificialist**: God or people have built everything (A river is built with water and earth)

3.3. Social Development Of Children

Ross D. Parke, in her article "Children's Home Environments: Social and Cognitive Effects", shows that from a very early age, variations in the social environment of the home have impact on the child's cognitive and social development. The amount, the type, and the timing of the social stimulation provided by the social agents in a child's home are important determinants of his later development. Parke emphasizes that the young children live in a complex social environment composed of mother, father, siblings, peers, and relatives. All of these agents play an important stimulatory role in early development (Parke, 1980).

Environments for children, to live in, learn in, and play in should give opportunities for children to make their own decisions. Otherwise, children find out ways against the limitations with their imagination. Children are often able to adapt themselves to the existing environment and change the environment according to their desires.

Understanding children development stages essentional for designing furniture .It will helps to consider and understand their psychological and physical bahaviour. This will help to make furniture desirable for children.

4. School Furniture and Anthropometric Measurement

4.1. Types of Furniture

1. Stand-alone: This type of furniture is movable. They can be rearranged, taken into another room. However, unless the piece is custom-made, it comes in standard dimensions.

2. Modular: Modular furniture offers great flexibility, allowing one to combine components to fit the child's exact needs. Many of the units stack or about to form larger composites. Components can be added and reconfiguration of the whole arrangement may be needed in the future. The components can be packed up when they are moved and rearranged in a new room. Some modular systems require assembly.

3. Furniture collections: Many manufacturers offer collections of furniture, composed of pieces that coordinate in style and finish. A collection designed for a child's room may include several different choices among stylistically coordinated beds, headboards, bedside tables, dressers, bookcases, desks, chairs, and framed mirrors.

4. Built-in: Built-in furniture is type of furniture that fits an area precisely. They are designed according to the requirements of the specific space. This kind of furniture can be built into nooks or under windows

Fig. 1.9 - Existing Furniture in Market

4.2. Anthropometric Measurement

Anthropometry refers to the measurement of the human individual. An early tool of physical anthropology, it has been used for identification, for the purposes of understanding human physical variation, in paleoanthropology and in various attempts to correlate physical with racial and psychological traits. Anthropometry involves the systematic measurement of the physical properties of the human body, primarily dimensional descriptors of body size and shape

In Many Schools wooden desks and benches are used as school furniture those lack standard anthropometric dimensions. The school administrations prepare procurement orders for supplying classroom furniture and the vendors supply school Furniture fabricated fromthe local carpenter shops.

In the process of learning comfort of the learner, in furniture adapted to his body, is likely to increase his learning effectiveness. Design of correctly dimensioned furniture will require dimensions of body segments of the users. Therefore matching of furniture and fittings to the body dimensions of the users is an important issue. It Has been proven that badly sized furniture can affect the physical development and academic performance of students.
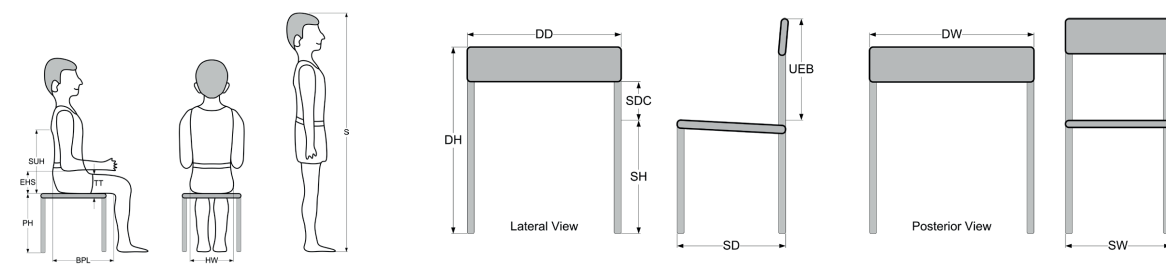
Fig. 2.0 - Anthropometric Measurement for School children Furniture

4.3 Criteria for Making Furniture

In order to establish the degree to which the parameters of school furniture and the pupil's dimensions were matching or mismatched, we analysed and tested the following criteria:

Popliteal height and seat height mismatch

The PH should be higher than the SH 1 but does not have to be higher than four centimetres or 88% of the PH in order to avoid compression in the buttock region. Based on existing research (Parcells et al., 1999; Castellucci et al., 2010; Panero & Zeinik, 1979; Panagiotopoulou et al., 2004; Cotton et al., 2002; Gouvali & Boudolos, 2006), we de ned a mismatch of popliteal and seat height as any seat height that is either >95% or <88% of the popliteal height.

Buttock-popliteal length and seat depth

In order to be able to use the backrest of the seat to support the lumbar spine without compression, the match criterion was de ned according to the equation (Parcells et al., 1999; Castellucci et al., 2010; Panagiotopoulou et al., 2004; Cotton et al., 2002)
0.80 BPL ≤ SD ≤ 0.95 BPL

Hip width against seat width

To properly t in the seat, the HW should be narrower than the SW. The match criterion is when the:
HW < SW

Thigh thickness and seat-to-desk clearance

Parcells (1999) proposed that the desk clearance should be 2 cm higher than knee height.The match criterion was de ned according to the equation (Castellucci et al., 2010): TT+2<SDC

Elbow height sitting against seat-to-desk height

This match criterion was de ned with a modi ed equation (Castellucci et al., 2010)

that accepts the EHS as the minimum height of SDH, in order to provide a signi cant reduction on spinal loading and considering that the maximum height of SDH should not be greater than 5 cm above the EHS:EHS ≤ SDH ≤ EHS + 5

Subscapular height and upper edge of backrest
To be able to move the trunk and the arms correctly, the SUH should be higher than the UEB. The match criterion was de ned according to the equation (Castellucci et al., 2010): SUH ≥ UEB

To be able to move the trunk and the arms correctly, the SUH should be higher than the UEB. The match criterion was de ned according to the equation (Castellucci et al., 2010): SUH ≥ UEB

These are standard considerations while designing furniture for school children. After considering these factor furniture is going to be ergonomically well designed and comfortable for school children.

5. Ideation for Furniture Design

5.1. Ideations Based on Logical Engagement

After primary and secondary research, there are so many possobilities for form exploration for furniture. There is exploration of form not only for sitting purpose but having some fun & Play Element
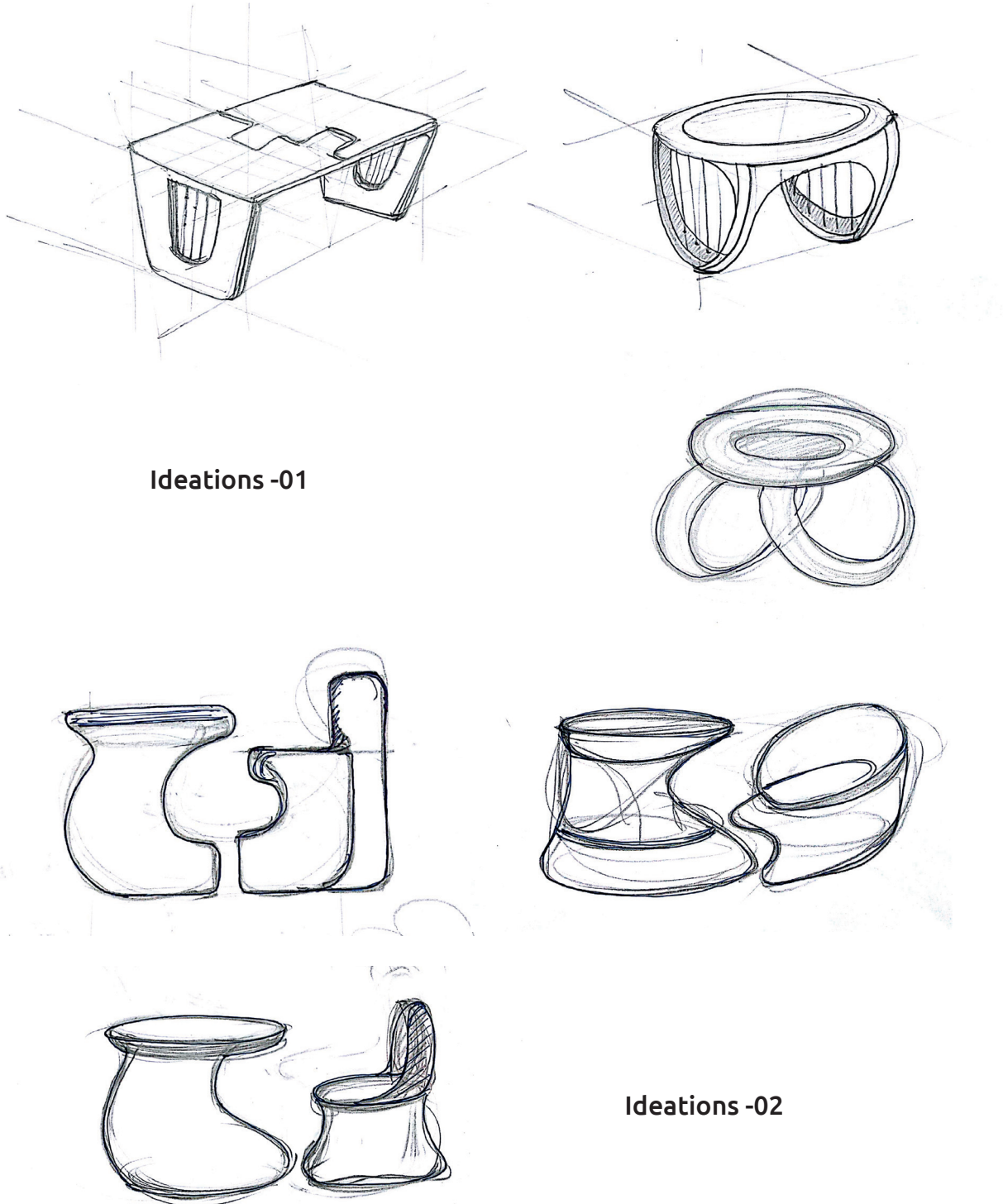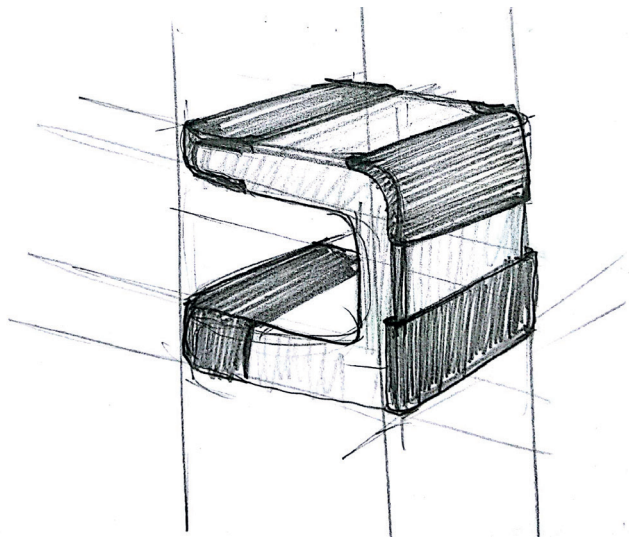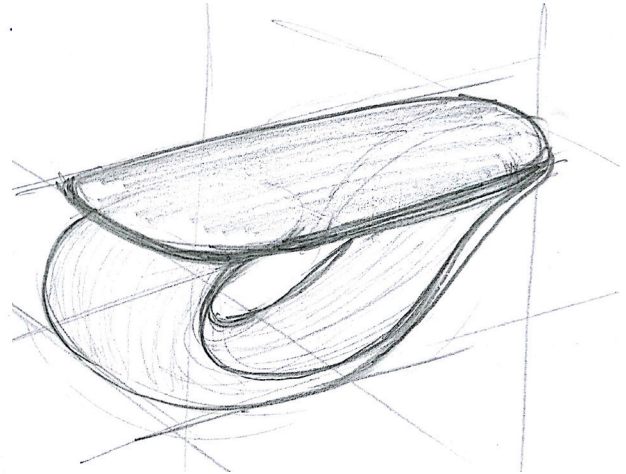
Ideations -01

Ideations -02

Fig. 2.1 - Illustrations showing Ideations Based on Logical Engagement
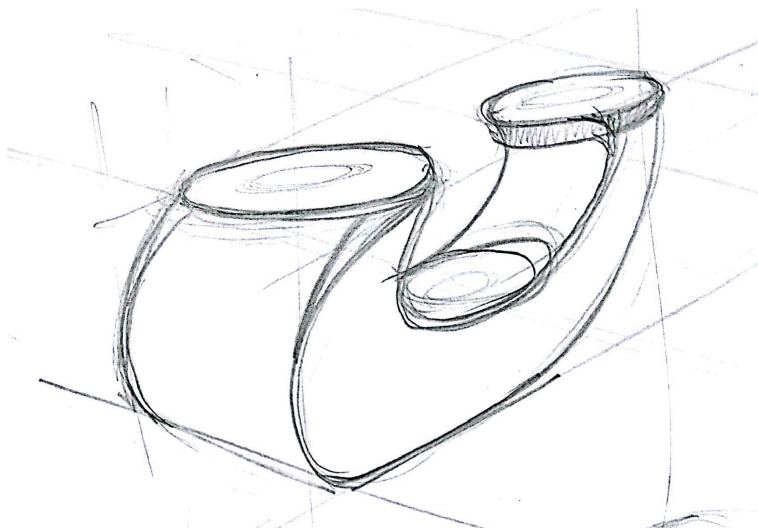
5.2. Ideations Based on Engaging Shapes

Some shapes attract children to engage with it. These some of the ideations to explore shapes to make children playful and active in the class
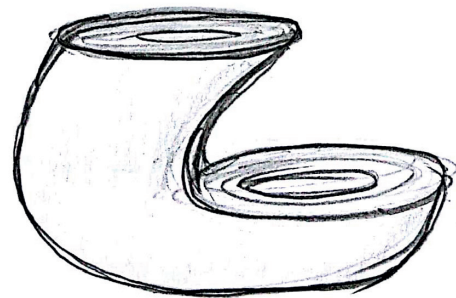
Ideation -03

Ideation -04

Ideation -05

Ideation -06

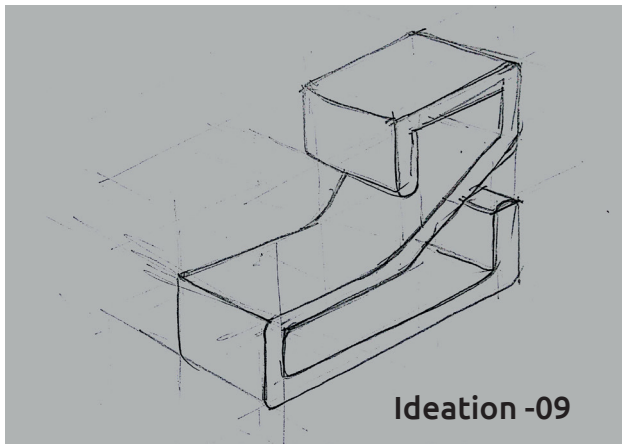Fig. 2.2 - Illustrations showing Ideations Based on Engaging Shapes
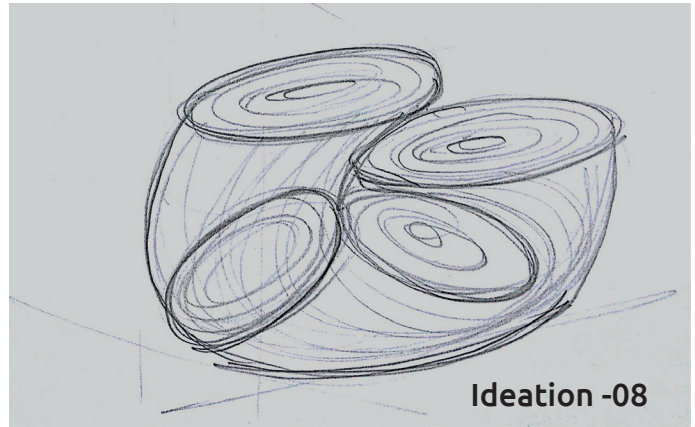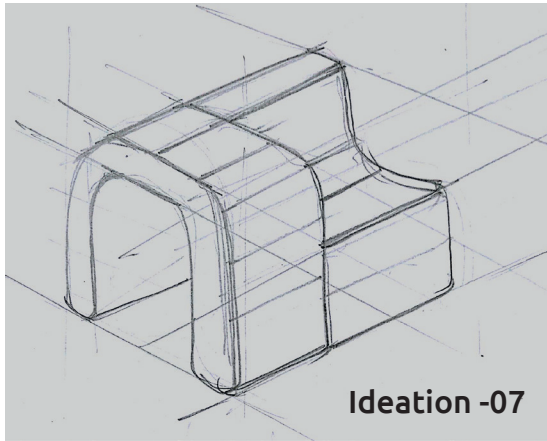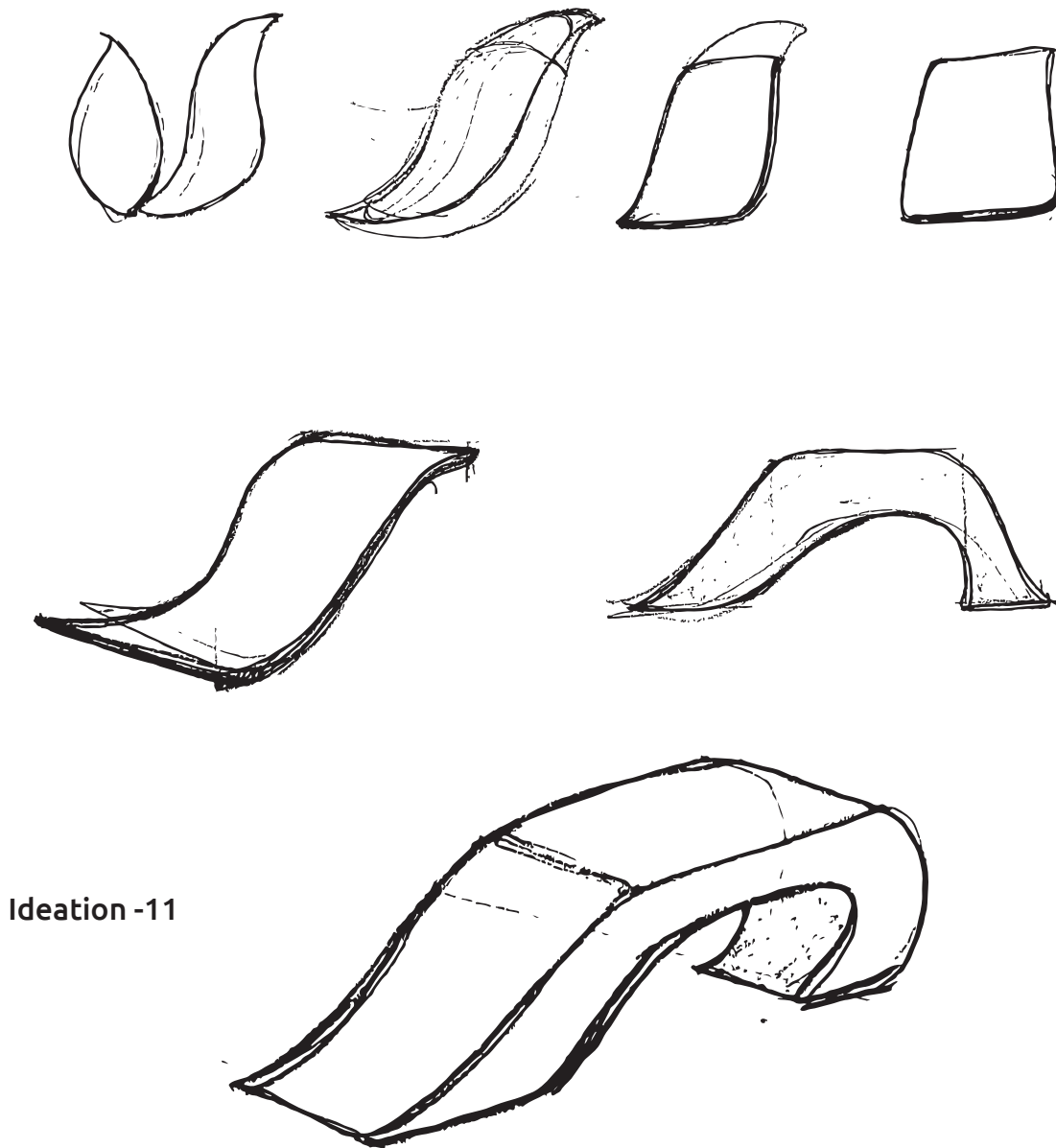
Fig. 2.3 - Illustrations showing Ideations Based on Engaging Shapes

5.3. Ideations Based on Natural Element

After understaning children and their need . Children love natural element like lotus.

Ideation -11

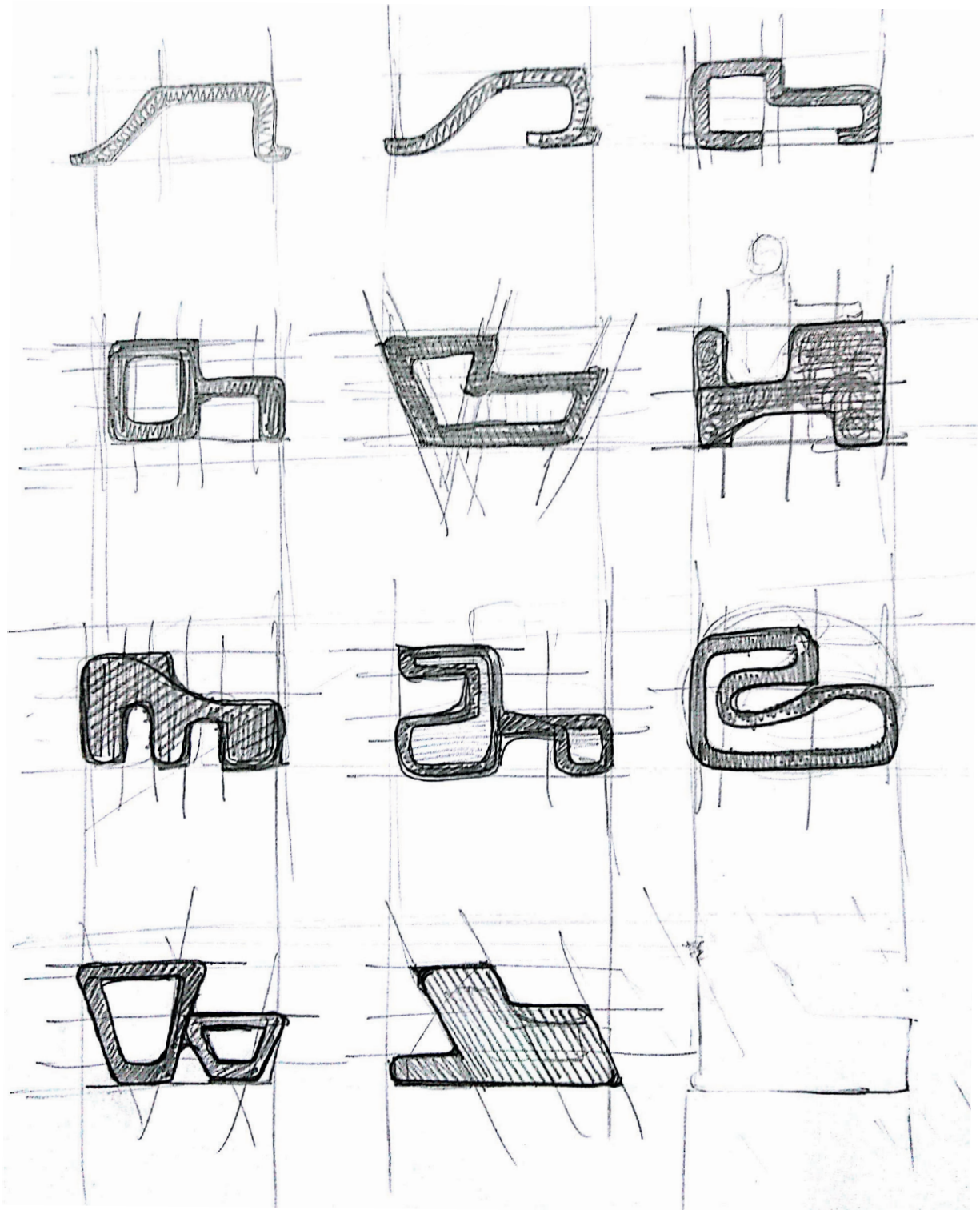Fig. 2.4 - Illustrations showing Ideations Based on Natual Element

Fig. 2.5 - Illustrations showing Structure and Shape explorations

6. Concept Generation

6.1 Concepts

Concept generation, which is when a product development team comes up with the ideas, is the most critical step in the engineering design process – without it, there is no design. A concept can be defined as both an "approximate description of the technology, working principles, and form of the product" as well as a "concise description of how the product will satisfy customer needs" (Ulrich & Eppinger, 2012).

Concept -01
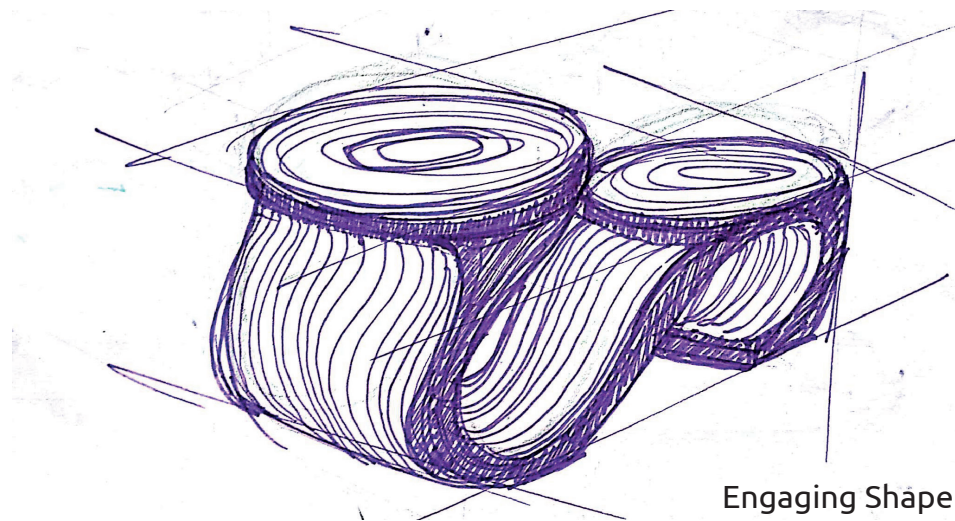
Engaging Shape to play with it

Fig. 2.6 - Concept Sketch -01

Concept -02

Multiple Engagement of pieces of furniture

Fig. 2.7 - Concept Sketch -02

Concept -03

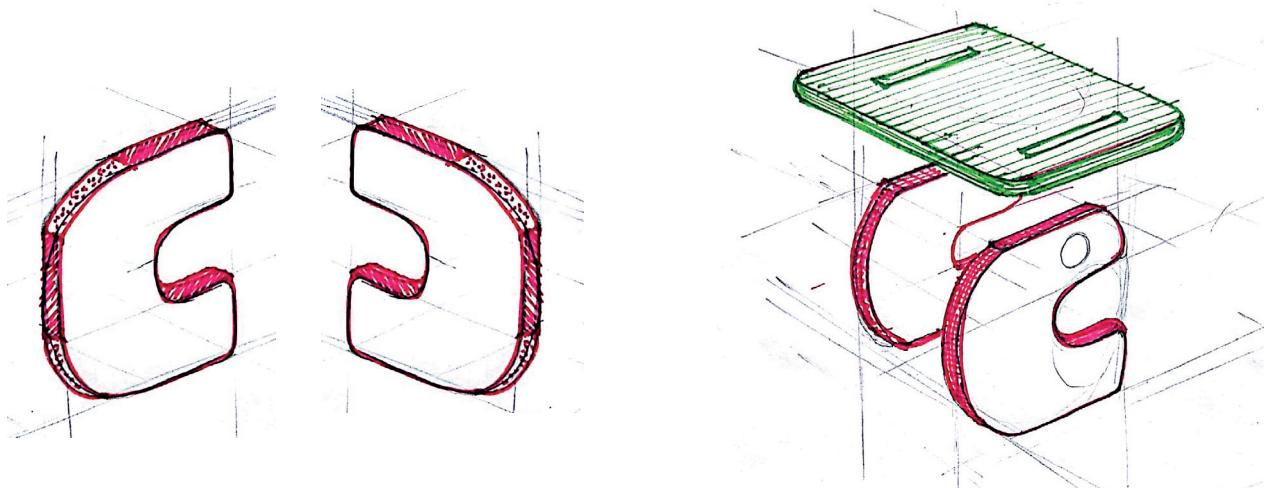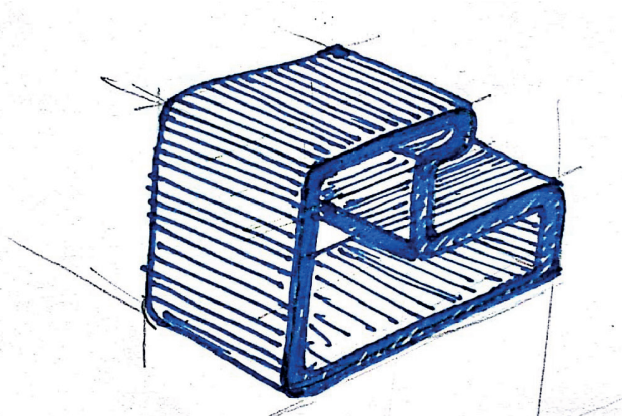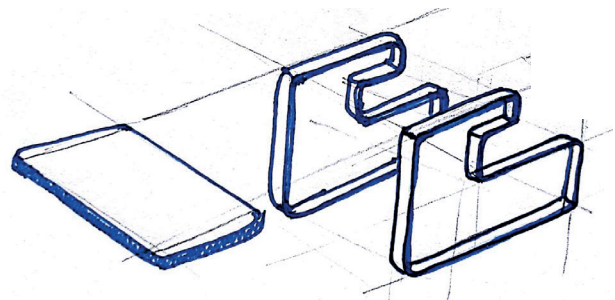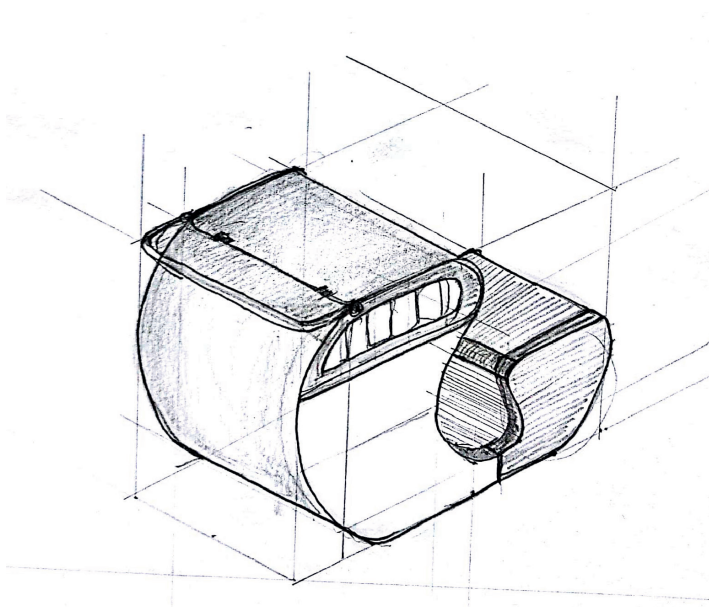Storage for the bags indiside the furniture

Fig. 2.8 - Concept Sketch -03

Concept -04
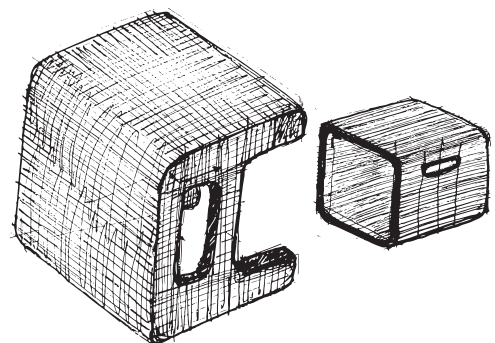

Ergonomically correct posture

Fig. 2.9 - Concept Sketch -04

7. Material Analysis for Furniture

7.1.Types of Materials

Materials can be divided into five parts according to the place where it is planned to be used. They can be arranged in order as

1.Constructional materials

(bamboo, basketwork, chipboard and plywood, metals and alloys, plastics, rubber and wood)

2.Sheet materials

(fur, leather, paper and board, plastics, rubber, textiles),

3. Coatings

(enamel, metal plating, paint and varnish, plastics, rubber)

4.Fillings and padding materials

feathers, foamed plastics, hair, straw, natural wadding, man-made wadding)

5.Supplementary materials

(bristles, cord, string and rope) (ISO / IEC Guide 50: 2002).

Wood is the most favored material for furniture construction. As a general principle, slower growing timber is better than fast growing, and for the timber ranges, those whose logs are closed and have evenly spaced annual growth rings. Wide growth rings indicate fast growing timber, which is less durable. Woods can be either hardwood (from deciduous trees) or softwood (from conifers).

The two groups differ in cell structure, appearance, and general properties. Common hardwoods used for furniture include oak, ash, beech, birch, maple, cherry, and walnut. Hardwoods make precise joints, hold fasteners better, are more resilient to wear than softwoods. Common softwoods are pine, fir, cedar, hemlock, linden used primarily in unfinished furniture. Several layers of wood are arranged with lengthwise grain in alternate directions to form plywood. All layers are glued together with synthetic resin that provides a very secure bond.

7.2.Material Comparisons

Wood products can be finished in three ways. First finishing method is painting and varnishing. Special attention should be paid to the quality of the paints and varnishes that are used for children's furniture. Second one is the veneer, as a thin slice of wood, it should not be used in moisture environments.

Third one is the plastic laminate which is combined of thin layers of paper coated with melamine, impregnated in synthetic binder and binded together. Particular attention should be given to the preservatives used, their type, toxicity, and flammability. They should conform the standards of the European Union or an equivalent country

The other material besides the wood is metal. Metal structures are avoided for safety reasons in children bedroom environment. The use of metal is restricted to some minimum structural elements or details of finishes in low risk zones, such as the legs of the bed and hinges of the storage units' doors. Metal parts need to be checked for sturdiness. The surface areas should be polished smooth and be free of any sharp burrs or bits of metal (Kayasü, 1998).

Plastics are one of the synthetic materials used in the children furniture. They are sturdy, durable, light in weight, interesting in texture and can be in many colors. On the other hand, they are very flammable and not very good for hygiene since in time dirt gets into their body (Robertson, 1990). Many types of forms and textures can be given to plastics with different manufacturing techniques used specially for plastic production.

As the last one, textiles are used in the manufacture of children bedroom furniture. The basic requirements for the various fabrics that are selected differ, because each one will be used under a different set of conditions. Therefore, it is important to know how a fabric will be used in order to select one that has the most appropriate properties.

The textiles can be distinguished among four areas: fibers (like cotton, silk and wood), construction methods (like weaving and knitting), the application of colors and patterns (like dyeing and printing) and finishes (waterproofing, shrink resistant and flame retardant). Since the users are the children, they should be durable to washing and fading.

Shrinkage percentage should be in minimum level (Stepat-De Van, 1980). Furthermore, for all of the material quality, ISO Standards states that all material used for children's furniture shall be visually clean and free from infestation. The materials shall be assessed visually by the unaided eye rather than under magnification (ISO 8124-1:2000).

Fig. 3.0 - Wood & Steel as material

8. 3D Modelling

8.1. Concept Modelling

Modelling &, which enables designers to reflect on their design activities and explore the design space, while taking into consideration aesthetic, ergonomic, market and production issues. In other words, modelmaking and prototyping is a way for designers to explore form, composition and functionality from idea to detail design.

Models and prototypes can be described as a "designer's multi-dimensional expression." This means that designers can use models and prototypes to express their ideas in accurate and precise manners to others. (Kojima, 1991). Similarly as "a picture tells a thousand words", "prototypes are worth a thousand pictures". (Kelly, 2001). Kelly also mentions in his research that prototypes are wonderful tools for understanding tangibility.

Model 01 - Wood Material

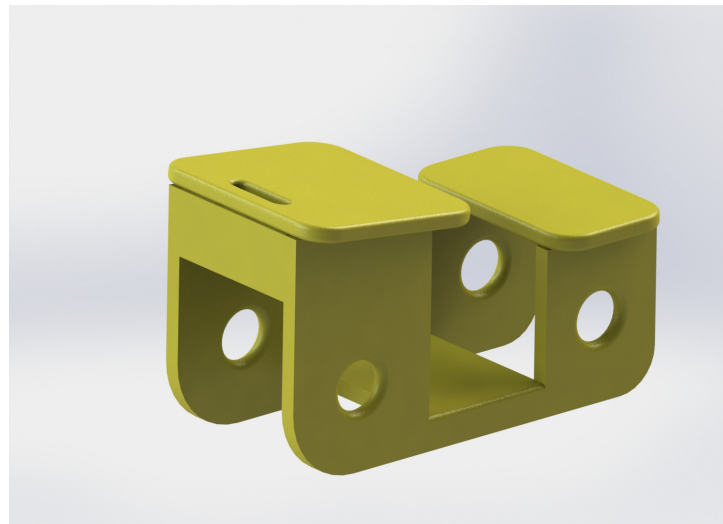First visualtion of the one of the concepts

Fig. 3.1 - Wood Model 01

Fig. 3.2 - Wood Model 02

Model 02 - Wood Material

Model 01 - Plastic Material

Fig. 3.3 - Plastic Model 02

Model 02 - Wood Material

Fig. 3.4 - Plastic Model 01

8.2. Solidwork As Modelling tool

The SOLIDWORKS® CAD software is a mechanical design automation application that lets designers quickly sketch out ideas, experiment with features and dimensions, and produce models and detailed drawings.
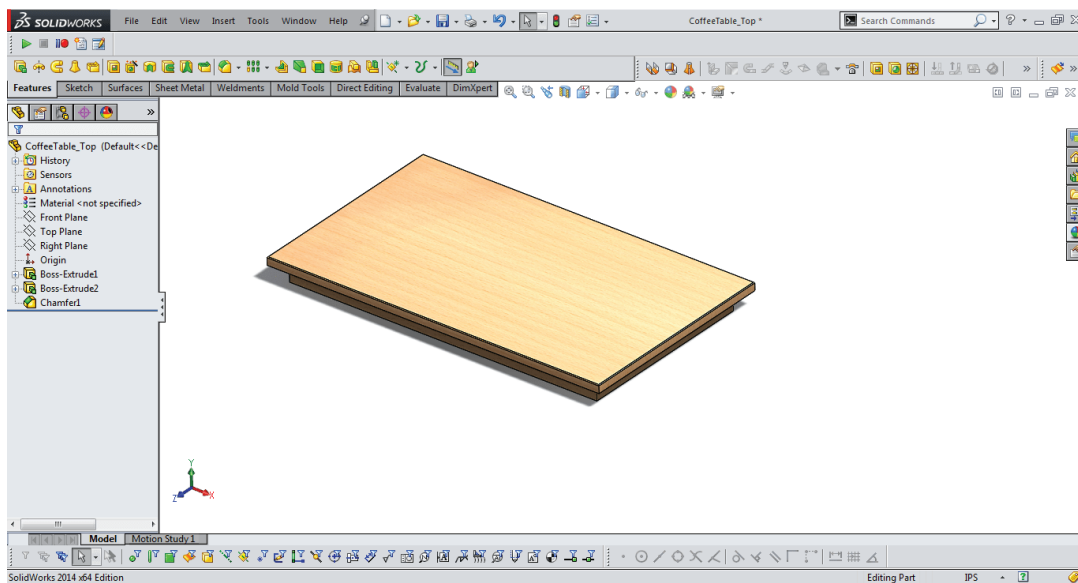
Fig. 3.5 - Solidworks Interface

SOLIDWORKS Industrial Designer is a concept design tool for quickly generating multiple industrial design concepts with unique tools for creating, manipulating, and modifying designs using native and imported geometry.
It provides all of the capabilities of other sketching and surfacing packages without their limitations. The software has allowed us to cut design time by 60 percent, which gives us time to create more concepts

9. Prototype Making

9.1. Furniture Calculations

In the furniture making, the correct measurment with respect to anthromopometric data of children is very important. So after understanding data for 3-6 year child and BIS standard for school furniture there are following calculations

Calculation of Seat

Seat Height = 0.25H (BIS H = 1016mm**)**

        25.4 cm = 10 inch

Seat depth = 0.25H (Ray H = 1113 mm**)**

        27.8 cm = 11 inch

 Seat width > Hip Breadth

Seat width = 10% addition from both side considering hip breadth

        = 1.2 X 22.8

        = 27.36 cm = 10.77 inch
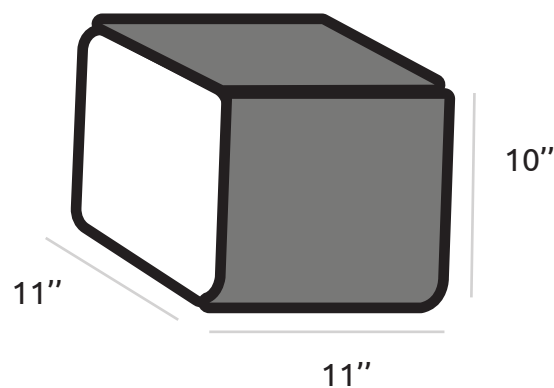
Fig. 3.6 - Illustration of seat box

Calculation of Desk

Desk Height = 0.41H (BIS H = 1016mm**)**

   = 41.65 cm = 16.4 inch $\approx$ 17''

Desk Width = 20 % addition from both side considering shoulder width

   = 0.3H X 1.28 (BIS = 1016)

   = 42.67cm $\approx$ 17''

Desk Depth = 0.41H (BIS = 1016)
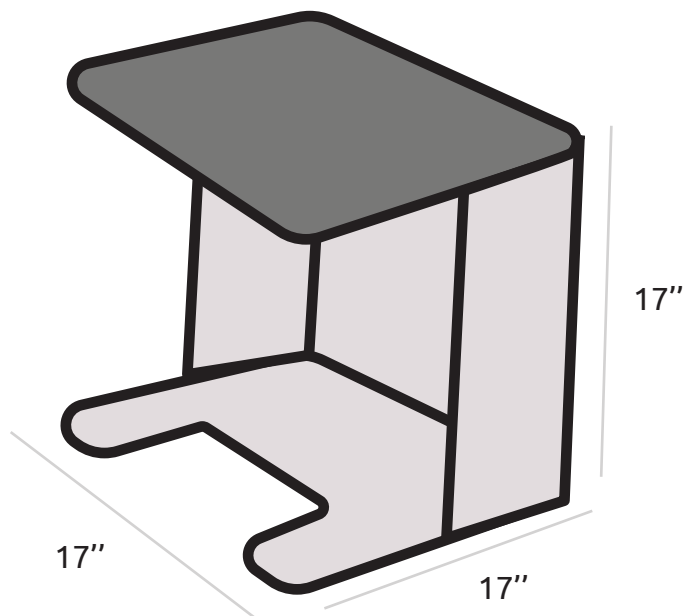
   = 41.65 cm = 16.4 inch

Fig. 3.7 - Illustration of desk

9.2. Making Process

Cutting & Binding

Fig. 3.8 - Making Process Step 1 & 2

Filing each piece

Fig. 3.9 - Making Process Step 2 & 3

Joining with glue & screw

Fig. 4.0 - Making Process Step 3 & 4

Finial finishing

Fig. 4.1 - Making Process Step 5 & 6

Final prototype of furniture

Fig. 4.2 - Wood Prototype

10. User Testing

User testing is most important of the prodcut to be manufactured. For the user testing age group was descided from 3-6 years old.

Fig. 4.3 - User Testing in school (1)

Fig. 4.4 - User Testing in school (2)

Fig. 4.5 - User Testing in school (3)

Fig. 4.6 - User Testing in school (4)

Fig. 4.7 - User Testing in school (5)

Fig. 4.8 - User Testing in school (6)

Fig. 4.9 - User Testing in school (7)

Fig. 5.0 - User Testing in school (8)

Fig. 5.1 - User Testing in school (9)

Fig. 5.2 - User Testing in school (10)

Fig. 5.3 - User Testing in school (11)

Fig. 5.4 - User Testing in school (12)

Fig. 5.5 - User Testing in school (13)

Fig. 5.6 - User Testing in school (14)

While doing test, children are very comfortable for writing, reading and taking their lunch. They are using it with ease and concentrate on task given in the class work. Furniture has been used with different orientations and arrangemants.

11. Conclusion

In Primary schools, there is absence of school furniture as medium to teach and learn things to children. Children use desks for sitting and writing in the classroom work. The classroom is not more than desks and cupboards as furniture in the schools. The space in the school are not designed for children to get comfort and playfulness.

Existing furniture is not made as per anthropometric measurement for pre primary-school children. Thus every school must check the school furniture as standard anthropometric measurement which will lead for children a comfortable sitting and increase inconcentration in the class.Anthropometric measurement data of each individual child should be compared to identify a match or mismatch between the students and the furniture. Healthy sitting culture and ergonomic issues are vital for reducing problems of school children.

After the field visit observations and child Development understanding,Furniture made out these is going improve their engagement in their learning activity. It leads to a strong foundation for intellectual growth, creativity, problem-solving and basic academic knowledge in the children.

12. Future Scope

This furniture is very helpfull to school where learning and teaching methodologies are very seriouly followed and implemented. The market does have the furniture having all three aspects of visual, Technical and logical in the furniture. This will going to help the children to improve their social, cognitive, physical and emotional development.

There is huge potential markets for the such type of furniture But there requirement making more test on the initial prototypes of furniture in the schools. Those feedback are very important to improve the feasibilty of the product.

Hence School and classroom can be filled with fun and playfull environment to improve the overall devlopment of Children.

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