CREATIVE AID FOR SCHOOL CHILDREN

PRODUCT DESIGN
PROJECT- III

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Submitted in the partial fulfillment of the requirements for the degree of

Master of Design
in
Industrial Design

Industrial Design Centre
Indian Institute of Technology
Bombay

November 2002

APPROVAL SHEET:

The Product Design Project-III titled **"Creative Aid for School Children"** by **Muralidhar K 01613005** is approved as a partial fulfillment of the requirements for Post Graduate Degree in Industrial Design.

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ACKNOWLEDGEMENT:

I would like to express my gratitude to my guide, **Prof . Athavankar** for guiding me through the project at all levels and at all times.

To my Parents who are always by my side.

My thanks to **Mr Vijoy Prakash, APCL Patna** for his valuable guidance whenever required.

I would like to thank my young friends **Akshay, Sagar, Gayathri** and their **parents** from the IIT Bombay campus for giving me their precious time and feedback all along the project.

I would like to thank the students, teachers and authorities of
The Kendriya Vidyalaya, IIT Bombay
The Municipal School, Thana
Campus school, IIT Bombay

My thanks to the entire studio **staff** in IDC who have extended their support at various capacities during the project.

To Ritu, my ardent critic for criticizing my work and giving feedback regularly.

My regards to all my friends whose invisible hands have helped me during the different stages of my project.

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PART - A

"The very essence of the creative is its novelty, and hence we have no standard by which to judge it."

Carl R. Rogers, On Becoming a Person

Initiate a learning process where standard parts are assembled to obtain known results with defined learning objectives. The process thus triggering a creative process of combining standard and non standard parts to obtain open-ended results bringing in new learning objectives

1.1 - INTRODUCTION:

"Spoon feeding in the long run teaches us nothing but the shape of the spoon."
-E. M. Forster

In our present educational system maximum importance has been given to the bookish way of learning (i.e., the manipulation of 26 alphabets and 10 numerals).

The interaction between the bookish knowledge, the reality in the environment and the self form the basis for a creative experience. The ability of the child to question, to find form and order, to rethink and restructure and find new relationships with knowledge at hand needs to be encouraged.

Optimal reading occurs when it is fun and the individual is challenged to the limits of ones abilities. This state occurs when the challenge is matched to the child's knowledge and skills.
Every kid must be taken to the optimal level of challenge, regardless of skill. Kids become winners when we enable differentiated learning, thus overcoming the traditional gap of 'winners' and 'losers'.

1.2 - SCOPE OF THE PROJECT:

'I hear and I forget. I see and I remember. I do and I understand'.
- Confucius

The project aims to

- To kindle and promote the natural ability of child to search discover and experiment.
- To aid the child to realize, that one can change and manipulate his environment to create experiences, both new and known ones.
- To get hands on work experience by making things with various materials.
- To clarify and apply theoretical knowledge gained in school.
- To open up new avenues to utilize the time available in the school setup. (Work education and art classes).

Scope of the project:

To design creative aids for school children of age 12 + years so that learning becomes a hands-on, enjoyable and self taught experience. The aid is aimed as a means for kids to work with and manipulate various materials and components which they can relate to their day to day activities like play, games, hobbies and academics.

Define learning objectives: Learning objectives from a particular aid is defined which can be situations/ products taken from the kid's day-to-day scenario, academics, etc.

Design is carried out to fulfill the learning objectives, the number and type of known results to be obtained, the components and materials to be provided etc are decided and testing of the device is conducted with the kids. The results obtained from the tests are directly taken as a feedback for redesign or to redefine the learning objectives.

2.0 - NCERT CURRICULUM AND THE PROJECT:

(1) Acquisition of tools of formal learning, namely, literacy, numeracy and ***manual skills***

(2) Acquisition of knowledge through observation, ***study and experimentation*** in the areas of social and natural sciences.

(3) Development of physical strength and team- spirit through sports and games.

(4) Acquisition of skills for planning and executing socially useful productive work with a view to ***making education work-based.***

(5) Acquisition of skills of ***purposeful observation***.

(6) Acquisition of habits of cooperative behavior within the family, school and community.

(7) Development of ***aesthetic perception and creativity*** through participation in artistic activities and observation of nature.

The objectives of school education of the NCERT framework clearly mention the need for learning manual skills, observation, experimentation and the necessity to develop aesthetic perception and creativity.

Following is the Time Allocation Per week for classes VI and VII according to the NCERT framework

1) Languages	7 hours
2) Mathematics	4 hours
3) History, Civics and Geography	4 hours
4) Science-An Integrated course	4 hours
5) The Arts (Music, Dancing, Painting)	**3 hours**
6) Socially Useful Productive work and Community Service.	**6 hours**
7) Games, Physical Education and Supervised Study.	4 hours
Total	32 hours

Work Education may be described as purposive, meaningful, manual work resulting in either goods or services, which are useful to the community.

Purposive, productive work and services related to the needs of the child and the community will prove meaningful to the learner. Such work must not be performed mechanically, but must include planning, analysis and detailed preparation, at every stage, so that it is, educational in essence.

Adoption of improved tools and material, where available, and the adoption of modern techniques will lead to an appreciation of the needs of a progressive society, based on technology.

The purpose of demarcating a distinct curricular area, as Socially Useful Productive Work is to emphasize the principle that education should be work centered, as the concept of Socially Useful Productive Work is to be developed in the light of Gandhian philosophy of Basic Education, in and through work.

2.4 - NATIONAL CURRICULUM FRAMEWORK - INFERENCES:

Referring to the National Curriculum Framework for School Education- November. 2000*(refer annexure);* some of the keywords can be adapted from the objectives of work education (SUPW),Art Education to obtain clues and guidelines for the proposed creative aid.

The key words obtained from the curriculum are

- The understanding of facts and principles involved in various forms of work.
- Purposive and meaningful manual work.
- Gain new perspectives through hands-on experiences.
- Active involvement with content, and not imitation or memorization of the material.
- Opportunities for peer collaboration and support.
- To carry out strenuous work involving higher skills and requiring closer neuro-muscular-coordination.
- To be based on observation, manipulation and work practice.

The key words shows the basic necessity for involvement in manual work and doing things with ones own hands, developing fine skills and work practice and stresses the importance of working in a group and building teams.

- Sensitivity to composition, attention to nuance, the exercise of imagination and the development of balance and harmony.
- Respond to the beauty in line, color, form, movement and sound.
- Handling of the materials for drawing, painting, collage, clay modeling and construction of puppets; creating artistic things by free expression method and specific topics method;
- Theater arts and dramatization may be suitably introduced.
- Emphasis should be laid on the use of learner's own imagination and development of his/her own concepts and expression through exploration.

The above clues point out other opportunities available in the curriculum for the creative aid to be used which include the subjects like art and craft classes.

PART - B

3.0 - CHILD PSYCHOLOGY:

3.1 - CHARACTERISTICS OF THE AGE GROUP:

Children in the age group of 12 + years have been selected as the target user group for the project.

Following are the keywords obtained from the characteristics of the age of reasoning or the gang age which gives a better insight of the target group.

- Children become **increasingly critical** of their own products.
- The kid is very particular about how he **appears to others.**
- Ability to **work in groups** .
- This age demand **constructive outlets.**.
- Stimulate the child's thinking .
- Children improvise on their own account combinations of materials that need not necessarily serve a useful purpose.
- Have a **meaning** in the life of the child.
- Increasing **social independence** from adult domination.
- Greater awareness to **detail.**

The teenager in this age becomes very critical of himself and about what he is doing. He is bothered about finishing a job rather than worrying about whether the work done was original or creative. The kid always identifies himself with objects that have a meaning in his life.

3.2 - STAGES OF COGNITIVE DEVELOPMENT:

"To present an adequate notion of learning one must first explain how the individual manages to construct and invent, not merely how he repeats and copies."

-Jean Piaget

Piaget identified four stages in cognitive development (refer annexure)

1 Sensorimotor stage (0-2 years)
2 Pre operational stages (2 – 7 years)
3 Concrete operational stage (7-12 years)
4 Formal operational stages (12+ years)

Since the project deals with the age group of 12+ years, the characteristics of the formal operational stages are mentioned.

Young people, no longer depend on the 'concrete' existence of things in the real world. Instead they can deduce conclusions from the abstract statements. They also reason in terms of verbally stated hypothesis and also to consider the logical answers from several possible solutions in a systematic manner. He can manipulate mathematical concepts like angles, ratios and trigonometric functions.
The above mentioned characteristics of the teenager of this age are important to device the learning objectives for the creative aid.

http://chiron.valdosta.edu/whuitt/col/cogsys/piaget.html

3.3 - DEVELOPMEANTAL STAGES IN ART:

It is important to know development of the child's artistic abilities (refer annexure), because it becomes one of the important ways he expresses himself. Following are some of the observations made during the interaction with the kids

- The teenager is very careful about what is being drawn.
- He pays a lot of attention to fill in details in his drawings.
- Always subjects familiar and liked by the kid are preferred if no subject is given for drawing.
- They have a keen sense of observing details like graphics etc.
- Color preferences are most explicit in their drawings but are very careful while using in their drawings.
- Some of the kids tend to include abstract images of real life objects like birds etc.
- Kids attempt to draw images in perspective.

Psychologists for learning have generated various theories. Five such theories are briefly described whose researches are mainly concerned with children's learning. They are

- Piaget's theory of learning
- Vygotsky's theory of the zone of proximal development (ZPD)
- Skemp's 'theory of learning'
- Jerome Bruner's 'Theory of Instruction' and 'Constructivist theory'
- Dienes 'theory of learning'

Important points which concern the project from the above theories are reffered and adopted during the design process.

PIAGET'S THEORY OF LEARNING:

From the Piagetian standpoint, children learn from actions rather than from passive observations; for example, telling a child about the properties of materials is less effective than creating an environment in which the child is free to explore, touch manipulate and experiment with materials.

The young mind at this stage is constantly forming and refining concepts. The teenager finds the information pouring in from a lot of sources around him like books, school, and conversation with parents, friends, television, internet etc.

Smith K Peter, Cowie Helen, Blades Mark, Understanding Childrens Development, 3rd edition, 1998, Blackwell publications, USA

VYGOTSKY'S ZONE OF PROXIMAL DEVELOPMENT (ZPD) THEORY

According to Vygotsky, ZPD is the distance between the child's actual developmental level and his or her own potential level of development under the guidance of more expert adults or in collaboration with more competent peers.

The intervention is in its most effective when it is contingent upon the child's existing repertoire of skills and knowledge. This makes it clear that a new intervention when made has to be within the child's existing knowledge which includes his academics, exposure to books, TV and other media.

As far as the project is concerned Vygotskys theories gives some important clues for design. They are

- Children learn from other people who are more knowledgeable than themselves. This point is very important for the teenager (12 + years) because this is the age he mingles more with friends and forms gangs where a lot of interactions happen.
- When a child's level of understanding is deliberately challenged (but not challenged too much) then he or she is more likely to learn new things effectively without experiencing failure. The above clue is very important because unless the teenager gets a challenge from the activity what he is doing, getting to the next step would be discouraging to him.

Smith K Peter, Cowie Helen, Blades Mark, Understanding Childrens Development, 3rd edition, 1998, Blackwell publications, USA

SKEMP'S 'THEORY OF LEARNING':

British psychologist Richard Skemp introduced the idea that concepts constructed by humans form a hierarchy viz. Primary, secondary, tertiary and so on. For example car, bus, lorry are primary concepts. Automobile is a secondary concept.

For a young person to learn about say a tent the primary concept will be a circus tent or a tent in the Scout camp. Triangular tent or a circular tent is the secondary concept or second level of learning. The triangular tent is a combination of two triangles at ends joined at its vertices by straight lines is a tertiary concept.

This concept of forming hierarchy by human lends itself well into the growth of a creative aid with that of the teenager. As the teenager goes from one level of learning to another he has to discover different levels of primary, secondary and tertiary cocepts by using the aid.

Smith K Peter, Cowie Helen, Blades Mark, Understanding Childrens Development, 3rd edition, 1998, Blackwell publications, USA

BRUNER'S 'THEORY OF INSTRUCTION'

Central to Bruner's thinking is the conviction that the process of learning is the same whether we are talking about the pioneer at the frontier of knowledge or the child engaged in making a construction of wooden blocks.Bruner's theories can be explained well with his concept of spiral curriculum.(refer annexure)
This concept can be seen in the school curriculum where a single concept for example in geometry thought in one grade is again repeated as a more complex chapter in another grade. In any learning method the type of incrementality mentioned above has a very important place.

The teacher should motivate them by giving them an idea of what they will be able to achieve with their new knowledge. This point can be well utilized in the system by using the creative aid in SUPW or the art class where the teacher is the main motivating force.

With a proper structured knowledge within a proper sequence if the children discover for themselves what is beyond it and how to do it- nothing more is reward able and motivating than this intrinsic satisfaction. Here proper means the principles and concepts of a particular subject to be taught or to be understood, must be relative and related to the needs of the learners.

The idea of motivation and reward is very important because when the teenager sees the positive results of his actions his is motivated to go to next level. The use of current / past knowledge means that the teenager recalls and applies to an activity, the previous skills and knowledge he has learnt or come across.

http://www.artsined.com/teachingarts/Pedag/Constructivist.html

DIENES 'THEORY OF LEARNING'

Zoltan Dienes theory of learning is a process of an increasingly intricate play. He says that these plays are of two types- primary play and secondary play.

Primary play is the activity with materials aimed at gratifying immediate desires or instincts. It involves the manipulation and investigation of materials for its own sake.

Secondary play is the activity performed with awareness, aimed at an end, which is beyond the immediate gratification of desires. This involves trying to build with the materials, discovering patterns or regularities and forming abstract conjectures or rules concerning the patterns found.

4.0 - INTERACTION WITH CHILDREN

The interaction with the end-users, the children has been happening right from the beginning of the project. In the initial stages interaction took place with 30 kids with varying intersets and different family and socio-economic back ground. The interactions focused mainly on their interests, hobbies and other extracurricular activities in school and at home.

The children whom interaction happened are from three schools namely Kendriya Vidyalaya, IIT Bombay, campus school- IIT Bombay and Municipal School, Thana. Speaking to the children happened in the school and also at their home, which helped to get closer to them, and understand them better. This also gave an opportunity to see and know about their hidden interests and activities which many of them were kept hidden during the interactions in the school.

Some of the important observations made during the initial interactions with the teenagers are

- Most of the children have varied hobbies and interests, which are usually not shared with many people and they remain hidden.
- Teachers play a major role in the type of activity the kid takes up in academics or extracurricular activities
- The child is greatly influenced by the peer group, which influences his choice of games and other activities.
- Computers and Internet have altered the interests of kids to a great extent. Virtual games have taken up a major time from the physical activities.
- Children like to show off their achievements.
- Academic books play a major role in deciding the extracurricular activities of children.
- The content in the acadaemic books decides the topics the teenagers choose for the science exhibitions, competitions and other extracurricular activities

"To invent you need a good imagination and a pile of junk."
-Thomas Alva Edison

The initial interactions with the kids lead to some insights for the design intervention

- The device should allow for use by maximum number of children.
- The device should allow or facilitate customization by the users.
- The child should be able to relate to or use the academic knowledge in the device.
- Device should lead to the creation of a knowledge base.
- Device should need minimum guidance from parents and teachers
- Device should help the kid to respond to real life situations.
- Graphics in the form of product name/ brand should be prominently part of the device.

"I will make the boat by splitting a plastic cup into two, join them towards the mouth and write 'TITANIC' on it"
– A kid during the interactions.

- Device should give a sense of accomplishment or achievement after every major or intermediate action.

The insights obtained during the interactions with the kids were used in the ideation process, which was simultaneously underway. The questions that arose at this stage were

The contents in the device and themes
The challenges offered by the device.

With contents and challenges as the criterion, a simple design problem like building a object was compared. The comparisons were made for building an object by making and building an object by assembling

Possible contents while assembling and building which include learning objectives, fun and academics are

- Basics of physics, geometry etc
- Getting to assemble objects of liking as the final product
- Learning Design fundamentals
- Object or solution for a school project or competition
- Planning, sequencing and the manual skill needed for assembling

Possible challenges assembling a particular object include

- Object may or may not have not have instructions to assemble—the unknown factor is a challenge.
- Assembling should be done with the components given— the constraint is a challenge.
- Assembling should be done within a stipulated time limit.
- In assembling and building is some kind of a result is always assured, e.g., in Meccano and Lego where the end result is known before starting the assembling

Assembling and building uses David Pye's concept of workmanship of certainty where the end result has been tried and tested before hand. In such a situation there are very little chances of failure when the kid is assembling the object

Possible contents while making and building include learning objectives, fun and academics. Apart from these making and building offers

- Choice for the kid to do his own thing rather than restricting to what the device offers.
- Visualize the object to be made and the materials and components needed.
- Training with the initial ways to work.
- Knowing and understanding the material.
- Search for the materials and components to be used—finding and searching the materials is a challenge.
- Making ones own components—challenge of the components going wrong.
- Assemble a particular component made by one — challenge of the assembly going wrong
- Personalize the object that is being made.

According to the constructivist theory by J. Bruner (refer annexure on child psychology) learning is an active process in which learners (children in this case) construct new ideas or concepts based upon their current/past knowledge. While making and building the child tries to build up from all of the previous experiences, the family, the environment, friends, teachers, textbooks etc as a routine way to go about doing things.

Making and building uses David Pye's concept of workmanship of risk where the end result is an open ended one where there are chances of failure. In such a situation there are more chances of expecting unexpected results while the kid is making the object.

The next level of interaction with children happened to find out the preferences of the kid about making objects or assembling them. This was done by posing a simple problem like 'Describe the process of making a box for your pebble collection'.
Cards were given to the child to write on and observed how they described the process. The level of detail and the number of steps taken in describing the process gave a clue to their preferences. The more detailed the description and the more number of steps shows the intention and aptitude of the child to go through those steps mentioned.

To get further insights into the likes and dislikes of kids, they were given cards with words written on them in a random order. The kids were asked to rank the words according to their preferences. The words included the child's preferences, priorities in

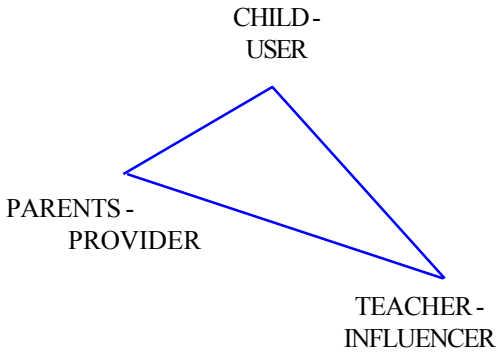
- Academics- the subjects at school
- Extra curricular activities
- Hobbies and interests

Some important insights obtained by this exercise are

- Kids who are interested in a particular subject in the school, necessarily does not mean they like the subject.
- Some kids like the subject because they score more marks in the subject.
- Some like a subject because they are not comfortable with another
- Most kids like a subject because the teacher is very good. This shows the role of the teacher in shaping the kids preferences about the activities to undertake both in school and otherwise.

Pye David, *Nature and art of workmanship, 1968*

4.3 - INTERACTION WITH PARENTS:



Parents complete the triangle of the user, influencer and provider, where the last role is taken by the parents. The other two being teacher as the influencer and the child as the user. Some of the insights obtained during the interaction with parents have been explained.

- When parents are buying games or toys for their kids they do not consider the price factor unless the product is beyond their affordability.
- When the toy/game is to be gifted to another kid they set a price bracket.
- Most of the parents interacted with took active part in their child's academic as well as extracurricular activities.
- Parents always cherish and show off their child's achievement.
- Some of the parents learnt the topics themselves before they taught their kids.
- Parents always act as a bridge between siblings.
- Parents are the best source to find out the likes and dislikes of the child.

Some of the views and insights obtained during the interaction with teachers are mentioned. The teachers interacted were from the Kendriya Vidyalaya, IIT Bombay, Municipal school, Thana and the Campus School, IIT Bombay.

- Most of the teachers do not consider work education and art and craft classes to be part of the main subjects.
- Teachers prefer that work education should be handled by a specialized teacher.
- Teachers decide and recommend the projects and activities to be taken up for both academic and non academic activities.
- Teachers provide the maximum support for the kids suggesting ideas, materials, procedures etc, for various activities other than academics.

The last point assumes great significance for any activity in general and work education in particular because after parents the kid believes and listens to the teacher the most. In most of the municipal schools where the kids are mostly from economically weaker sections, the support given by the teacher goes a long way in boosting confidence of the child.

Summary 4.1 to 4.4:

Chapters 4.1 to 4.4 can be summarized as

- Kids need a mix of assembling and making for any building activity to make it more participative and fun. The assembling activity can be the initiator and the making activity can follow once the kid is familiar with the device.
- Teachers and academics play an important role in the type of activity the kids take up, the subjects kids like etc.
- The peer group is one of the major influencer for kids to take up or wish to acquire a game/toy/device.

PART - C

5.0 - EXISTING PRODUCTS AVAILABLE IN THE MARKET:

Existing products available in the market were studied to find out the variety of creative aids available for the age group of 12+years

The search for the existing products was done by

- Visiting toy shops in Mumbai city
- Speaking with educationalists
- Searching the Internet.
- Attending Science exhibitions

The products available in the market can be grouped into

- The learning aids by assembling the components.
- Learning aids by building based on instructions
- Toy tools available for kids

Existing products searched were analyzed for the following criterion

The Challenges offered
Learning objectives
Special characteristics
What the product doesn't do

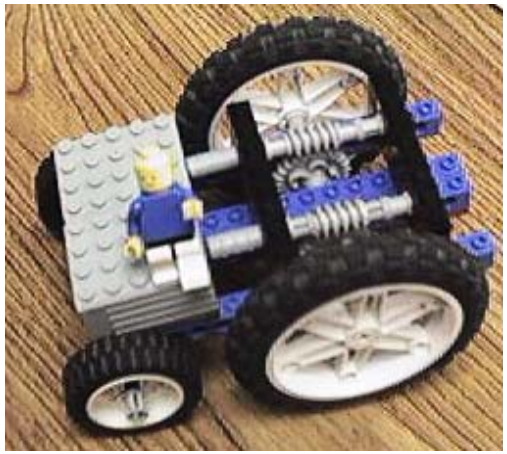
The products searched included

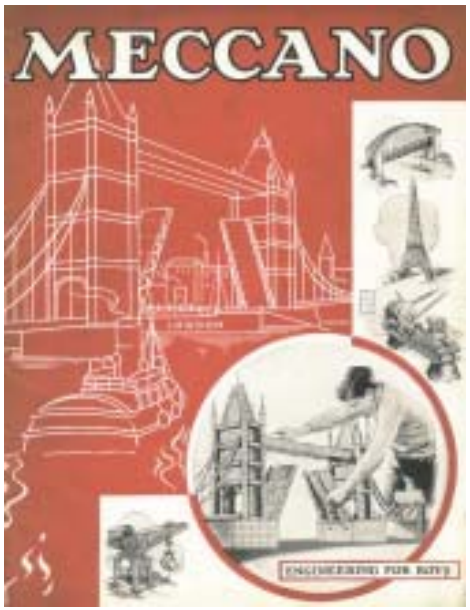
Construction kits

* Mechanical kits
* Architectural kits
* Electronics assemblies
* Robotic kits

Educational kits relating to academics

* Physics
* Chemistry
* Geometry





Construction kits are divided into categories based on the specific area of interest they cater to like Meccano, Erector, train building kits, Lego, Mechanix(Indian duplicate of meccano), Senior architect and Junior architect

The products assembled include the illustrated examples given by the manufacturer like automobiles, bridges, houses etc. Though most of the kits are designed specifically to obtain an end product, the components can be combined in different ways according to the imagination of the user.

http://www.geocities.com/Area51/Corridor/6981/TMG_files/history_files/meccano_early_years/meccano_the_early_years.htm

Special characteristics:

- Build models of 3 different bridge types - The Roman Arch, The Truss Bridge, and The Suspension Bridge.
- Contents: Landscape Base; Bridge Parts; Casting Compound, Molds, Scraper, and Sandpaper; Architecture Book, with instructions; Painting Guide; Non-Toxic Paints, Glue, and Brush; Sticks and Thread.
- 48-page Fact & Fun Bridge Architecture Book.

Learning objectives:

- Learn about how bridges work.
- Planning, sequencing.
- Improves manual skill in handling and assembling objects.

What the system doesn't offer:

- The system lacks variety.
- After the assembly of the three bridges there is no challenge left in the system.
- The looks of the joinery and details keep girls away from the system.

http://www.discoverthis.com/ourambrid.html

Mechanical kits are part of the building by assembly kits in which different mechanical parts like pulleys, gears, motors etc become part of the assembly.

The mechanical parts may or may not be part of the standard accessories given by the manufacturer.

Frank Hornby devised Meccano in the year 1901.

Meccano is a miniature engineering construction system consisting of Angle Girders, Strips, Plates, Flexible Plates, Brackets, Pulleys, Gears, Axles.

Special characteristics

Uses familiar joinery details using nuts and bolts

Modular parts in the system are perforated at 0.5 inch (12.5mm) intervals, enabling very strong small or large assemblies to be made.

Most of the components in the system all available separately.

No special tools required.

The system can reproduce almost any type of engineering structure or mechanism.

Learning objectives

Real life and abstract objects can be assembled.

Teaches about engineering structure or mechanism.

Planning, sequencing.

Improves manual skill in handling and assembling objects.

What the system doesn't offer

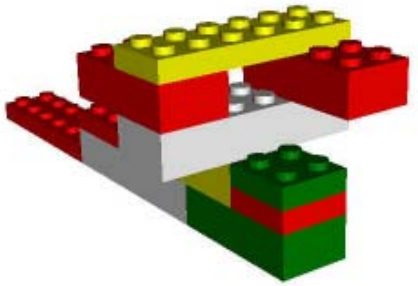
Fixing details are very prominent and look unnatural on the scale of the object assembled.

The looks of the joinery and details keep girls away from the system.

http://www.geocities.com/Area51/Corridor/6981/

Ole Kirk Christiansen, master carpenter and joiner,founded LEGO in the year 1932. LEGO is from the Danish words "LEg GOdt" ("play well"). In Latin the word means "I study" or "I put together".

The LEGO constructopedia uses the Lego brick features to its mechanicals like motors, gears , pulleys etc.



Special characteristics:
System comprises of a set of interlocking components and subsystems.
Grows in complexity with addition of components to old ones.
The joinery and appearance of the components makes it popular with both boys and girls.

Learning objectives:
Can learn about various mechanisms.
Visualization, planning and sequencing .

Challenges offered:
Adapting standard components to assemble different objects.
To obtain variety within the standard details .

What the system doesn't offer:
System details does not encourage the use of external components.
System does not involve making.

http://www.lego.com/eng/play/

THE ERECTOR:

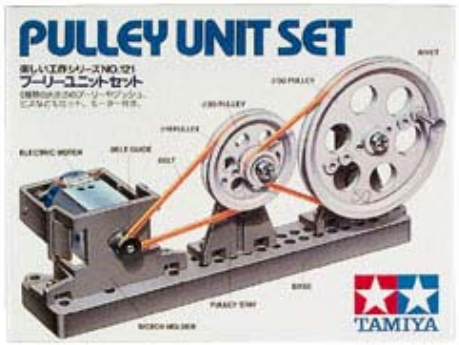
The ERECTOR is another system, which has a lot of mechanical parts in it, which assembles products like Cranes, Excavators, Dumpers and the like. The main attraction of Erector for kids is that it looks like real and functions like the real one but in a smaller scale.

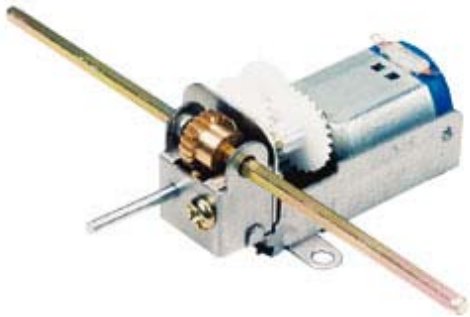
What the system doesn't offer

Very western in nature.

Difficult to make the system culture specific.

: www.legacystation.com/ Erector.htm

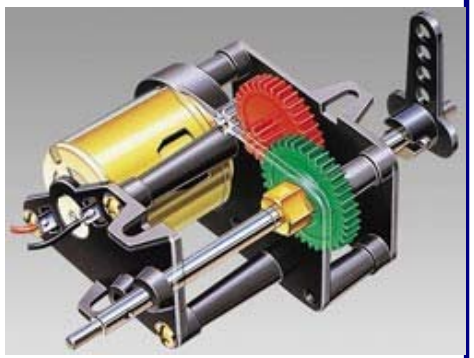




Special characteristics:

The units can be adapted to various objects as per necessity.
The components and subsystems are available separately.

Learning objectives:
Learn about different mechanisms individually and to combine them.
Develop manual and technical skills in combining components.



Challenges offered:
Combining different components and make them work.
Integrate individual components with the whole.

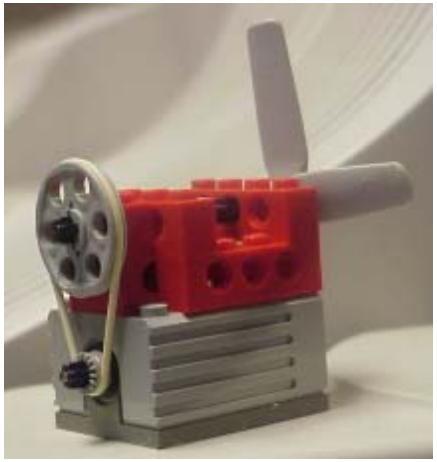
What the system doesn't offer:
A project or an initiator is necessary for the product to be used.
Novice users cannot use the components.

http://www.traintownhobbycrafts.com/10%20Models/product/Modeling%20Information.html

Electronics kits include assembly kits in which various circuits are pre-assembled as components e.g. Logiblocs, or available as individual components which the child has to assemble on a given platform as per instructions.

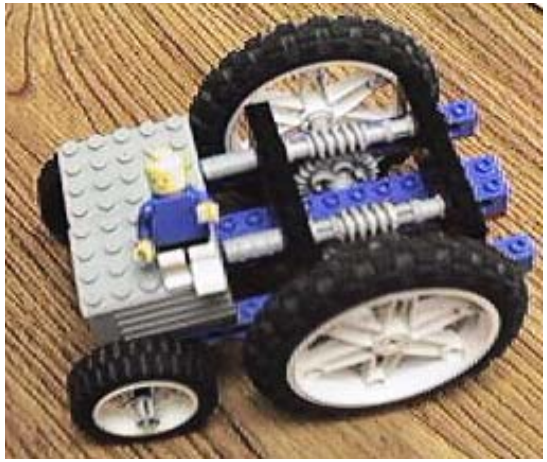
The kits include DIY books like Easy-to-do Experiments by Pustak Mahal.

http://www.childrenstoybox.com/Educational_Insights_LogiBlocs.htm#EDU3674



Robotic kits: these kits are available in various combinations and complexities of assemblies and functions. For example some of the kits developed by Lego allow the teenager to stretch his imagination by providing components with which programming can be done for the desired product to perform the functions needed.

RCX™
Microcomputer



Special characteristics:

Lets the user design and program real robots to do things as per the programming.
The features include RCX™ Microcomputer which controlls the entire system.
The system can use all other LEGO components.

Learning objectives

Learn about working principles of commonly used electro-mechanical devices.
Improves coordination and understanding of elctromechanical skills.
Visualization, programming and sequencing.

Challenges offered:

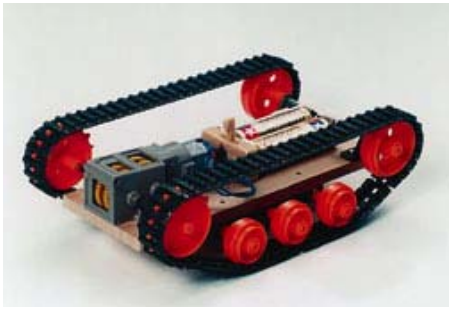
Using the basic components or subsystems working models of complex systems can be achieved.
Coordination between the programming (software) and hardware to make the system work.

What the system doesn't offer:

The user is required to have prior programming knowledge.
The system looks visually complicated.

http://mindstorms.lego.com/eng/products/ris/index.asp

TAMIYA VEHICLE KIT :



Tank Tracked Vehicle Chassis Kit

This is a Tank Tracked Vehicle Chassis Kit from Tamiya. It's for very experienced model builders.

Kyocera Blue Eagle Assembly

The Solar Powered Kyocera Blue Eagle Assembly Kit from Tamiya.
State of the art solar technology in a miniature sized model.

Special characteristics:

Scaled down working models of popular products or devices.
Available as a set of components and subsystems.
Uses miniature versions of the real mechanisms.
Customization available in the form of painting the components.

Learning objectives:

Understanding the working mechanisms of various objects by assembling the real one.
Improves coordination and understanding of assembling elctromechanical components.

Challenges offered:

Planning and sequencing is crucial.

What the system doesn't offer:

Boredom after finishing the assembly.
Multiplicity is not possible with the same components.

http://www.traintownhobbycrafts.com/10%20Models/product/Modeling%20Information.html

Some of the insights obtained by analyzing the existing products are

- The products to be made should possibly be scaled down working models of popular products or devices.
- Use miniature versions of the real mechanisms.
- Multiplicity of use should be possible with the same components.
- The system should look visually finished.
- The system should lend itself to be made culture and context specific.
- System should encourage the use of external components.
- System should involve making to a certain extent.
- The looks of the joinery and details should be compatible with both boys and girls.

The project involves the design of a creative aid for school children to fulfill the learning objectives through active participation by making and assembling model objects of everyday use and occurrence.

Target users:

The target users for the product are school children of the age group of 12 + years or VII th standard upwards.

Essential objectives:

- Help children understand working principles found in day-to-day products and situations by making and assembling models.
- To make children familiar with the basics of fabrication in different materials.
- To develop sensitivity towards handling tools and hand work.

Desirable objectives:

- To develop and provide opportunities for team work including boys and girls
- To provide opportunities for the child to develop ones own aesthetic sensitivity.
- To develop sensitivity towards culture specific activities.

Guidelines to fulfill the objectives:

- The aid has to initiate the kid into the learning process and go through the initiation process through ease and not put him off.
- Effort to be made so that both boys and girls should be able to use the aid.
- The design should throw challenges to the kid but avoid situations that may make him fail.
- The device should allow the kid to personalize so that the kid can show off.
- The kid should be able to relate the creative process or the end product to real life situations, e.g, when playing with a parachute the kid must try to learn about the properties of air, understanding the basic mechanisms in an automobile while assembling a car.

The product will be in the form of

- A set of common standard components.
- A set of specific components resulting in various end products.
- A set of materials/ information to prompt the kid to try out unknown, open-ended product configurations.
- Complete instructions about how to use the components.
- Complete instructions about how to create known products.

The product is to be put forward as a marketable proposition so as to fit within the existing system of the **CBSE** Curriculum. The product is to be worked out such that it can be targeted as both self owned, to be given as a gift item or to be owned by the school. This can be achieved by the type of materials and manufacturing techniques used.

Safety features:

The product has to consider the following safety features when it is being used.

- Use of electric power from mains is to be avoided.
- Use of toxic and hazardous materials to be avoided.
- Proper storage facilities to be provided for storing the device when not in use.
- Care to be taken to design components to avoid accidental injury.
- Instructions to be provided for the proper use of tools and materials

Creative activity for the kid can be

To make things work
To make something new
The proposed design intervention for a creative aid has to offer both steps 1 and 2 in the same order
Step-1 will be the initiation stage where the kid will recreate the process as instructed.
Step-2 is where the kid will apply the knowledge what he has learnt in step-1 and obtains an open ended product.

As a prerequisite to the concept generation following data regarding kids of the age 12 + years were collected. Most of the data mentioned has been obtained while interacting with the kids

Objects kids can make:
These include the objects kids make as hobbies, as school assignments, competitions, exhibitions, playtime with or without peer group and culture specific activities like festivals

List of tools used by kids:
The list helps to find out the familiarity of kids with using tools and various types of tools.

Objects kids like to show off:
Some objects kids like to show off are listed which include gifts, toys etc.

Materials used by kids:
Materials used by kids are listed down because kids use any material they can lay their hands on.

Products which throw challenges :
These objects are listed down because of their inherent potential to catch the attention and engage the kid to use the object.

These include the objects kids make as hobbies, as school assignments, competitions, exhibitions, playtime with or without peer group and culture specific activities like festivals

Mechanical

Mandap with lighting
Hydro-electric plant
Kandeel
Film projector
Lamps

Electrical

Boats
Airplanes
Wind mills
Conveyer belts

Stationary

Automobile models
Aero models
Furniture
Photo frames
Boxes
Periscope
Dart board
Paper Mache
POP casting
Clay work

Mobile

Mandap with rotating base
Automobile with movable parts
Kites
Propellers
Puppet making

Electro-mechanical

Motor boats
Remote controlled vehicles

During the interactions it was found that

- Kids modify everyday objects into tools when specific tools are not accessible. They usually get the information about these tools from their peer group and elders, e.g. the use of agarbathi for cutting thermacole.
- It was also found that kids like to use most of the tools what adults use except the power tools.
- They were not able to differentiate between specific tools of the same family e.g. Pliers of different profiles were seen to perform the same function.
- Kids have access to most of the tools adults use.
- There is a lacuna for some tools for kids whose presence can make a difference. They include tools for making holes and bending materials like wire etc.

Screwdriver, cutting pliers, forceps, Hammer
Agarbathi, Shaving blade,
Set squares, compass, divider, spanners, Scale,
Nails, screws, Bolts, nuts,
Scissors, Kitchen knife, Candles
Magnifying glass, Cutter.

During the interactions one of the important insights obtained is that kids like to show off their paraphernalia they like. These include objects

- At home include pets, gifts and presents, family photographs etc.
- From school are greeting cards, prizes, certificates, school bags, geometry box, objects kids make for competitions, dramas, exhibitions etc.
- From hobbies and play area include toys, games, cycles, collections like stamps, coins, cars etc.
- Kids like to show off only the best of their possessions or what they consider is an achievement.

7.3 - PRODUCTS WHICH THROW CHALLENGES:

These objects are listed down because of their inherent potential to catch the attention and engage the kid to use the object. Products throw **challenges** (refer annexure) in numerous ways which include curiosity, power, motion, and balance, elasticity, engaging etc. This is very important in case of a kid because the product has to catch the attention of the kid and engage him to use it continuously all by itself.

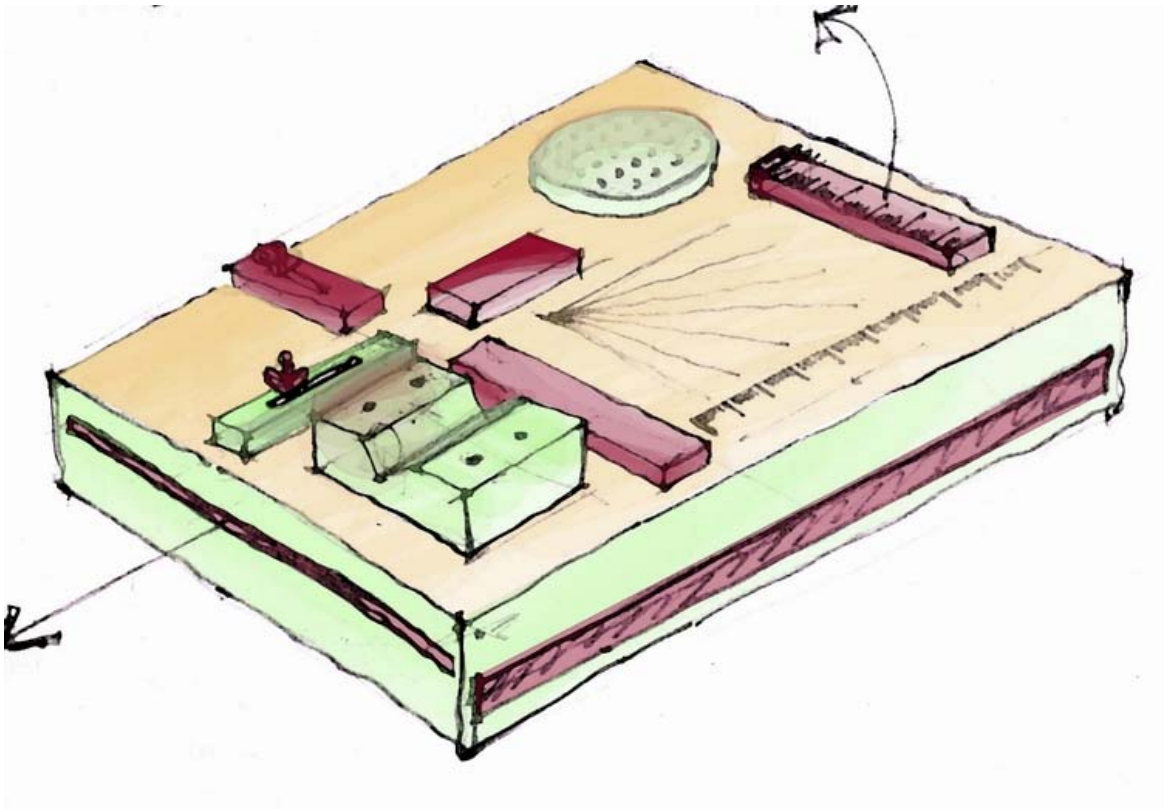
The objects in general include finished products, tools, and components

Finished products
Rubik cube- ***puzzle***
Combination lock- ***puzzle***
Skate board- ***thrill, movement, balance***
Scooter- ***thrill, movement, balance***
Yo-Yo with rubber band- ***engaging***
Magnifying glass- ***curiosity***

Components
Hinges- ***curiosity***
Magnets- ***engaging***
Rubber bands- ***engaging***
Springs- ***spring back***
Foams- ***spring back***
Gears, Pulleys, Motors- ***curious***
LEDs- ***eye catching***
Zippers- ***curiosity***

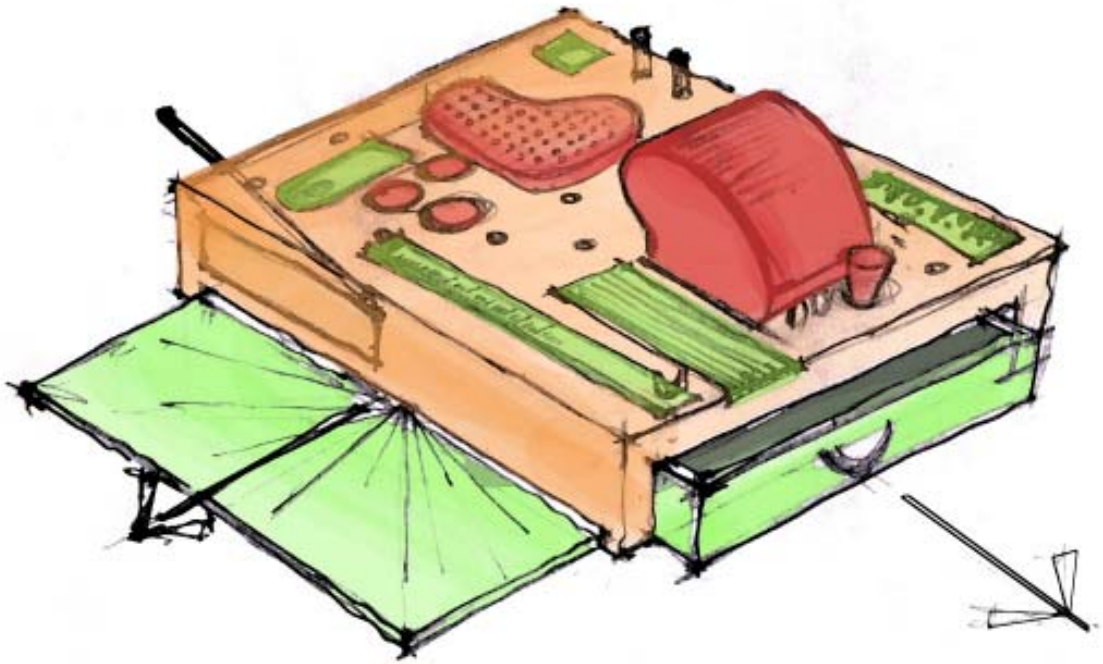
Tools
Weighing scale- ***curiosity***
Ratchet- ***curiosity, action***
Pliers- ***curiosity, action***
Soldering gun- ***power***
Drilling gun- ***power***
Scissors- ***cutting action***

The creative aid ideally should include all the three categories as a total system. The kids can be made familiar with various tools and also to use the components to come out with products of their own.



Initial ideations resulted mostly in the design of multiple use tools which help the kid to improve manual working skils. The making of objects with the materials that usually kids use was the priority. The insights for this were obtained during the initial interactions with the kids. These include

- Kids expect a result or feedback at every step while working.
- Kids are influenced by the work elders are doing, which pushes them to try that activity.
- Kids of this age group always work towards obtaining a finished job.
- The work done by kids is not always creative or original.
- They look for a finished job which they can show off.
- Teachers have a big impact on the activities they take up.
- Kids learn or pick up unusual techniques of working from their friends and elders e.g. cutting thermacole with an agarbathi..



The approach followed was to introduce kids to the basics of fabrication techniques. This was done by listing down the various materials kids use and the tools and techniques they use. The idea was to offer kids some tools and techniques by which the kids would be able get some unusual results e.g. bending of Thermacole sheets. Also the kids were to be introduced to proper working techniques like marking to scale, bending and shaping different materials, using and obtaining different angles, sanding etc

Some of the characteristic features of the initial ideations were

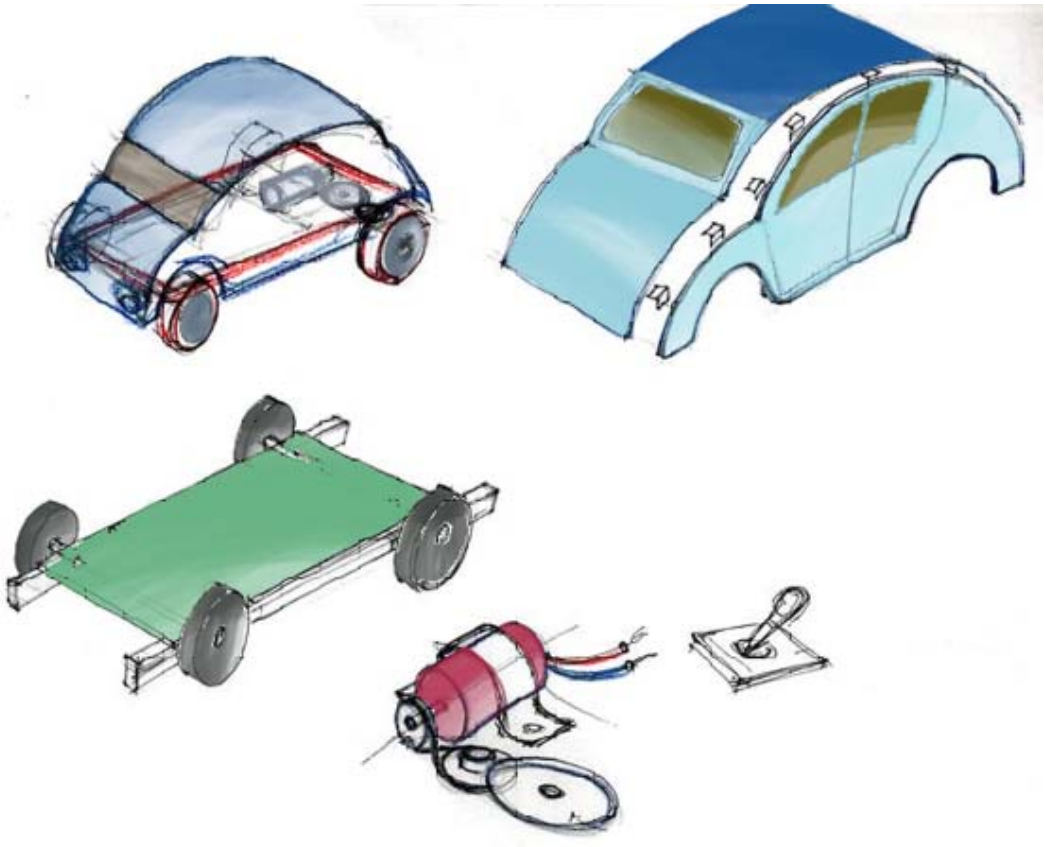
- Provision for bending different wires.
- Provision for cutting, marking and sanding.
- Device for heating and bending Thermacole.
- Storage space for templates, miscellaneous tools.
- Feedback in the form of light or sound when a particular action is performed right or wrong.

Of the above mentioned features the idea of bending wire and thermacole was further worked upon. The reason being that these ideas gave out interesting results out of commonly available materials and the ones frequently used by kids.

Some of the main disadvantages in the initial ideations(also refer annexure) of making tools were that none of the ideations initiated the kids into the activity. None of the ideas threw any challenges nor had an element of surprise or the reason for the kid to be involved in the device on his own. This involvement would happen only in case of an external initiator like the teacher, school assignments or a competition or an exhibition.

The concepts have been analyzed using the following criteria that were used to analyze the existing products in the market.

- Special characteristics
- Initiation
- Learning objectives
- The child's tasks or challenges
- What does the concept lack?



Special characteristics:

The system is a combination of components and subsystems.
Activities include making of components.
Components like shafts, wheels, platform and subsystems like motor, battery pack, gears etc.
Personalizing is possible by adding lamps, bumper etc by the kid.
Grows in complexity with the user.

Learning objectives:

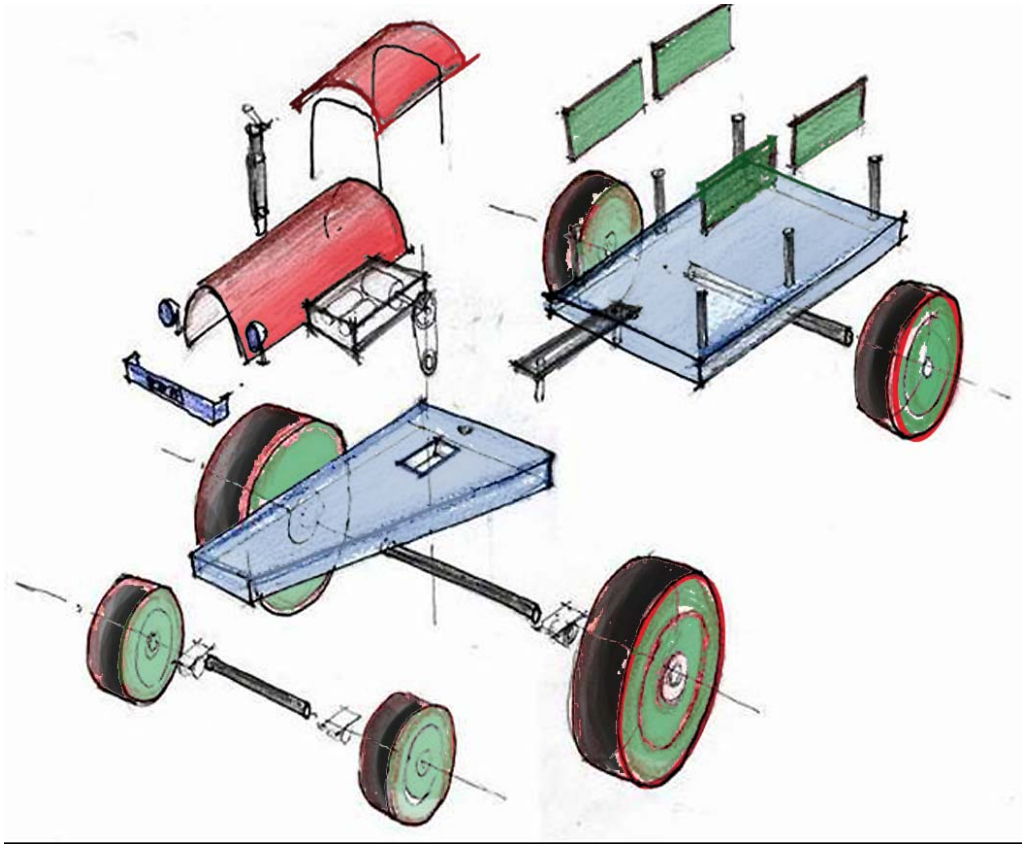
Assembling powerpack to the platform.
Developing surfaces and making components like head lamps etc.
Visualization, planning and sequencing.
Develop the aesthetic sensitivity in the kid.
Increase the manual skill for handling small components and tools.

The child's tasks or challenges:

Add personal elements.
Planning and sequencing is critical.
Increase complexity after initialization.

What does the concept lack?

Device will not be acceptable by girls.
Device does not relate to the curriculum.



Special characteristics:

Assembly of unusual vehicles like tractor trailer, road roller, dump truck etc.
Assembly can be made culture specific because of the image the tractor has in the country.
Components like shafts, wheels, platform and subsystems like motor, battery pack, gears etc.
Personalizing is possible by adding lamps, bumper, hood, exhaust etc .

Learning objectives:

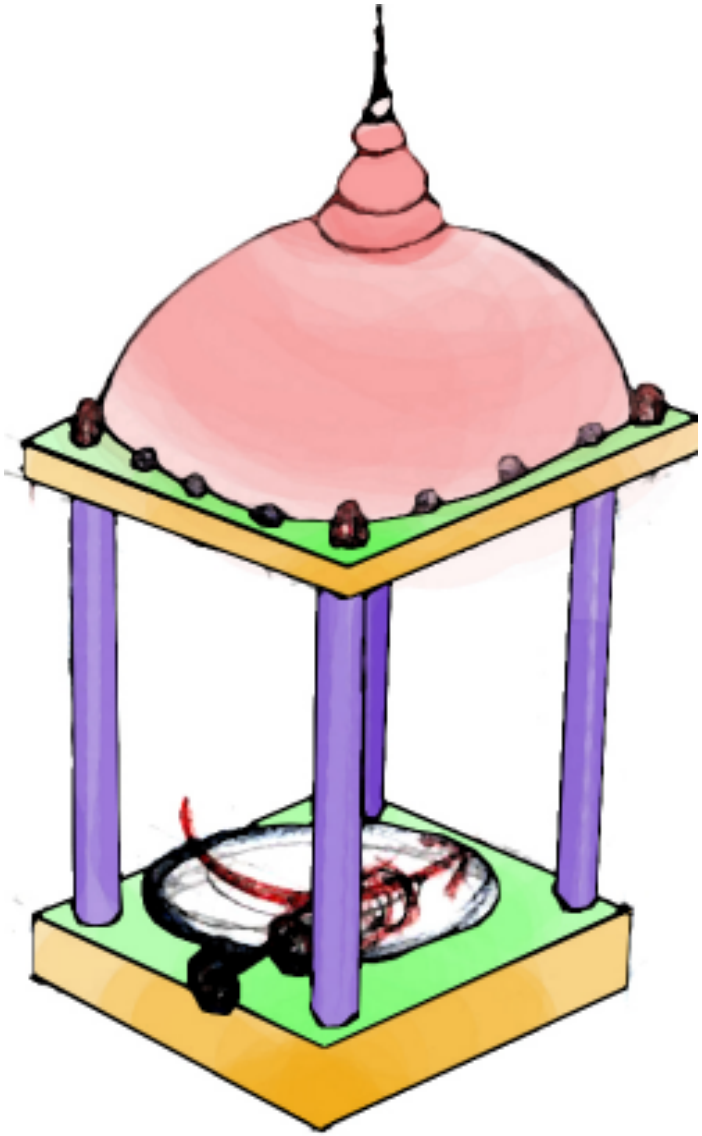
Assembling powerpack to the platform and attach trailer.
Developing surfaces for hood, bonnet and making components like head lamps etc.
Visualization, planning and sequencing.
Develop the aesthetic sensitivity in the kid.
Increase the manual skill for handling small components and tools.

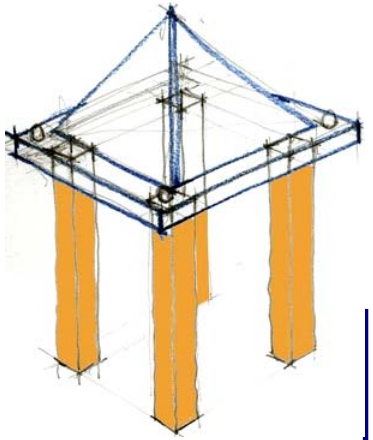
The child's tasks or challenges:

Add personal elements like choosing colors and painting them
Planning and sequencing is critical
Selecting different platforms for different vehicles and their trailers
Adapt same components to similar concepts.

What does the concept lack?

Device will not be acceptable by girls
Device does not relate to the curriculum





Special characteristics:

Culture specific assembly specially coming alive during festivals, processions, exhibitions, dramas etc.
Includes standard components like columns, shafts, rotating platform and subsystems like motor, battery pack, gears etc.
Can be used by both boys and girls.

Learning objectives:

Develop the aesthetic sensitivity in kids.
Learn about various mechanisms like gears, pulleys, motors etc.
Learn about different electrical connections.
Development of surfaces like domes etc.
Sourcing alternative components.
Visualization, planning, sequencing .

The child's tasks or challenges:

Assembling mechanisms like gears, pulleys, motors etc.
Different electrical connections to be made.
Development of surfaces like domes etc.
Sourcing alternative components.
Planning and sequencing is critical.

What does the concept lack?

Device can be used only on specific occasions.

Special characteristics:

A Culture and context specific assembly.
Includes standard components like shafts, rotating backgrounds, screens and subsystems like motor, battery pack, gears etc.
Can be used by both boys and girls and in groups.
Device can be used in parties, dramas etc.

Learning objectives:

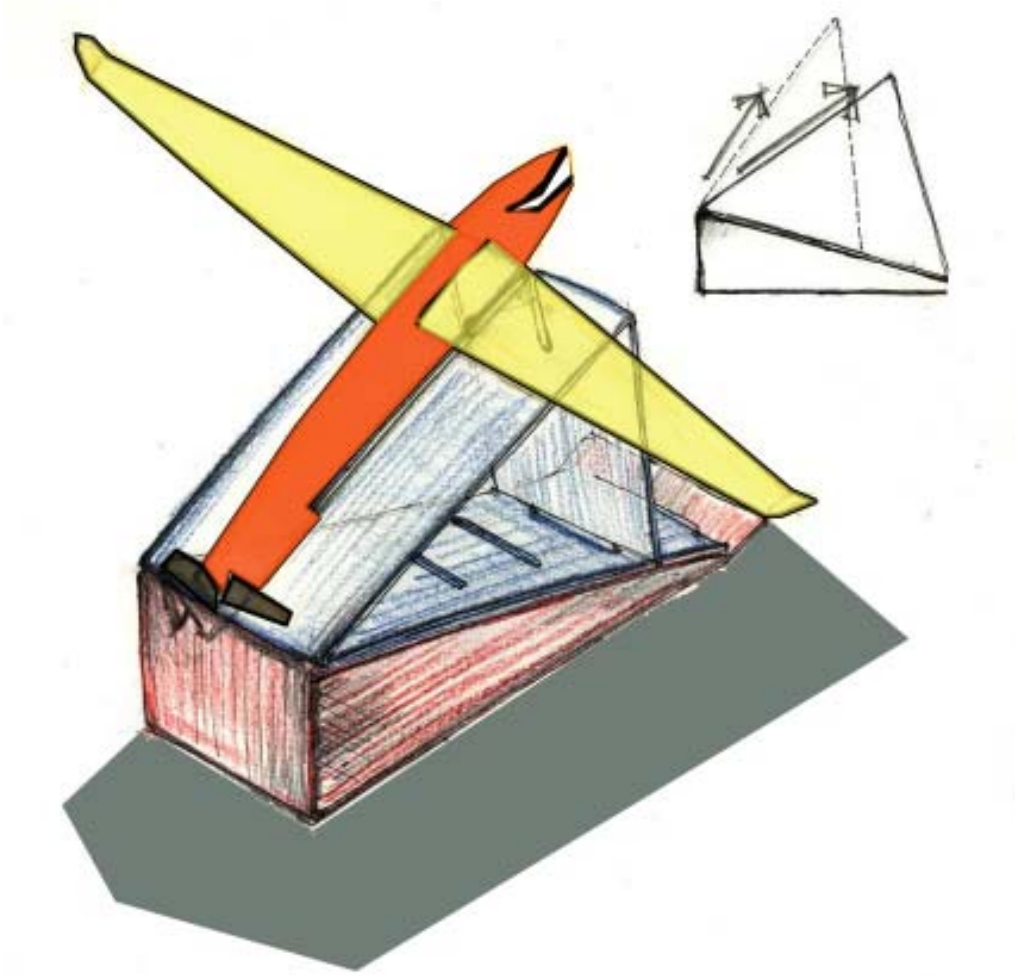
Develop the aesthetic sensitivity in kids.
Learn about various mechanisms like gears, pulleys, motors etc.
Learn about different electrical connections.
Provides a scenario for story writing, acting, mimicry etc.
Visualization, planning, sequencing.

The child's tasks or challenges:

Assembling mechanisms like gears, pulleys, motors etc.
Different electrical connections to be made.
Making drawings of scenes, backgrounds etc.
Visualization, Planning and sequencing is critical.

What does the concept lack?

The acting or the mimicry can take the limelight rendering the stage unnecessary.



Special characteristics:

Device can be made with commonly available materials like corrugated board etc.
Device can be adjusted for various angles and is scalable.
Keeps the kids engaged for a long time.
Includes standard components like strings, rubber bands etc.
Can be used by both boys and girls.
Device can be used in exhibitions, competitions etc.
Number of variations possible.

Learning objectives:

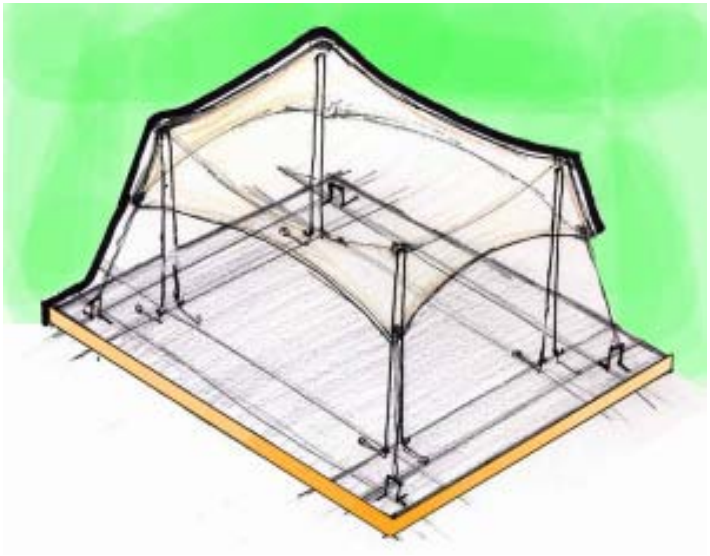
Can learn about different flying objects like gliders, rockets, parachutes etc.
Sourcing of materials for different components.
Visualization, planning, sequencing .

The child's tasks or challenges:

Visualization, planning, sequencing is critical.
Development of surfaces.
Sourcing alternative components.
Planning and sequencing is critical.
Concentration while using the device.

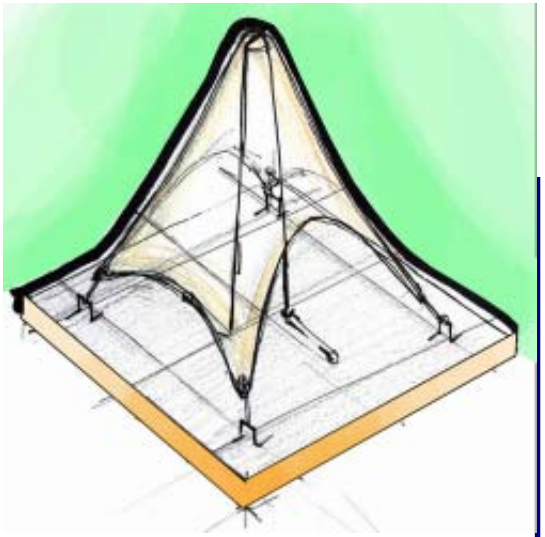
What does the concept lack?

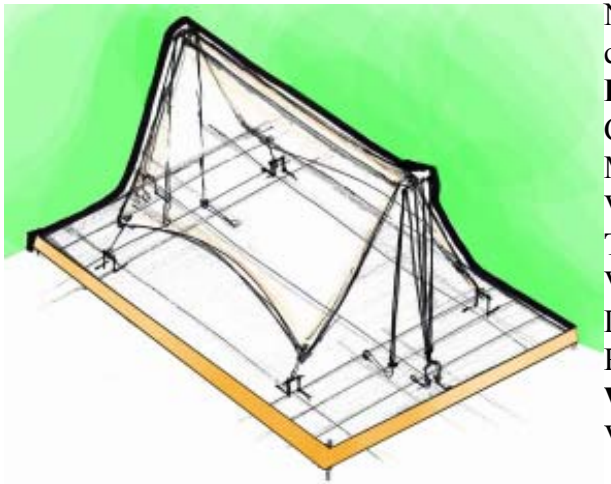
Device can be used effectively only in open spaces.



Special characteristics:

Device infers to the curriculum to a great extent.
Device is scalable.
Device can be dismantled and reused.
Includes standard components like posts, string, anchors, rubber bands etc.
Can be used by both boys and girls.
Device can be used in exhibitions, competitions etc.





Number of variations of tents possible within the components given.

Learning objectives:

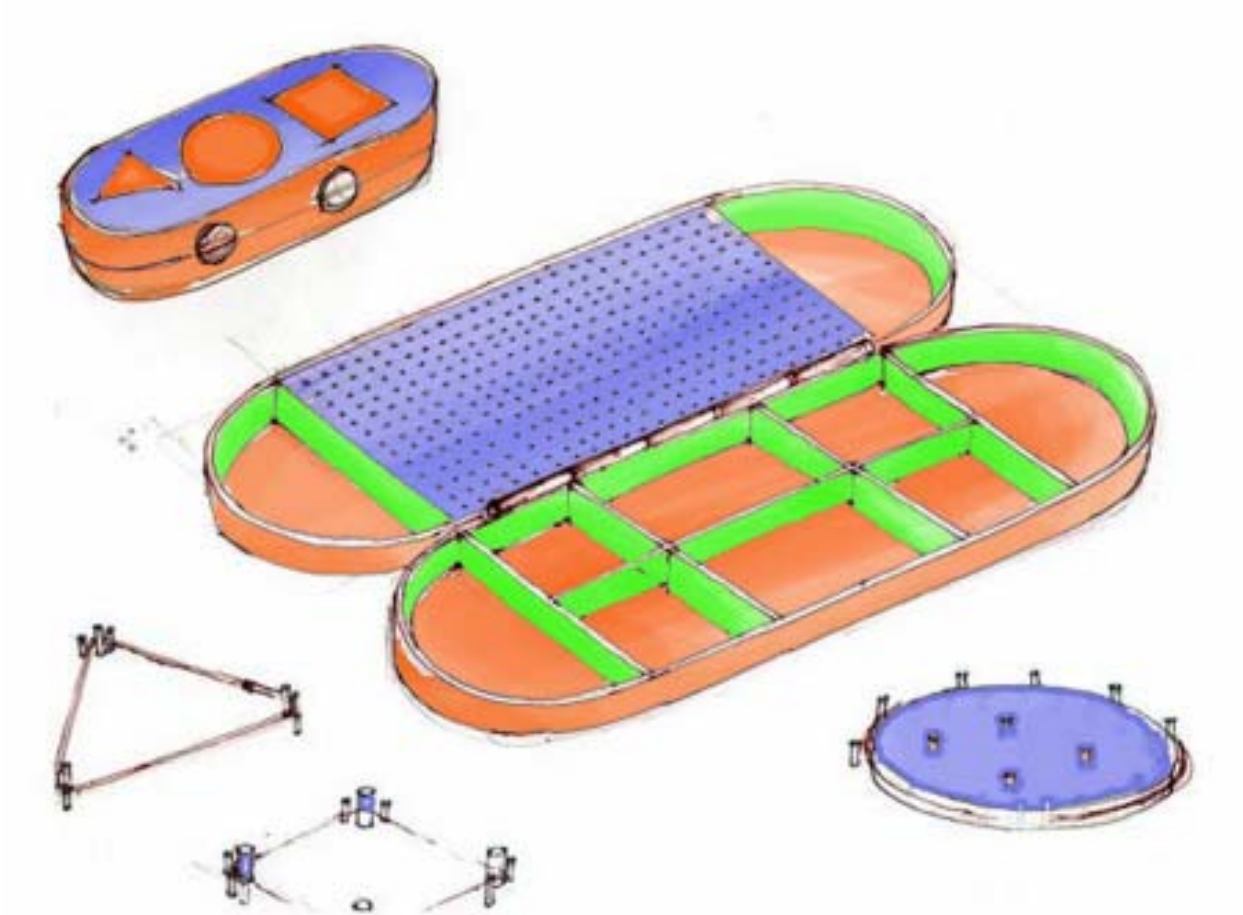
Can learn about basics in geometry.
Manual skill and dexterity in assembling and making.
Visualization, planning, sequencing.

The child's tasks or challenges:

Visualization, planning, sequencing is critical .
Development of surfaces.
Requires skill and dexterity.

What does the concept lack?

Variations other than tents.



Special characteristics:

Device used for shaping wires.
Includes components for various geometric shapes.
Can be used by both boys and girls.
Device can be used for making puppets, posts, rings etc.
Simple jigs included in the system.

Learning objectives:

Can learn about basics in geometry.
Manual skill and dexterity in making.
Visualization, sequencing.
Learn about properties of different materials.

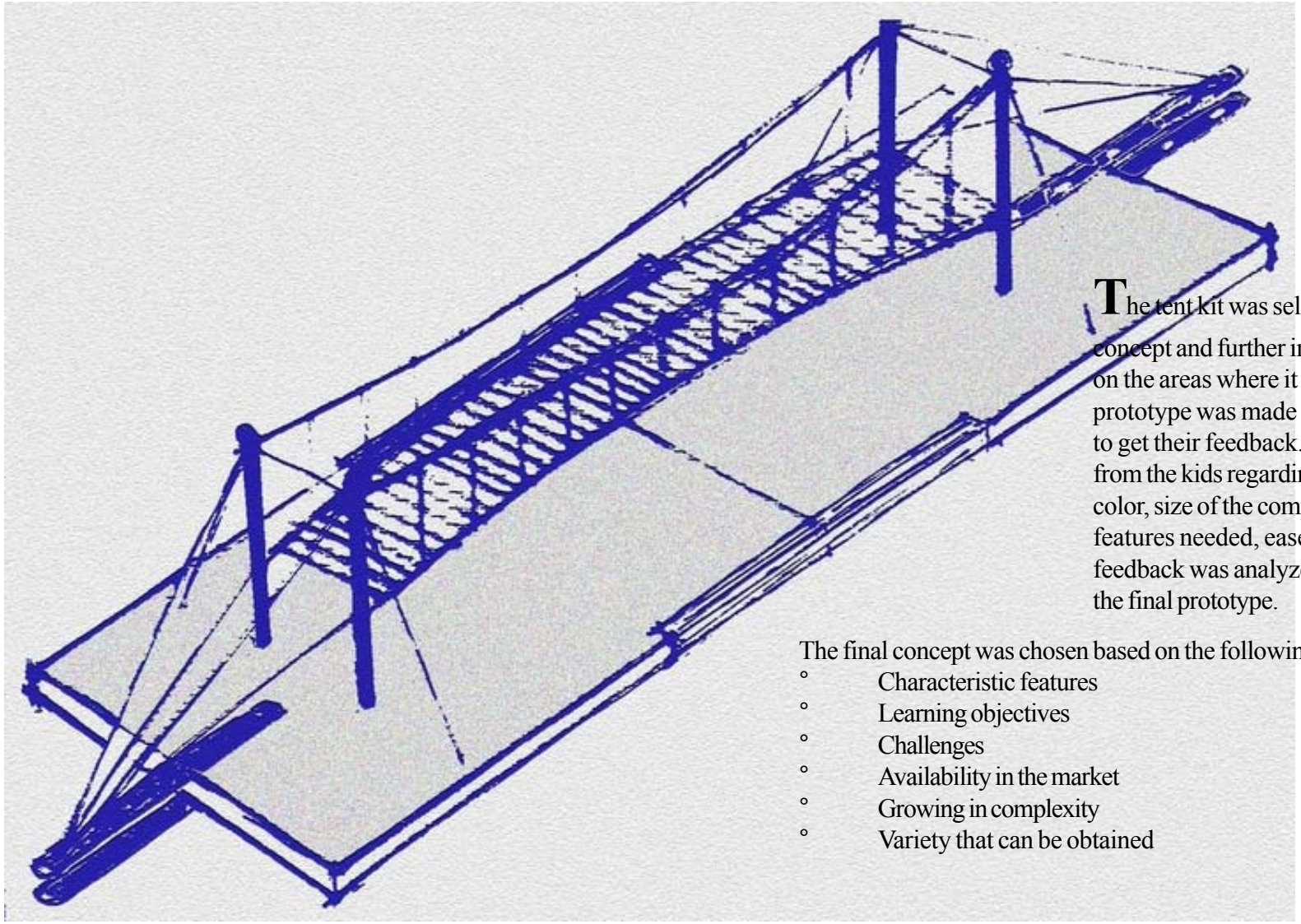
The child's tasks or challenges:

Visualization, planning, sequencing is critical
Development of surfaces
Requires skill and dexterity

What does the concept lack?

Need for external initiator.

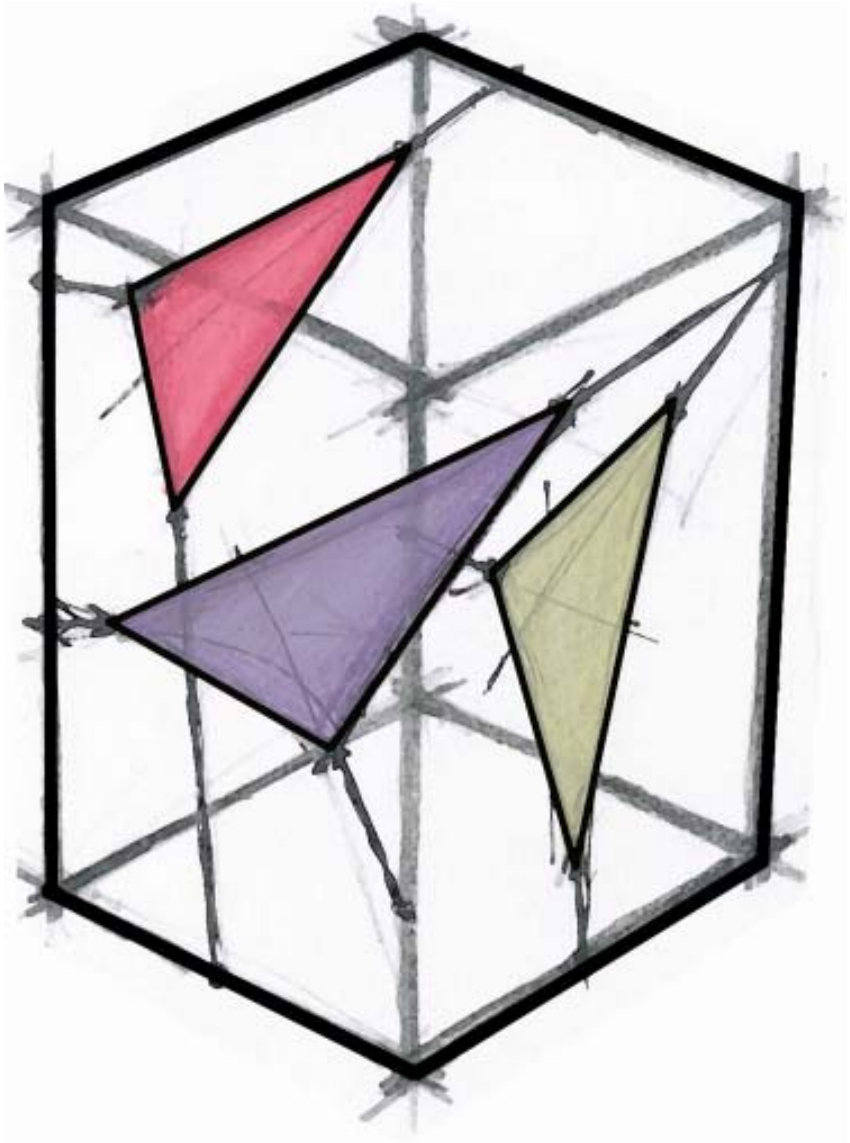
PART - D



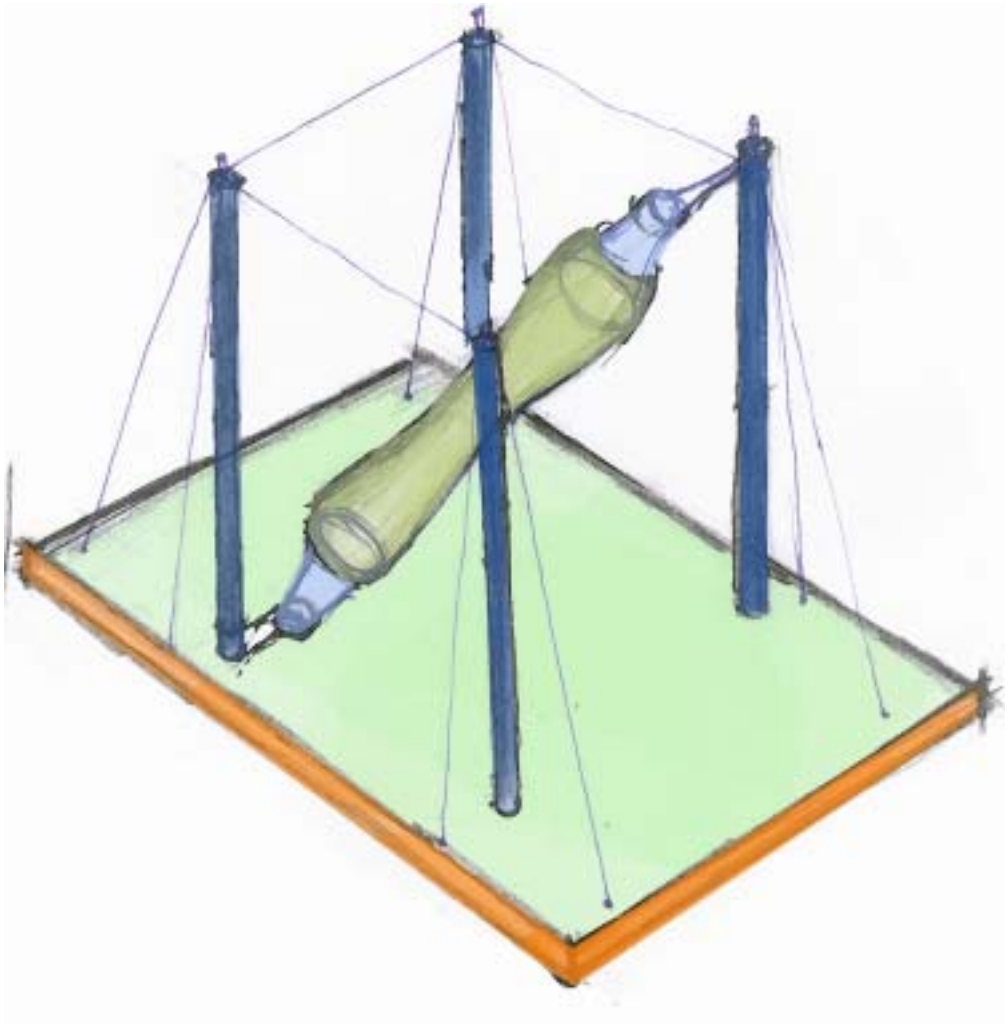
The tent kit was selected as the final concept and further improvements were done on the areas where it was lacking. Test prototype was made and tested with the kids to get their feedback. The feedback obtained from the kids regarding the device included color, size of the components, additional features needed, ease of use, looks etc. the feedback was analyzed and incorporated in the final prototype.

The final concept was chosen based on the following criterion

- Characteristic features
- Learning objectives
- Challenges
- Availability in the market
- Growing in complexity
- Variety that can be obtained



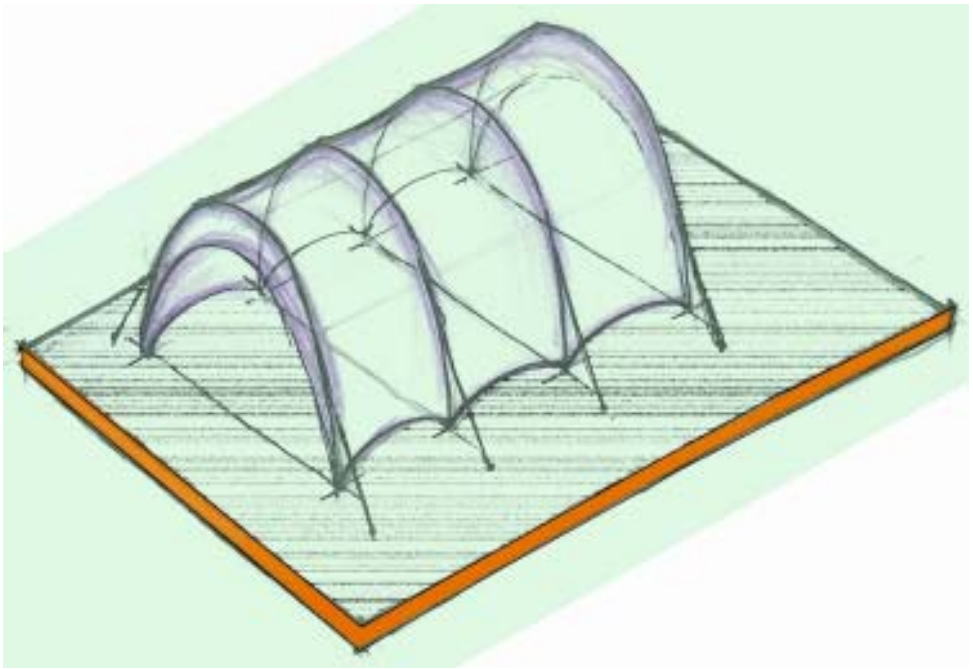
- The kit comprises of modular base and components.
- The components can be made using various materials and processes which will help to place the product in different price brackets.
- Provision of personalizing the product by the user.
- Possibility of using materials other than the ones provided in the kit.
- The product can be used by both boys and girls.
- Group of kids can work together on the product.
- The user can obtain real life and abstract objects from the device.
- Provision for providing lighting and other personalization elements.
- The product can be made culture and context specific.

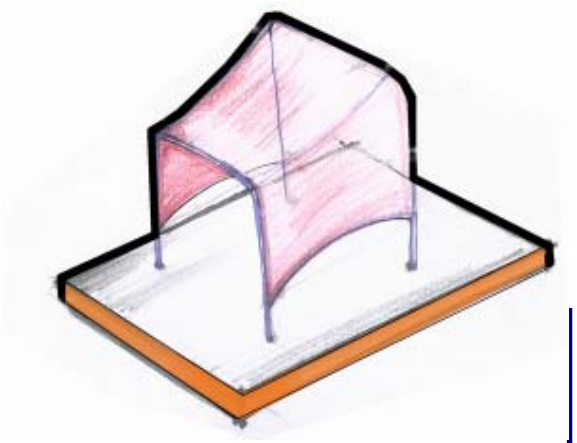


The learning objectives from the product (refer annexure) can be classified into various categories like

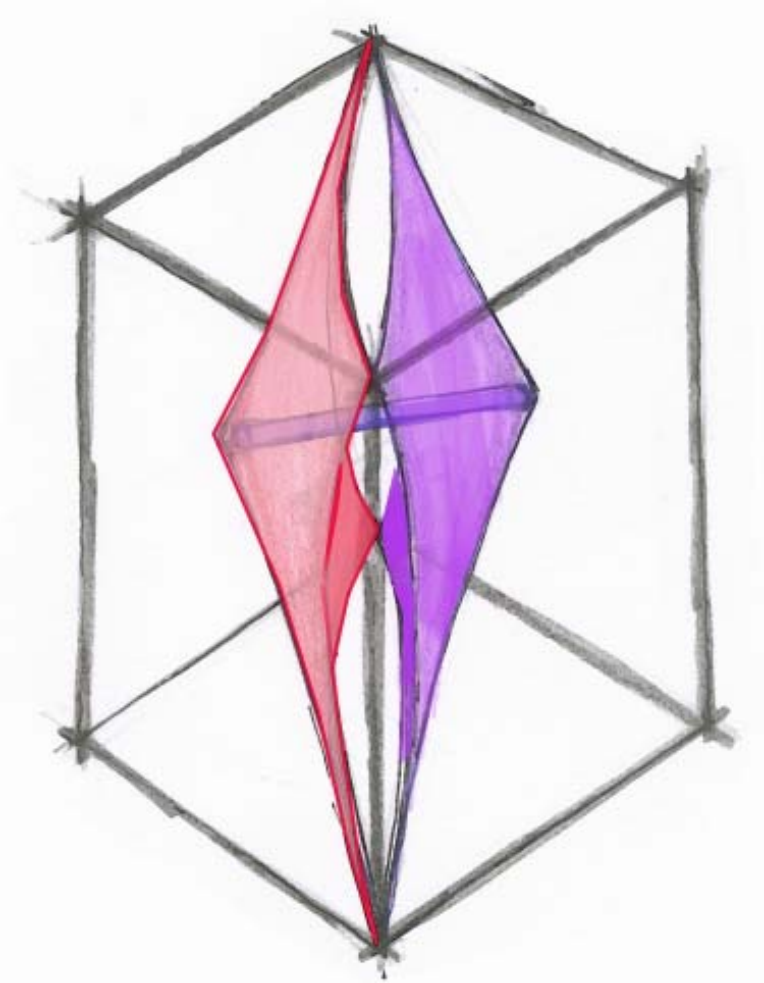
- Academics
- Visualization
- Planning
- Sequencing
- Accomplishment
- Multiplicity of use
- Group work
- Develop ones aesthetic sense
- Work within constraints

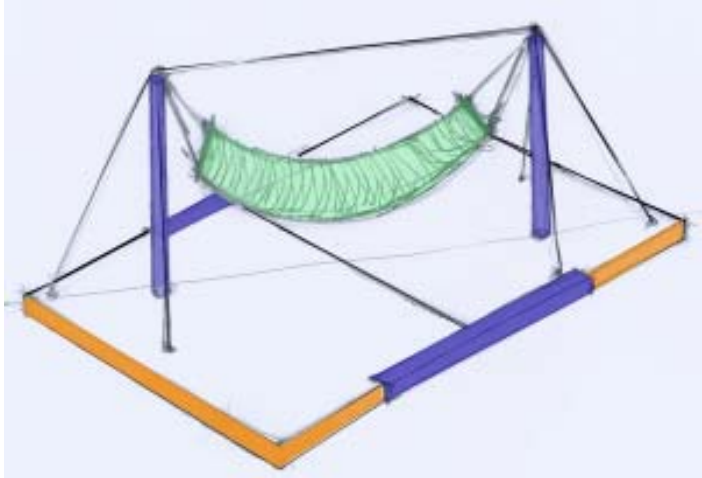
9.3 - AVAILABILITY IN THE MARKET:





- The product when placed in the market will have the following advantages
- The device can be used by both boys and girls
- The device can be personalized
- The product can be made culture and context specific depending on the area it is being catered to, since most of the products sold are western in nature
- The product can be targeted at various segments and price brackets
- Can be owned by the kid or by the school (refer annexure for possible ways of the school having the product).





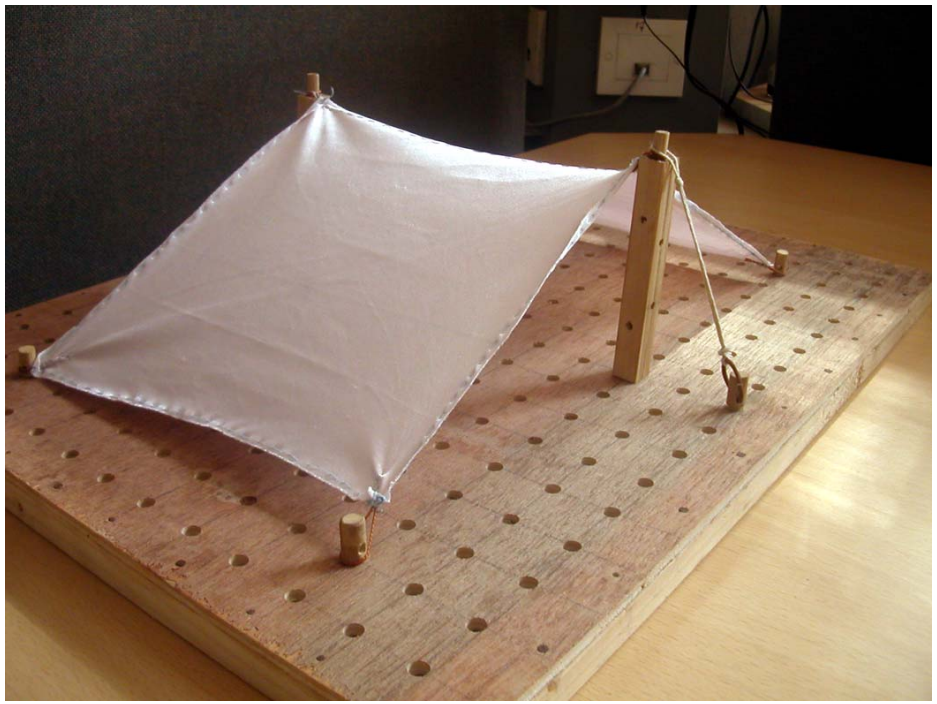
° The product can grow in complexity with the user.

° Kids can use the same device for addressing different topics and subjects in the curriculum and extracurricular activities.
° The kid can use the same device in the higher classes to learn new topics.
° The device can be used to satisfy the growing complexity in art and craft classes.

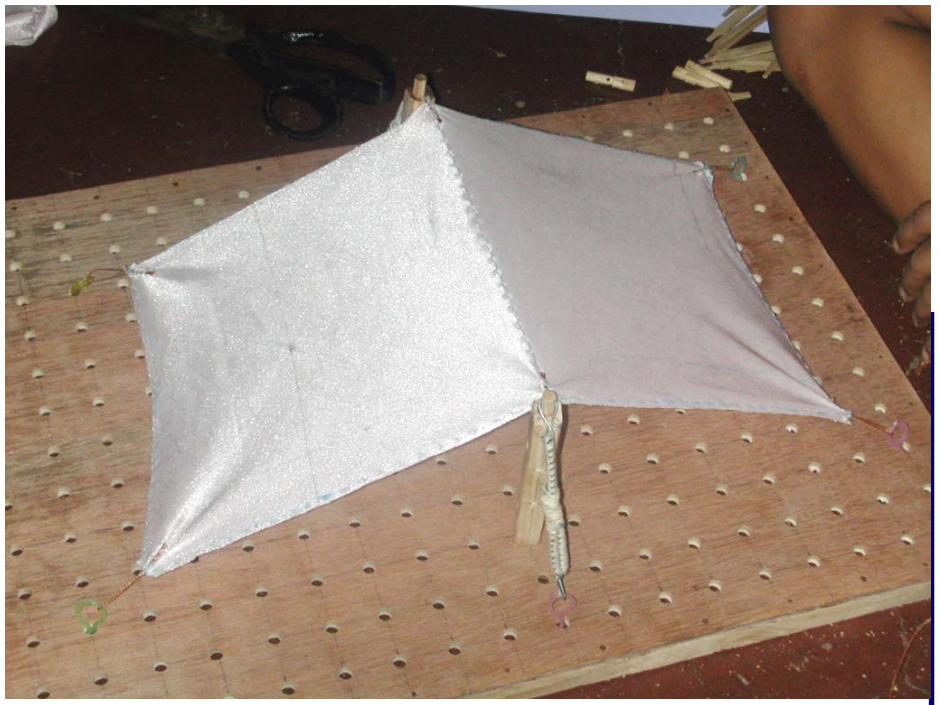
Variety that can be obtained:
The device can be used in multiple ways in various situations. Some of the objects that can be obtained from the device are Tents, bridges, sculptures, beds, hammocks, tunnels, hoods for vehicles, sails etc. the device can also used as a tool for bending and shaping wire.

Initial tests done on a test prototype

- During the initial testing kids were given the components and asked to assemble some object of their liking without mentioning the possibilities. Some of the results obtained are shown.
- Kids could replicate the models easily when they were shown pictures of models earlier assembled.
- Some of the components provided were used in a totally different way than they were previously envisaged to be used.



Photograph of the model that was shown to the kid



Photograph of the model that was assembled by the kid

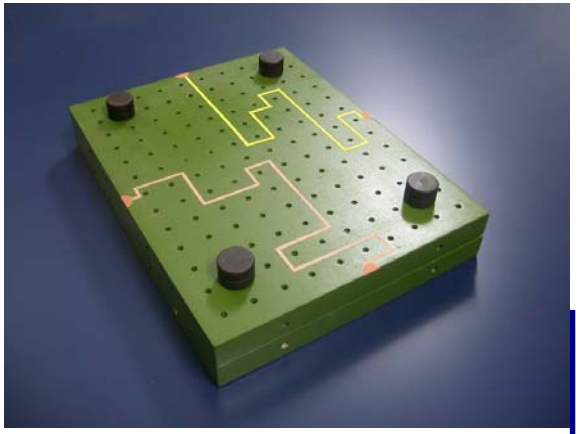
THE TEST PROTOTYPE:

The test proto-type consisted of a single baseboard made with 6mm Ply with a pinewood frame. The other components provided include Square post (wood), Triangular and circular pieces (plastic), Circular inclined post (plastic), stretchable cloth of various shapes with loops, 6mm dia Bamboo sticks of various lengths, pegs made of cane, Rubber bands, Elastic, cylindrical pieces made of Bamboo, Connectors/ ties (plastic), Threads etc. natural color of the components was retained during the tests. Regular feedbacks from the tests were incorporated into the design of new components and redesign of existing ones.

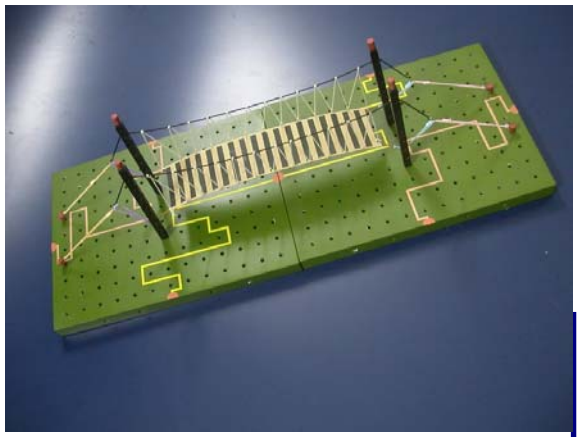
THE PROTOTYPE:

‘MAADU- to make’, the final proto-type consists of two Baseboards, which double up as packaging after use. The baseboards encase a tray, which contains the rest of the components. Four teakwood knobs inserted with M6 bolts and nuts hold the entire assembly. Transparent components in the form of connectors /ties are introduced in the prototype replacing the opaque ones of the test prototype.

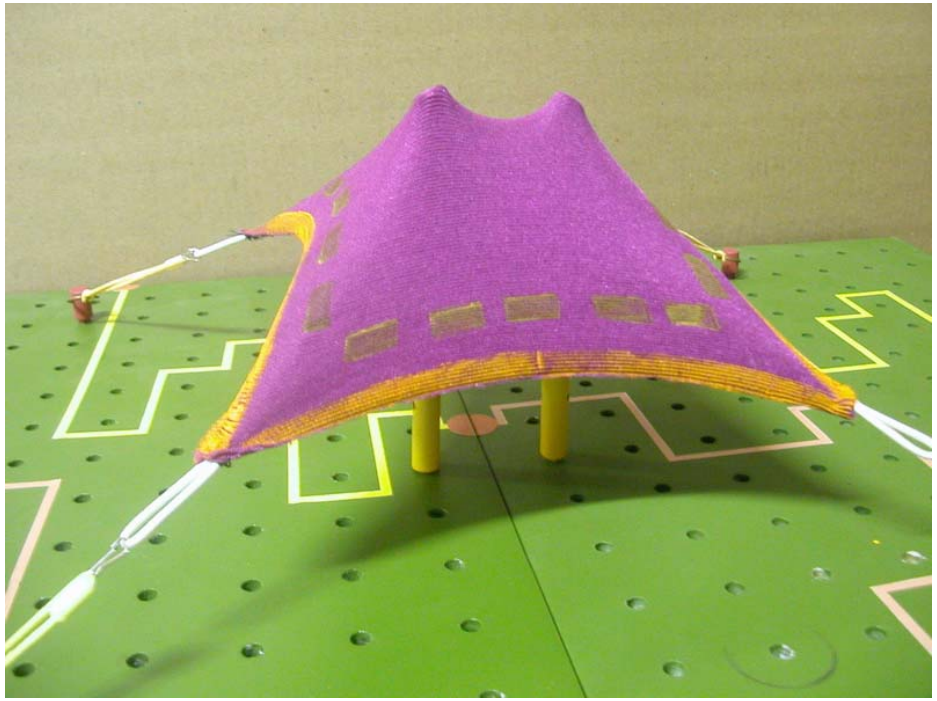
The color scheme used in the prototype reflects the ones specific to the Indian scenario including popular festivals like Diwali, Ganapati etc and those found in day-to-day objects like clothes, artifacts etc.



Manufacturability:
The prototype **'MAADU'** is designed considering the eventual manufacturing by the woodworking industry. Some of the highlights include the 32mm c/c hole spacing, which is a standard adopted in the industry.
Other components used that can be outsourced include plastic components both Transparent and opaque, elastics, stretchable fabric, thread etc.



Some of the objects that were assembled using the components from the prototype include tents of various shapes and sizes and bridges. The images show the configurations the baseboard that can be used.



CONCLUSION:

‘MAADU’ taken from Kannada, meaning ‘to make’, was chosen as the name for the prototype. To make things with ones own hands has been the emphasis of the project throughout. The use of a variety of materials both natural and manmade for the components allows the child to get a feel of the materials first hand.

The project was a collaborative effort involving the end users having varying interests and backgrounds. The end users included both boys and girls.

One of the interesting aspects found during the tests was the involvement of age groups other than the ones the product was designed for. This provides an excellent opportunity for the same product to be marketed to different age groups.

‘MAADU’ true to its name emerged as an activity emphasizing the making of objects with ones own hands and as a collaborative effort both as a design project and during the making of objects.

PART - E

1.4.11 Relating Education to World of Work

Work education is a thoughtful strategy to develop the understanding of facts and principles involved in various forms of work and to create a positive attitude towards work.
At the upper primary stage, the continuation of work education would reinforce respect for meaningful work.
In its final analysis the whole intent of work education is viewed as purposive and meaningful manual work, organised as an integral part of the learning process.

1.4.13 The Child as a Constructor of Knowledge

The acquisition of knowledge through active involvement with content, and not imitation or memorisation of the material, is at the root of the construction of knowledge. In the constructivist setting, the learners have autonomy for their own learning, opportunities for peer collaboration and support, occasions for the learner generated problems that drive the curriculum, time for self- observation and evaluation and outlets for reflection. Autonomy encourages learners to construct their own knowledge and gain new perspectives through hands-on experiences rather than follow prescribed information. This perspective recognises the teacher as primarily a facilitator of learning.

Development of Aesthetic Sensibilities:

Aesthetic experience is potential in any area in which the individual interacts with the environment. Solving an algorithm, creating a sculpture, planting a garden — all can be sources of aesthetic experience. Since such experiences are emotionally complete and coherent and provide intrinsic satisfaction, they increase the likelihood of individuals' inclination toward subjects/sources through which they have been secured.
Subject matters or disciplines, when addressed with aesthetic considerations, have in common the features of cognition, sensitivity to composition, attention to nuance, the need for flexible purposing, the exercise of imagination and the development of balance and harmony. Aesthetic education refers to developing learners' ability to have such experiences and must therefore be the concern of curriculum.

Work Education, Art Education – Upper Primary Stages:

Work Education is viewed as purposive and meaningful manual work organised as integral part of the learning process and resulting into goods or services useful to the community besides the pleasure of self-fulfillment.
At the upper primary stage, the learners are sufficiently mature to carry out strenuous work involving higher skills and requiring closer neuro-muscular-coordination.
The methodology has to be based on observation, manipulation and work practice. At this stage, the learning and mastery of skills becomes more important than at the primary stage.

Art Education:

Art education constitutes an important area of curricular activity for development of the personality of the learners. The aim of art education may be perceived as development of aesthetic sensibility among learners so as to enable them to respond to the beauty in line, colour, form, movement and sound.

Art education can provide the most satisfying medium of creative expression which has to be given due importance in the best interest of the society.
At upper primary stage, art education program should comprise, handling of the materials for drawing, painting, collage, clay modeling and construction of puppets; creating artistic things by free expression method and specific topics method;
Theater arts and dramatization may be suitably introduced. Emphasis should be laid on the use of learner's own imagination and development of his/her own concepts and expression through exploration.

Scribbling stage (approximately 2 to 4 years)

In this stage, children:

- Are amazed at their ability to make marks.
- Spend much time practicing motor skills.
- Draw circles first, then squares and other geometric shapes.
- Begin trying to create (draw) their world.
- May want to point to and name parts of their drawings.

Pre-schematic stage (late preschool to approximately age 7)

At this stage, children

- Make first attempts to represent people or objects. Efforts are recognizable to adults.
- Are fascinated with the wide variety of colors.
- Achieve obvious connections between different parts of a drawing.
- Are easily discouraged and fatigued.
- Are active, hands on, eager to learn, and self-centered.
- Are highly imaginative yet tend to focus on one idea at a time.
- Search for ways to represent their ideas.

Schematic stage (approximately 7 to 9 years)

Children at this stage

- Increase the use of symbols, such as a heart for love or dark colors to represent night.
- Still do not have a realistic understanding of their environment. eg, the sky in a child's picture may not meet the ground at the horizon.
- Show improved eye-hand coordination and fine motor skills.
- Have an increased attention span.
- Begin developing a sense of humor.
- Represent special characteristics for each person or object in their drawings. e.g, if Mom wears glasses , the child will include these characteristics in the drawing.

Realistic stage (9 to 12 years)

Children at this stage

- Are greatly affected by peer influence.
- Increase the amount of detail and use of symbols in drawings.
- Have expanded individual differences.
- Begin to develop a set of values.
- Want to do things "right."

Pseudo-naturalistic stage (12-14 years)

At this stage, children

- Are highly critical of the products they make.
- Use a more adult-like mode of expression.
- Experience a period of great individual differences physically, mentally, emotionally, and socially.
- For many children, this will be the last opportunity to have art instruction.
- Experience a period of heightened self-consciousness.

Children in the age group of 12 + years have been selected as the target user group for the project. Following are the important characteristics of the age of reasoning or the gang age:

- This stage marks the end of creating as a spontaneous activity and the beginning of a period of reasoning when children become increasingly critical of their own products.
- The child has become much more critical and aware of himself than before.
- The child is concerned about the looks, dress, and speech and is very particular about how he appears to others.
- One of the outstanding characteristics of this is the child's discovery that he is a member of society, a society of his peers
- It is during this time that children lay the groundwork for the ability to work in groups and to cooperate in adult life
- There is a growing awareness that the group is more powerful than a single person.
- The age is the time for peer groups or gangs
- The emotional and psychological concerns of children of this age demand constructive outlets.
- At this age it is vital to stimulate the child's thinking and provide them with opportunities for discoveries relating to the natural beauty of materials that are found unspoilt within the environment. E.g., pebbles, rocks.
- Children improvise on their own account combinations of materials that need not necessarily serve a useful purpose
- The material and design is feasible for the child only when both have a meaning in the life of the child
- This age also shows an increasing development of social independence from adult domination.
- It is a time when boys take interest in group sports, build elaborate hideouts from boxes or stray pieces of lumber.
- The greater awareness to detail, such as an accumulation of details, such as those items that are emotionally significant to him

Piaget identified four stages in cognitive development:

1. Sensorimotor stage (Infancy, 0-2 yrs). In this period (which has 6 stages), intelligence is demonstrated through motor activity without the use of symbols. Knowledge of the world is limited (but developing) because its based on physical interactions / experiences. Children acquire object permanence at about 7 months of age (memory).
Physical development (mobility) allows the child to begin developing new intellectual abilities. Some symbolic (language) abilities are developed at the end of this stage.

2. Pre-operational stage (Toddler and Early Childhood, 2-7 yrs). In this period (which has two sub stages), intelligence is demonstrated through the use of symbols, language use matures, and memory and imagination are developed, but thinking is done in a nonlogical, nonreversible manner. Egocentric thinking predominates

3. Concrete operational stage (Elementary and early adolescence, 7-12 yrs). In this stage (characterized by 7 types of conservation: number, length, liquid, mass, weight, area, volume), intelligence is demonstrated through logical and systematic manipulation of symbols related to concrete objects. Operational thinking develops (mental actions that are reversible). Egocentric thought diminishes.

4. Formal operational stage (Adolescence and adulthood, 12+). In this stage, intelligence is demonstrated through the logical use of symbols related to abstract concepts. Early in the period there is a return to egocentric thought. Only 35% of high school graduates in industrialized countries obtain formal operations; many people do not think formally during adulthood.

Piaget postulated three basic learning processes. They are

FORMATION: Formation of mental concepts, for example, a teenager forms of concepts that an automobile has four wheels and a body with a steering.

ADAPTATION: Adapting concepts in the light of experiences the teenager either assimilates or accommodates the earlier found concepts.

RELATION: Relating of concepts to form structures like trains, trams etc. can also be called as automobiles because they have some similarities with the earlier concepts.

According to Piaget, adaptation is the most important as he claims that adaptation is the essential ingredient of learning. He says humans adapt in one of two ways.

Assimilation: a process of fitting new experiences to the existing concepts, e.g. – the automobile also has a chassis on which the body rests and there is an engine to move the automobile.
Accommodation: a correcting process by which one either restricts or broadens the concepts, e.g. Automobiles which have more than four wheels can also be called automobiles.

Skemp has proposed a Theory of learning' which takes into account that emotions plays a dominant part in the way one learns. In this theory he states that there is a Director System in each and every organism which directs and organizes its behavior towards a goal.
The function of the director system is governed by emotions, such as,

- Pleasure- signals the approach or reaching of a goal state.
- Confidence- signals the ability to reach a goal state.
- Displeasure- signals a retreat from a goal state.
- Frustration- signals the inability to approach or reach a goal state.
- Frustration- signals the inability to approach or reach a goal state.

As the goal states there are anti-goal states too. Emotions attached to these are

- Fear- signals their approach.
- Anxiety- signals inability to avoid them.
- Relief- signals a retreat from them.
- Security- signals the ability to retreat from them.

Dienes 'theory of Learning'

Zoltan Dienes theory of learning is a process of an increasingly intricate play. He says that these plays are of two types- primary play and secondary play.

Primary play is the activity with materials aimed at gratifying immediate desires or instincts. It involves the manipulation and investigation of materials for its own sake.

Secondary play is the activity performed with awareness, aimed at an end, which is beyond the immediate gratification of desires. This involves trying to build with the materials, discovering patterns or regularities and forming abstract conjectures or rules concerning the patterns found.

Central to Bruner's thinking is the conviction that the process of learning is the same whether we are talking about the pioneer at the frontier of knowledge or the child engaged in making a construction of wooden blocks

Bruner's theories can be explained well with his concept of spiral curriculum. By this Bruner means that the principles of a subject come to be understood by a person at increasingly sophisticated levels.Bruner's concept of the spiral curriculum implied that even quite young children can grasp ideas in an intuitive way which they can return to later at progressively more complex levels of difficulty.

At first the ideas can be Imprecise but honest e.g. 'Square' will first be used by children to describe a primary concept- in response to the sense data they receive- from a particular shape.

At a later stage the same ideas must be revised and described Precisely e.g. 'Square' at a later stage will be associated with the existence of equal length, right angles, symmetry and so on.

Motivation and reward: Bruner asserts that it is very important for a child to know that his work is leading towards a goal. The knowledge that they gain must be seen as a useful tool.

Overview:

A major theme in the theoretical framework of Bruner is that learning is an active process in which learners construct new ideas or concepts based upon their current/past knowledge. The learner selects and transforms information, constructs hypotheses, and makes decisions, relying on a cognitive structure to do so.

Cognitive structure (i.e., schema, mental models) provides meaning and organization to experiences and allows the individual to "go beyond the information given".

As far as instruction is concerned, the instructor should try and encourage students to discover principles by themselves. The instructor and student should engage in an active dialog (i.e., Socratic learning). The task of the instructor is to translate information to be learned into a format appropriate to the learner's current state of understanding.

Curriculum should be organized in a spiral manner so that the student continually builds upon what they have already learned.

In his more recent work, Bruner (1986, 1990) has expanded his theoretical framework to encompass the social and cultural aspects of learning.

Scope/Application: Bruner's constructivist theory is a general framework for instruction based upon the study of cognition. Much of the theory is linked to child development research (especially Piaget).

The ideas outlined in Bruner (1960) originated from a conference focused on science and math learning. Bruner illustrated his theory in the context of mathematics and social science programs for young children (see Bruner, 1973).

The original development of the framework for reasoning processes is described in Bruner, Goodnow & Austin (1951). Bruner (1983) focuses on language learning in young children.

Example:

This example is taken from Bruner (1973):
"The concept of prime numbers appears to be more readily grasped when the child, through construction, discovers that certain handfuls of beans cannot be laid out in completed rows and columns. Such quantities have either to be laid out in a single file or in an incomplete row-column design in which there is always one extra or one too few to fill the pattern. These patterns, the child learns, happen to be called prime. It is easy for the child to go from this step to the recognition that a multiple table, so called, is a record sheet of quantities in completed multiple rows and columns. Here is factoring, multiplication and primes in a construction that can be visualized."

Principles:

1. Instruction must be concerned with the experiences and contexts that make the student willing and able to learn (readiness).

2. Instruction must be structured so that it can be easily grasped by the student (spiral organization).

3. Instruction should be designed to facilitate extrapolation and or fill in the gaps (going beyond the information given).

Zoltan Dienes theory of learning is a process of an increasingly intricate play. He says that these plays are of two types- primary play and secondary play.

Primary play is the activity with materials aimed at gratifying immediate desires or instincts. It involves the manipulation and investigation of materials for its own sake.

Secondary play is the activity performed with awareness, aimed at an end, which is beyond the immediate gratification of desires. This involves trying to build with the materials, discovering patterns or regularities and forming abstract conjectures or rules concerning the patterns found.

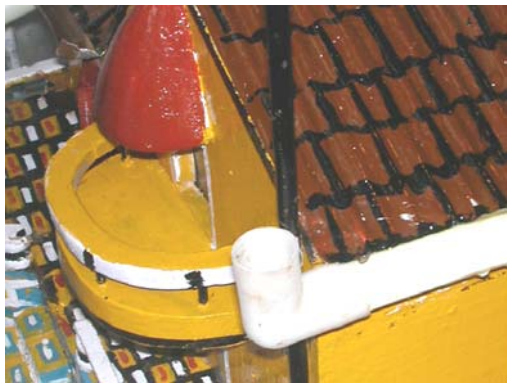
What are some guiding principles of constructivist thinking that we must keep in mind when we consider our role as educators? I will outline a few ideas, all predicated on the belief that learning consists of individuals' constructed meanings and then indicate how they influence museum education.

- **Learning is an active process** in which the learner uses sensory input and constructs meaning out of it. The more traditional formulation of this idea involves the terminology of the active learner (Dewey's term) stressing that the learner needs to do something; that **learning is not the passive acceptance of knowledge** which exists "out there" but that **learning involves the learner s engaging with the world.**
- People learn to learn as they learn: **learning consists both of constructing meaning and constructing systems of meaning**. For example, if we learn the chronology of dates of a series of historical events, we are simultaneously learning the meaning of a chronology. Each meaning we construct makes us better able to give meaning to other sensations which can fit a similar pattern.
- The crucial action of constructing meaning is mental: it happens in the mind. Physical actions, hands-on experience may be necessary for learning, especially for children, but it is not sufficient; **we need to provide activities which engage the mind as well as the hands** (Dewey called this reflective activity.)
- Learning involves language: the language we use influences learning. On the empirical level. researchers have noted that people talk to themselves as they learn. On a more general level. there is a collection of arguments, presented most forcefully by Vigotsky, that language and learning are inextricably intertwined. This point was clearly emphasized in Elaine Gurain's reference to the need to honor native language in developing North American exhibits. The desire to have material and programs in their own language was an important request by many members of various Native American communities.
- Learning is a social activity: our **learning is intimately associated with our connection with other human beings, our teachers, our peers, our family** as well as casual acquaintances, including the people before us or next to us at the exhibit. We are more likely to be successful in our efforts to educate if we recognize this principle rather than try to avoid it. Much of traditional education, as Dewey pointed out, is directed towards isolating the learner from all social interaction, and towards seeing education as a one-on-one relationship between the learner and the objective material to be learned. In contrast, progressive education (to continue to use Dewey's formulation) recognizes the social aspect of learning and uses conversation, interaction with others, and the application of knowledge as an integral aspect of learning.

- **Learning is contextual**: we do not learn isolated facts and theories in some abstract ethereal land of the mind separate from the rest of our lives: we learn in relationship to what else we know, what we believe, our prejudices and our fears. On reflection, it becomes clear that this point is actually a corollary of the idea that learning is active and social. We cannot divorce our learning from our lives.
- One needs knowledge to learn: **it is not possible to assimilate new knowledge without having some structure developed from previous knowledge to build on**. The more we know, the more we can learn. Therefore any effort to teach must be connected to the state of the learner, must provide a path into the subject for the learner based on that learner's previous knowledge.
- It takes time to learn: **learning is not instantaneous. For significant learning we need to revisit ideas, ponder them try them out, play with them and use them.** This cannot happen in the 5-10 minutes usually spent in a gallery (and certainly not in the few seconds usually spent contemplating a single museum object.) If you reflect on anything you have learned, you soon realize that it is the product of repeated exposure and thought. Even, or especially, moments of profound insight, can be traced back to longer periods of preparation.
- **Motivation is a key component in learning**. Not only is it the case that motivation helps learning, it is essential for learning. This ideas of motivation as described here is broadly conceived to include an understanding of ways in which the knowledge can be used. Unless we know "the reasons why", we may not be very involved in using the knowledge that may be instilled in us. even by the most severe and direct teaching

http://www.artsined.com/teachingarts/Pedag/Dewey.html

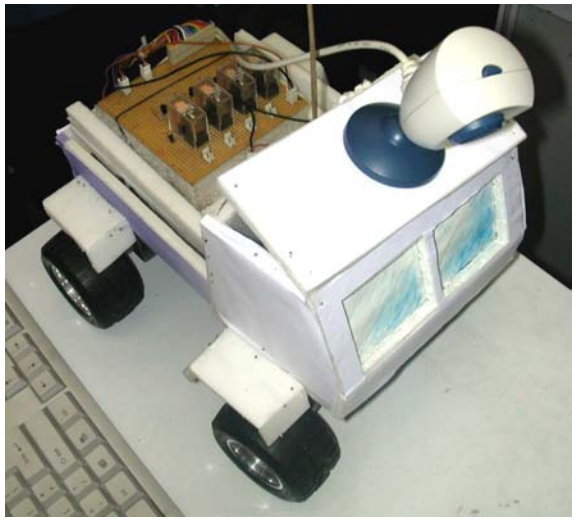
Model of a rain water harvesting system made with card borard, plastic pipes, straw, hay, paints etc. The model was made by a VIII class student who was accompanied by her teacher.



Detail showing the gutter for the rain water harvester. the gutter was made of pvc pipes and stuck to the body of the house.

Following observations were made during the visit to the Intel science exhibition held at KRESIT, IIT Bombay. The exhibition was conducted for school students from various schools across the country.

- The students who took part in the exhibition were mostly from class VII to XII.
- The exhibits were mainly addressing environmental issues like non-conventional energy, water harvesting, organic manure, and organic pesticides etc.
- The models presented also included solar harvesters, hearing aids, computer controlled cars etc.



Model of a truck made with a plywood platform and thermacole body, Computer controlled with a web cam. the model was made by a XII th standard student with the help of his science teacher.

Model of a Solar powered harvester made with plywood platform and aluminium sheet body. Materials like nails and screws were used for joinery.
Battery power was used to simulate the power generated by the solar panels mounted on the body of the harvester. The model was made by a X class student.

- Most of the models exhibited were working models of varying sizes.
- Barring a few the models exhibited or the ideas on which they were based were not completely new.
- The achievement of having the model work and the kid being able to present his work at a national level was important for the kid.
- The materials used for making the models were commonly found materials like thermacole, cardboard, tin sheet, plywood, plastic bottles etc.
- Most of the students were accompanied by their teachers. This shows the importance of the teacher in such activities.

To achieve a task which has a lot of unknown factors?

To pursue and stick on to a task which has got constraints.

To finish or complete a given task within a stipulated time.

To find a solution to a problem which has varying levels of difficulty?

A task that seems impossible at the beginning but gives a slight hint that it can be achieved .

The emotionally rewarding state of flow emerging from having hard fun is what motivates us to learn. Optimal learning will not come from giving more instruction but rather, from giving children better opportunities to construct.

When children construct things in the physical world they simultaneously construct knowledge in their minds.

This new knowledge then enables them to create ever more sophisticated solutions yielding more knowledge and so on in a self-reinforcing cycle. This is called learning by making.

If children are in supportive learning environments they will enter the learning cycle, confident that they will be able to solve any challenge.

Hence they will enjoy the learning by making way in a wholesome way.

http://www.lego.com/dacta/philosophy/desiretolearn.asp
LEGO Educational Division Learning Philosophy

Academics:

The creative aid will be of assistance to learn academics by trying to Internalize or make understand about basic principles, theorems etc. The device mainly addresses the geometry syllabus of the VII th standard of the CBSE curriculum(refer annexure). The learning objectives that addressed the topics in the syllabus are

Different types of triangles

By providing different types triangular profiles for tents

With the help of the triangle maze (refer sketch)

Bisecting a given line, drawing a line perpendicular to a given line

Has to be used when making a bridge where the centre of the span has to be determined

To draw a line parallel to a given line

Used to draw a rectangle on a piece of cloth

To construct a triangle

Used for drawing a triangular piece on a given cloth or paper

Symmetry

When two triangular pieces of equal properties have to be assembled on one common side

When a template has to be repeated exactly on the other side

Pythagoras theorem

With any two known parameters the third unknown parameter can be found. Some of the parameters that can be found are

Height of the post

Length of the chord

Distance for the peg to be put up

To draw a right angle

Pythagorean triplets

These set of numbers can be used by the kids so that they can increase or decrease the scale of a particular object the kids are making

Cicumcentre of a triangle

When the kid is making a tent with circular base and triangular roof (circumcentre of a triangle is equidistant from its vertices

Angle bisector of a triangle

Angle bisectors can be used as locators for the post

Congruent figures

These can be used to get identical pieces from paper or cloth

Quadrilaterals

A rhombus, square and rectangle can be used as roof membrane for tensile tents

Diagonals of rhombus bisect each other at right angles

This property has to be used for tensile stretchable roof

Areas

To find areas of finished or to be made pieces both regular and irregular using grid paper

Perimeter

To find length of the thread used

Visualization:

The object to be made has to be visualized before actually making it. This refines the drawing skills of kids, which otherwise stops growing at this age (Creative and mental growth, refer annexure on stages of artistic abilities of kids)

Planning:

The components in the creative aid and the type of object to be made make the kid to plan the entire activity of making of the object before hand

Sequencing:

The components in the creative aid and the type of object to be made make sequencing a critical step for completing the task at hand

Develop ones own aesthetic sense:

The creative aid helps the kid to develop his own sense of aesthetic by giving scope for personalization by adding external elements. Also the type of components and the results given by it gives an aesthetic where the form itself gives the required beauty.

Accomplishment:

The creative aid helps the kid to know about what is seen in a real life situation and that something open-ended can be achieved by him

Multiplicity of use:

The components that make up the creative aid lets the kid know about the cooperation and resistance offered by each component. He also gets to know that a particular component can be used only a particular way and others can be used in more than one ways.

Group work:

Though the creative aid can be used by an individual, it becomes easy and convenient to use by more than one person due to the type of joints and steps involved. The kid learns to work in a group which can include both boys and girls

Work within constraints:

The kids learns to work within constraints like the number of components, the type of material, the maximum area available to work etc

Various options for the device to be targeted between the school and the kids

Option 01:

School has its own creative kits where students work on different projects in work education and art and craft classes.

Kids has own kit to work at home and works in the school with the school kit.

Option 02:

School has a main component which the kids cannot carry to the school

Kids have their own kit, but carry only the smaller components to the school.

Option 03:

School buys the kit and gives it to the kids to use in the school projects or work education.

School encourages kids to have their own kits, but need not get it to school.

Option 04:

School buys a whole lot of specific tools and kids are thought to use the tools.

Kids have their own kits and use the tools in the school to suit their specific needs.

Option 05:

School and kids pay 50/50 and obtain both tools and product kits. Kits are kept in the school and belong to the school.

Kids get to use the kits and tools by paying only half the price.

Option 06:

School pays for the kits and gives it to the kids. Kids works are exhibited and sold where costs are recovered.

Kids get to use the kits for free. Part of the money obtained in the sales and exhibition will be given to the kids as prizes.

Option 07:

School keeps the kits in the school and gives it to the kids for using.

Kids pay for the kits and use it at school. Every kid has to do something with the kit, which ensures maximum numbers of kids are exposed to its use. Kids have the option of taking the kit with them after that particular grade or give it to the school.

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Urls:

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