



# Designing for Children

- With focus on 'Play + Learn'

## Human Centered Design Approach in Development of Educational Toy: A case study of Alphabets Learning

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**Abstract:** Playing with toys and learning about things surrounding us is an important part of growing up. Children can play with almost anything considering it as a toy and pretending it to be the thing of their own imagination. Through play children learn various things such as motor skills, social interaction skills, imagination etc. Though every toy has educational value, there is immense opportunity for toy designers to develop the form, physical features of the toy which gives visual and tactile clues to the children in order to help them learn educational concepts from the school curriculum.

This study is conducted to attempt to answer the questions like - how children learn alphabets in pre-primary school? Given a toy, which is designed for teaching alphabets, how children derive meaning out of it? This would help to understand current techniques used by schools to teach alphabets as well as get a sense of issues involved in designing educational toys.

Six phase human centred design process of IDEO have been adopted to conduct this study. In the first phase of Observation, two pre-primary schools have been selected to visit and understand behaviour, patterns and pain points of the stakeholders i.e. children and teachers. The whole process was documented with photographs and video recordings. Carefully analysed recorded data assisted to gain accurate and deep understanding of the activity of play and learn. A team of four design research students was involved to conduct interviews with teachers. Subsequent phases involved (i) generation of number of concepts based on the key observations, insights from the literature review, (ii) building prototypes, (iii) user feedback, (iv) iteration as well as modification and finally (v) implementation of feedback for future solutions.

**Key words:** Educational toys, alphabet learning, form design, visual feedback, spatial skills, prototype.

### 1. Introduction

Alphabets are taught in preschool to children of the age 3-4 years. At this stage of cognitive development, children start to recognize words, gestures and images are symbols that represent something else. Children develop a sense of symbolic meaning and try to associate it with their interpretation. The constant process of learning new things and making these associations is happening through visual and tactile feedback during the activity of play. This sensory feedback also develops shape knowledge in early childhood. Shape knowledge is considered vital part of child development and it is also an essential part of some of the high-quality academic standards such as Common Core State Standards (Common Core State Standards Initiative, 2010).

Research suggests that recognition of geometric forms is connected to early spatial skills (Verdine, et al., 2017) and one of the essential factors of academic success especially in the STEM subjects (science, technology, engineering, and mathematics) is spatial skills (Mix & Cheng, 2012; Wai, Lubinski, Benbow, & Steiger, 2010). As shape knowledge and spatial skills are significant in early learning, it becomes essential to create techniques for children to gain understanding from their exposure with shapes (Verdine, et al., 2019). For example, the activities like sorting shapes by aligning them with the cut-out in the shape sorters or creating shapes with tangram encourage action of noticing shape features, similarities and differences between them. Thus, shape exposure through play to children helps utilizing spatial skills and enhances their ability to learn. The current study aims to explore alphabet learning in children through activity of play with shape based toys.

### **1.1 What types of geometrical shapes are incorporated in shape based toys?**

Current toy market survey revealed that ample of traditional geometrical shapes (e.g., rectangle, triangle) and well-known shapes (e.g., ring, heart) are being used in a number of shape based toys. These shapes can be classified into two categories, canonical shapes and non-canonical shapes. Canonical shapes are nothing but 'typical' or 'standard' genre of that shape and non-canonical shapes are atypical variant of that shape category (Resnick et al., 2016).

### **1.2 What auxiliary information can be included along with the shapes?**

When a geometric shape and an alphabet are presented together, for example, how meaning is driven out of it by children? Does it affect the learning of alphabets in children? Before conducting the study, the speculation is that such exposure to shape based activity may serve as a foundation for learning new concepts and may lead to greater proficiency in understanding of those concepts.

### 1.3 The context and setting of current study

To investigate the issue presented above, the current study is undertaken. This study involved observation and data collection at two different preschools namely Akshara Pre-Primary School, IIT Guwhati and Mrunalini Devi Shishu Niketan, Amingaon both in Assam state of India. Both the preschools include approximately 60 children (age 3-4 years), who regularly attend the preschool sessions. During the course of this study, varieties of toy design explorations are carried out considering these children as the end users.

## 2. Method

The approach taken for the current study was six phase human centric design process followed by IDEO by which understanding and apprehension of a set of circumstances is obtained through constant interaction with end users. The insights gained from the observation of end users are beneficial for the validation of the process as well as it serves as stimuli for designers which is tough to be attained through empirical studies (Kouprie & Sleeswijk Visser, 2009; KeayBright, 2007b, Battarbee & Koskinen, 2005). The study focused on qualitative and discovery-led methods to uncover the situations of play and learn rather than relying totally on empirical data.

### 2.1 Gathering Data

Four researchers undertook three observation sessions with pre-school students and teachers over a period of a month. Each observation session lasted around 25-30 minutes. The researchers focused on observation of school children, teachers, environment and tools used in teaching sessions. Moreover, by conducting short unstructured interviews with school teachers, the researchers learnt about current techniques used to teach alphabets. Relevant data is recorded using video cameras, photography and writing down the crucial observations. These observations equipped researcher with adequate information to enable him try-out new ideas with certain settings during subsequent sessions.



Figure.1 Observation Session in School, Interview with Teachers

One principle of the study, that got established during the phase of observation is to develop shape based toys for children with little technical and financial means. Thus, complicated equipment setup, high-cost instruments and specialist software toys are not appropriate for this target group of pre-schools. In spite of these constraints it is still possible to design shape based toys to create interesting playful experience.

## 2.2 Concept Generation

The observations phase revealed that the current technique used by schools to teach concept of alphabets involves object-image association with the particular alphabet, for example, image of ball is used to teach alphabet 'B'. This object image association technique is coupled with repetition to reinforce the concept. Moreover, the object colour is also used to identify the particular alphabet. Consciously recognising these observations, a number of ideas of shape based toys are generated to create a playful experience for children while learning the concept of alphabets.

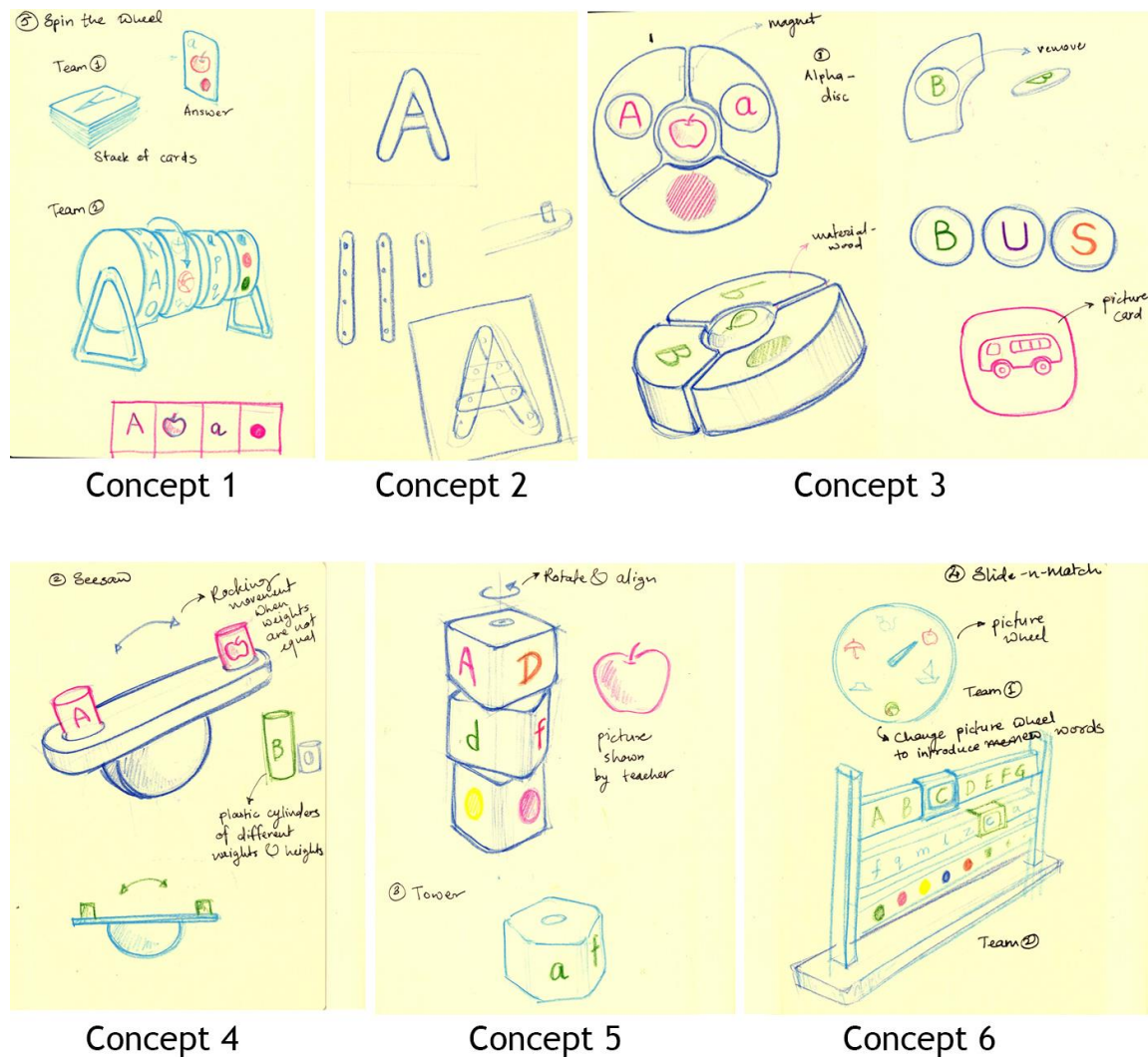


Figure.2 Concept Generation Phase ideation sketches

### 2.3 Concept Selection

Research studies have revealed that circular shapes were notably more likely to be presented across shape learning materials compared with other geometrical shapes (circle is used in 93% of books, 85% of shape sorters, and 95% of software applications) (Resnick et al., 2016). Moreover Clements et al. (1999) and Verdine et al. (2016), through their research, put forth that young children (3-6 years old and 2.5 years old, respectively) are comparatively better at identifying circular geometry and much less precise in identifying other shapes. Thus concepts involving circular shapes (concept 1 and 3) are given preferences in concept selection and concept 3 is selected as the final concept through a round of discussion with other researchers.

The selected toy design concept has three elements namely central cylinder with object image, alphabet and colour coins and arc of circle like geometry on which alphabet coins get attached (refer fig3). The alphabet coins get attached with arc of the circle elements with the help of magnets. The shape of the attachment area of each alphabet and colour coin is different to avoid mismatch pairing. Similarly the arcs of the circle elements also get attached to each other with the help of the magnet and complete a circular geometry.

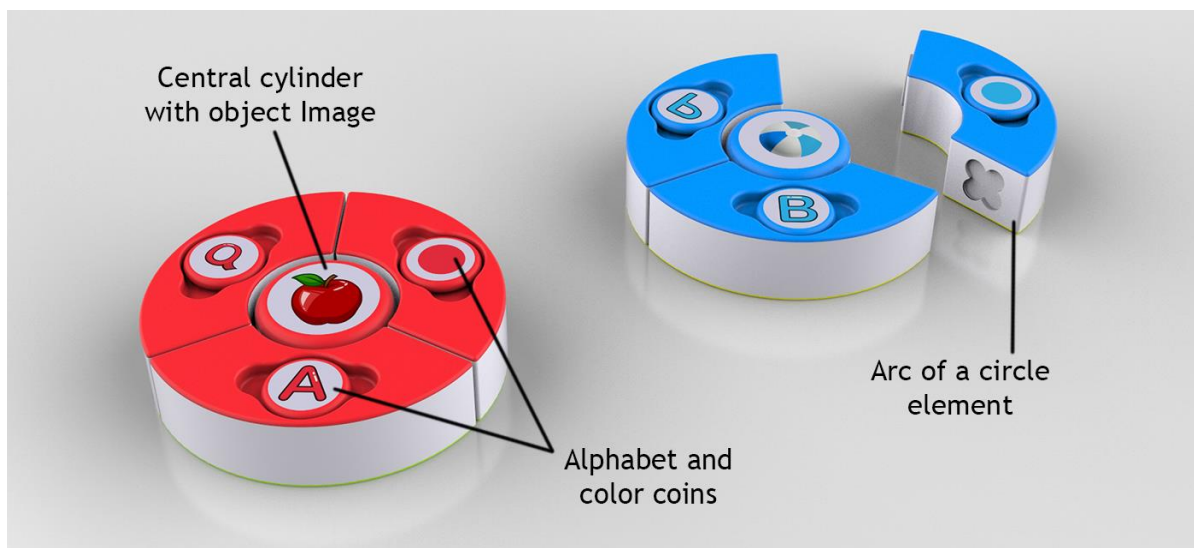


Figure.3 Alphabet learning toy components

### 2.4 Building Prototypes

A prototype is nothing but conversation a designer has with his ideas. A quick mock-up explaining the actual plans for the final product is created first using polystyrene which gave a sense of size and shape of the toy. The dimensions obtained from this rough and dirty mock-up is useful for making 3D model using CAD software. Eventually, the prototype

is made using 3D printing technology. Finished prototype is taken back to the school for usability testing and feedback.



Figure.4 Polystyrene Mock-up, CAD model and 3D printed prototype

## 2.5 User Feedback

The mechanism of user feedback into a design process works to verify whether the user is able to perform the intended task conveniently. Moreover, consulting with the end user helps refining product and give final touches before the launch.



Figure.5 Prototype testing session in the school

## 2.6 Iteration, Modification and Implementation of feedback

Following are the user testing session feedbacks which are implemented in further iterations of prototype.

- Removal of all sharp edges.
- Increase in the size of alphabet coins so that children will not be able to swallow them.

## 3. Results and Discussion

### Activity of Play and Learn

The activity of play with the designed toy is planned in such a way that the teacher places the central cylindrical element with object-image in front of students and students have to complete the circular geometry of the toy by correctly joining associated alphabets and colour coins. The process involves the principle of object-image association. The study has

resulted in evolving a process of designing shape based toys which enables children learn from their experiences with shapes.

### **Visual Feedback through form and colour**

The arrangement of toy elements in circular geometrical order has helped to get a sense of completion of task and a natural feedback to the children as the toy acquires a closed circular geometrical shape. Thus, the form of the toy itself enables passage of information of accomplishment of the activity. Furthermore, any mismatch in colour while completing the circular form of the toy has immediately generated responses from the fellow students or teacher about inaccurate action, thereby enabling the students to recognize and correct the object and colour associations.

### **Group Play**

Another activity of play with the toy is planned in such a way that two groups of children are formed. One group gives a task to another group by placing any one element of the toy in the centre. The next group has to find the other matching elements of the toy from a lot of a number of mixed elements and correctly complete the circular geometry of the toy. Through this activity of group play children are seen to learn collaboration and social interaction skills.

### **Spatial Visualization and Orientation**

The study lead to the discovery that the shape based toy design evolved during the study encourages the basic spatial skill building activities like flip, turn and slide in children. Moreover, they are also exposed to solving problem by performing these transformations. A few play sessions later, children are seen to demonstrate understanding the geometry and spatial visual ability to complete the circular geometry of the toy. Children will not comprehend about the characteristics of geometric forms if they do not get exposure to such shape based materials. The current design of the toy encourages object identification based on colour, develops ability to relatively position the elements of the toy and instigates spatial orientation vocabulary.

## **4. Conclusion**

The study has facilitated the researcher to achieve the objective of finding how children learn alphabets in pre-primary school by observing children and teachers in their true environment. Findings of the study indicate that the current techniques used for alphabets learning in selected schools have been focussing on principles like object-image

association and repetition while children get feedback from the teacher or fellow students. It was also found that the process of learning alphabets can be done in an effective way through designing shape based educational toys which use same principles of association and repetition and generate feedback through their form, physical features. Early experience with designed shape based toys helps to form foundation of basic spatial skills on which more complex skills can be built. Moreover, the study has enabled the researcher in developing the confidence to expand the study by proposing fresh toy ideas and prototypes to the pre-school children. Thus, toy designers can effectively create shape based toy designs with Human Centered Design approach and plan activities with those toys so that young children are engaged in group play and simultaneously learn through it.

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