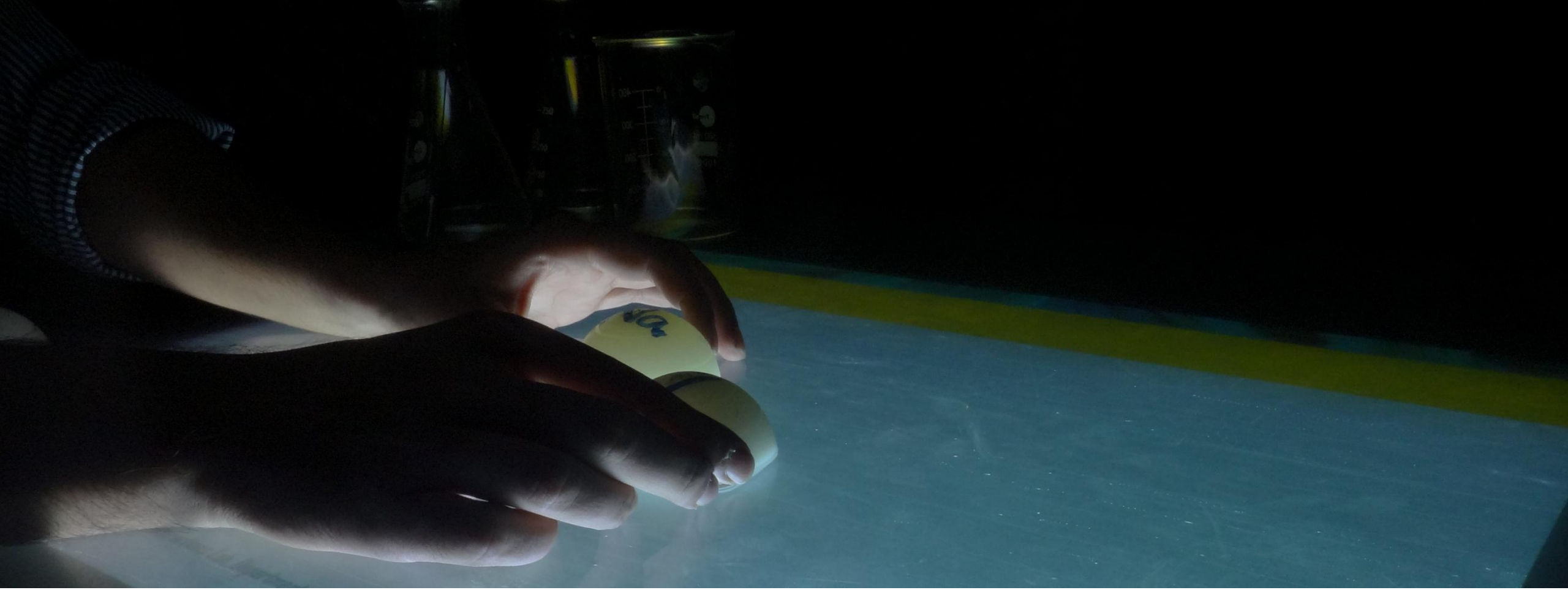


ChemicAble

Tangible Interaction Approach for learning Chemical Bonding

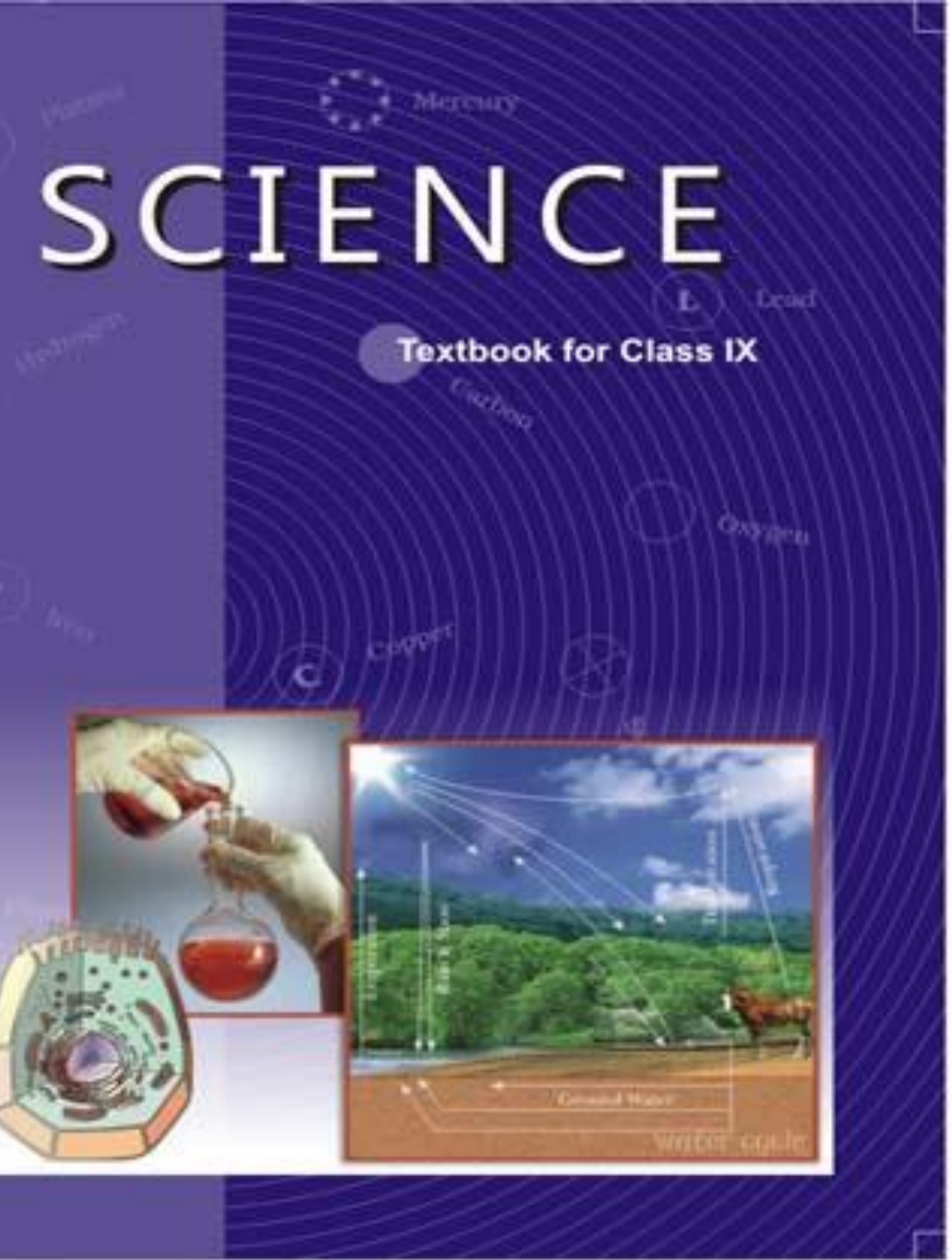
Mehul Agrawal, Minal Jain, Vikas Luthra, Ashok Thariyan and Keyur Sorathia

Flow of presentation

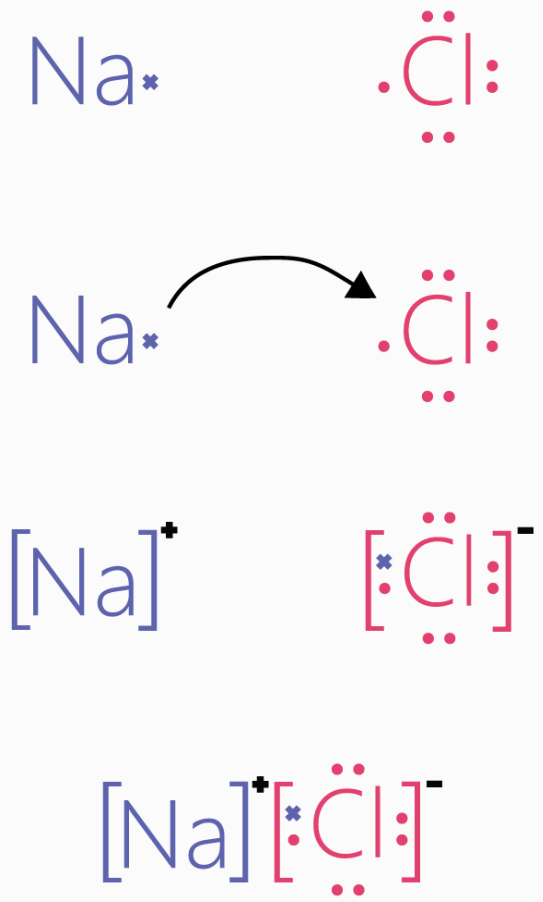
index

Current way of teaching chemistry in India

Lewis structure forms the base for understanding the concept of electron transfer for students of grade 8 and 9 in India.



Formation of NaCl by lewis dot structure



Current way of teaching chemistry in India

Chemical bonding is one of concepts students find most difficult to comprehend.

Abstract nature of chemistry.

No scope for exploration.

It is difficult to visualize.

The task of understanding the Lewis model and the electron transfer with the help of just text and figures is a really herculean one for kids.

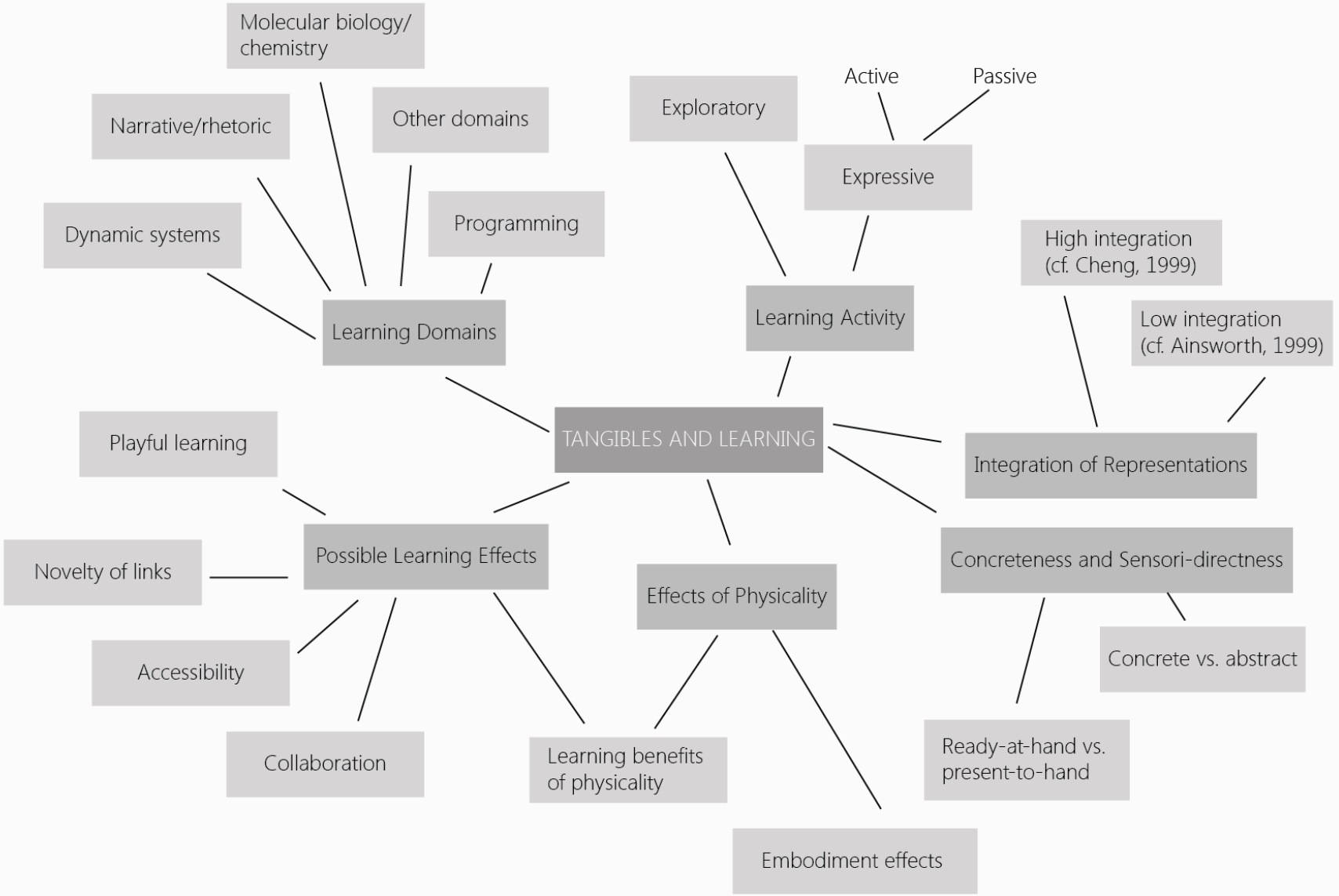
Lets take a look at alternative methods of teaching

Manipulating physical objects supports and develops thinking in children and hence tangible user interfaces might bring about expedited natural learning.

- Piaget's developmental theory

Piaget, J. The language and thought of the child. Psychology Press, 1998

Tangible User Interfaces

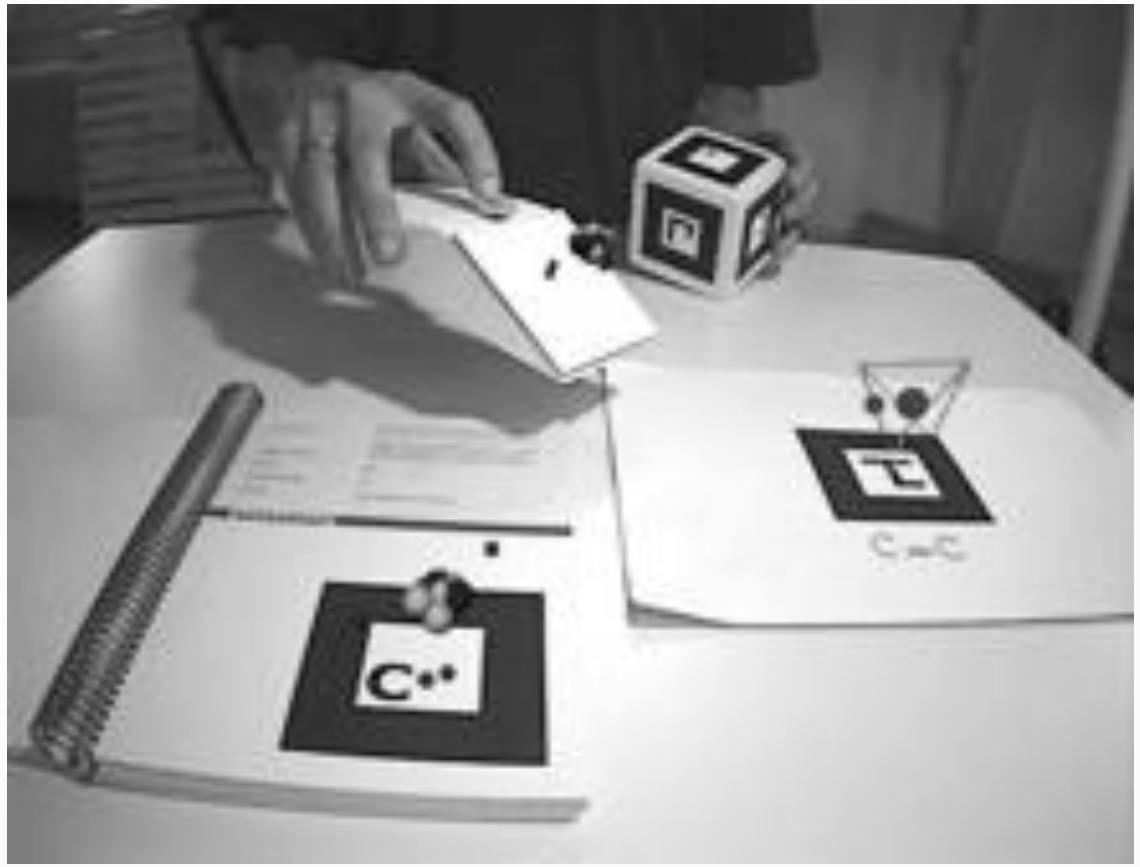


Analytic framework on tangibles for learning

Paul Marshall (2007). Do tangible interfaces enhance learning? In proceedings of TEI'07, 163-170

Augmented Chemistry - Tangible User Interface for Chemistry Education

AC system with back-projection screen



The rotation cube is operated with the right and while the constructed molecule sits on the center platform

Fjeld, M., Fredriksson, J.,Ejdestig, M., Duca, F., Bötschi, K.,Voegtli, B., Juchli, P. (2007). Tangible User Interface for Chemistry Education: Comparative Evaluation and Re-Design, proceedings of CHI'07, 805-80

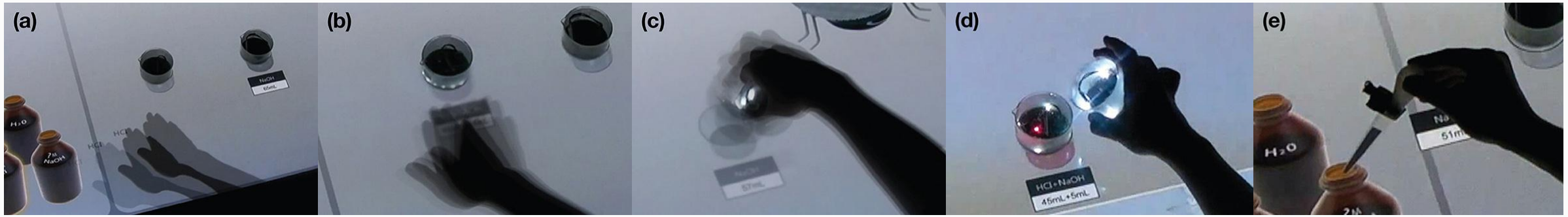
Chemieraum - Tangible Chemistry in Exhibition Space

First-person perspectives of the interface

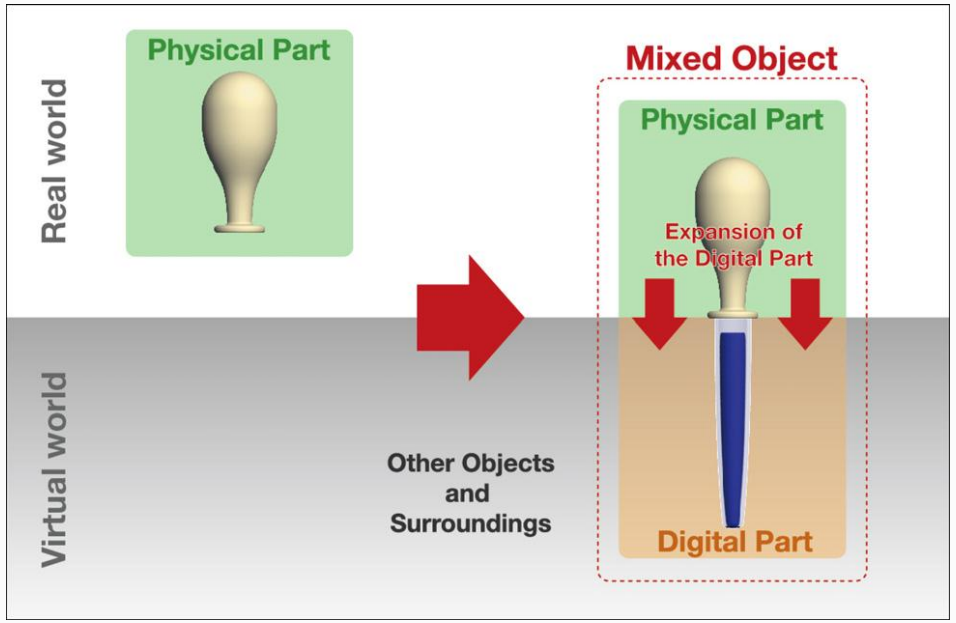
Usability test with pupils from secondary school

Gläser, T., Franke, J., Wintergerst, G., Jagodzinski, R. (2009). Chemieraum - Tangible Chemistry in Exhibition Space, Proceedings of TEI'09, 285-288

CheMO: Mixed Object Instruments and Interactions for Tangible Chemistry Experiments



Use of CheMO and detailed interactions



Concept of the Mixed Object - A MO pipette where the top is physical and squeezable, and where the bottom is a graphical representation of a glass tube

Song, K., Kim, G., Han, I., Lee, J., Park, J., Ha, S. (2011). CheMO: Mixed Object Instruments and Interactions for Tangible Chemistry Experiments, in proceedings of CHI 2011, 2305-2310

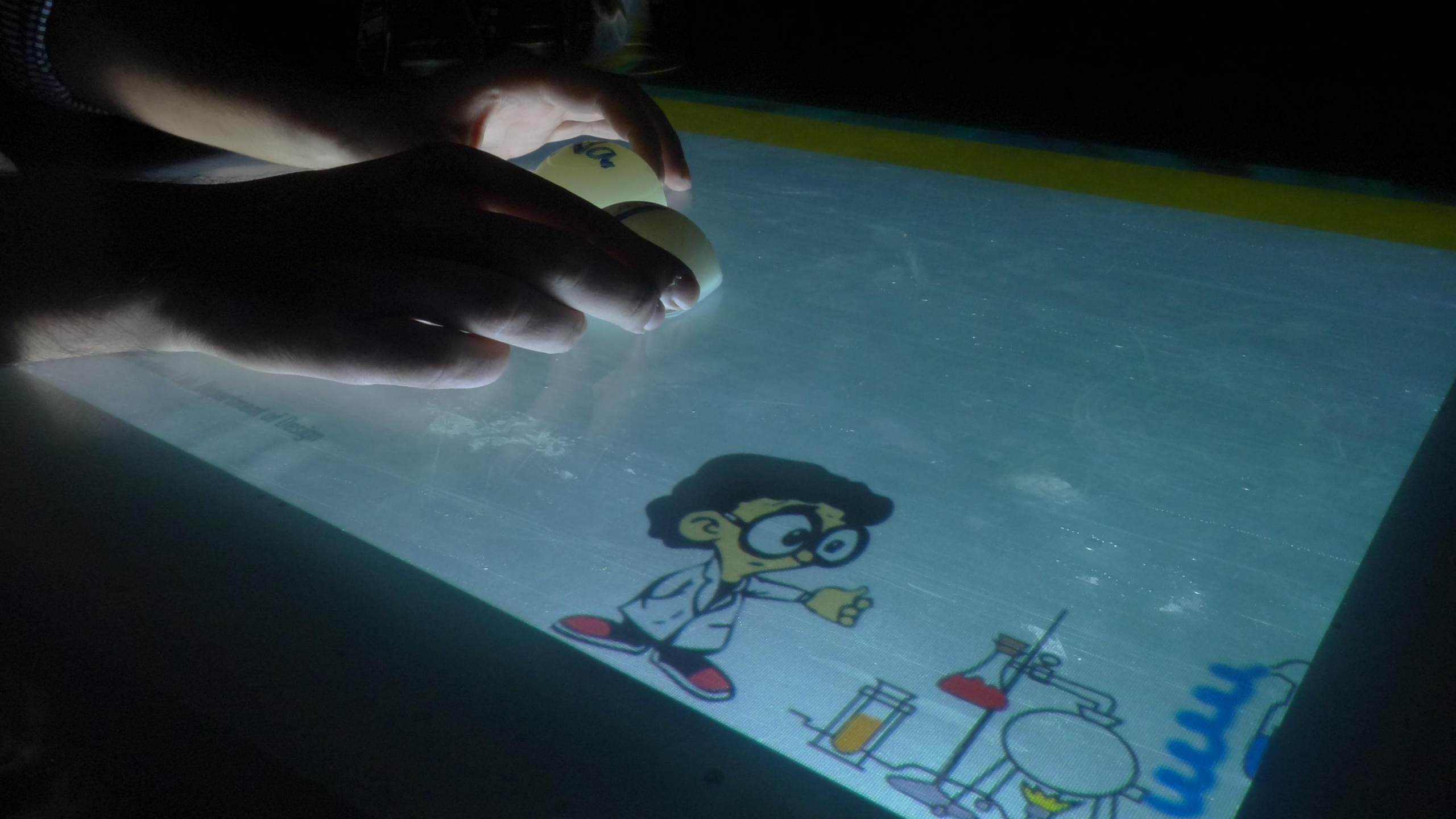
There hasn’t been any significant work done in this direction specifically for the Indian context.

There hasn’t been any significant work done in this direction specifically for the Indian context.

We try to leverage the concept of Lewis dot structure taught to Indian students and build upon that to develop a system particularly relevant for the Indian education system.

Introducing

ChemicAble



A tangible user interface that helps children understand ionic compound formation.

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Exploratory in nature and promotes collaborative learning with fun.

A tangible user interface that helps children understand ionic compound formation.

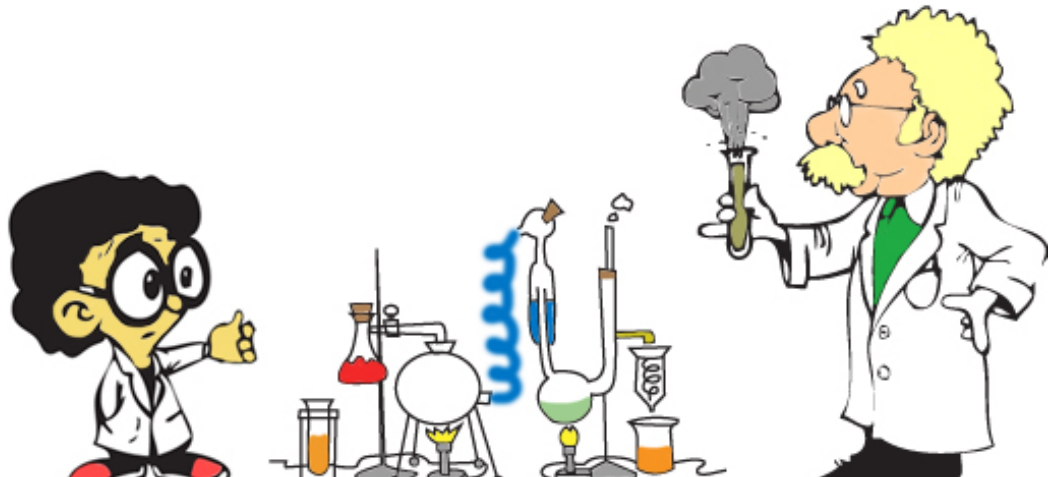
Exploratory in nature and promotes collaborative learning with fun.

Interactive table-top interface in which first 20 elements of the periodic table are represented by 20 tokens.

Here is how it works

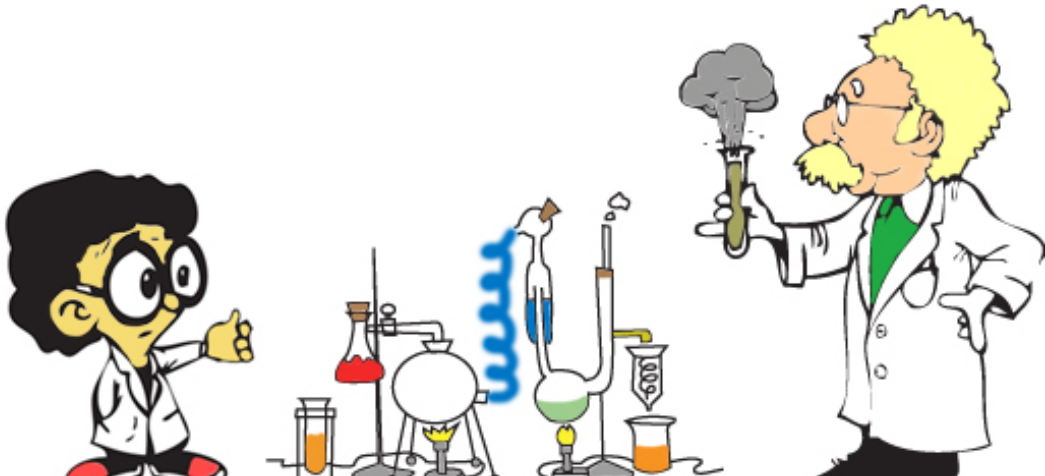
Fun with Chemistry

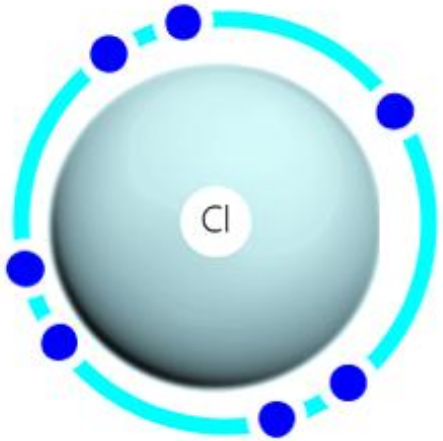
Embedded Interactions Lab, Department of Design



Fun with Chemistry

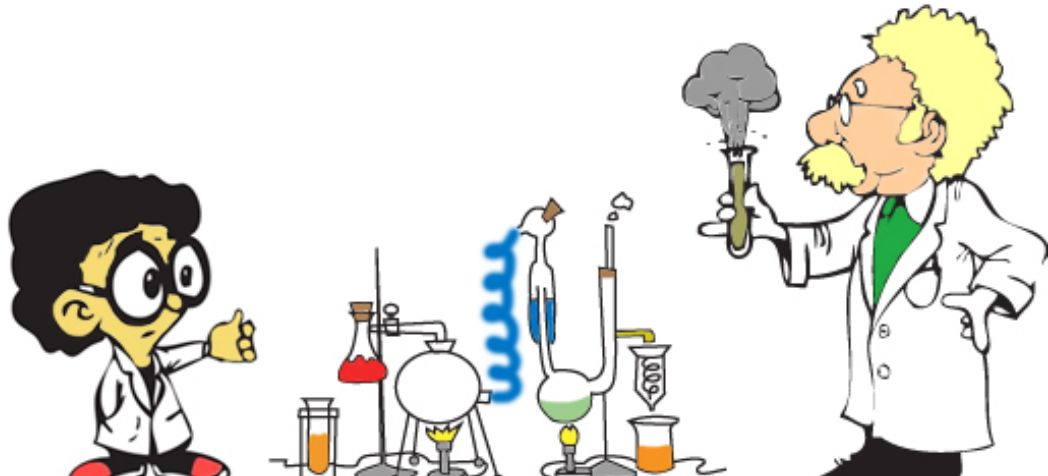
Embedded Interactions Lab, Department of Design



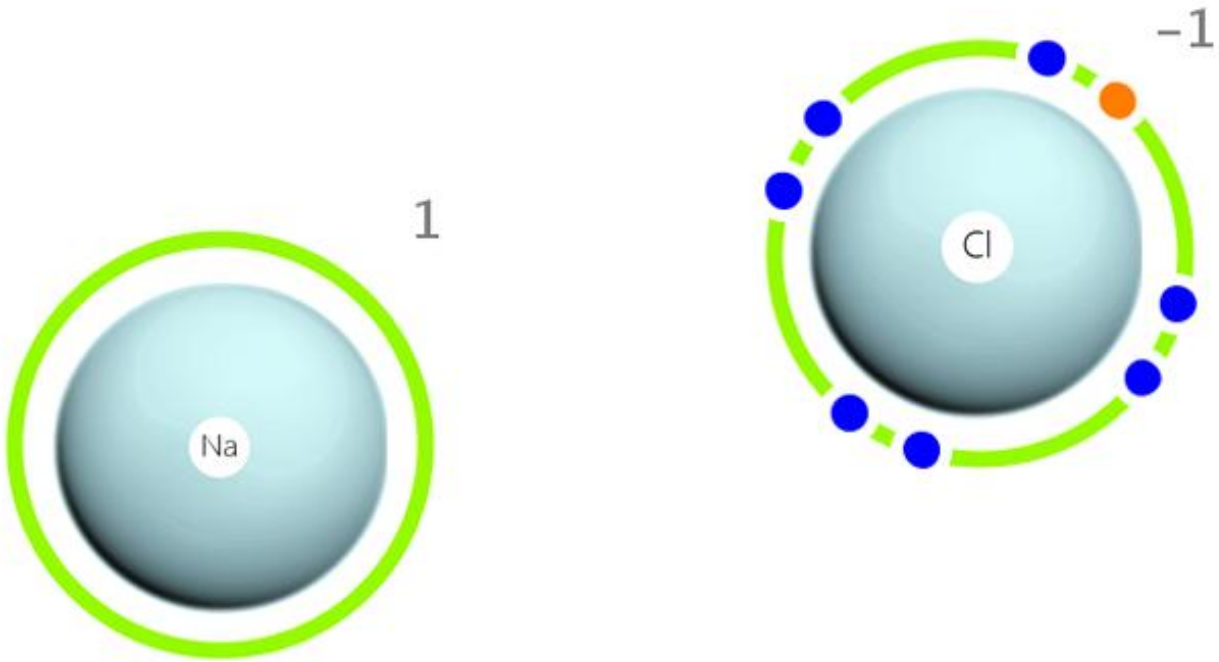


Fun with Chemistry

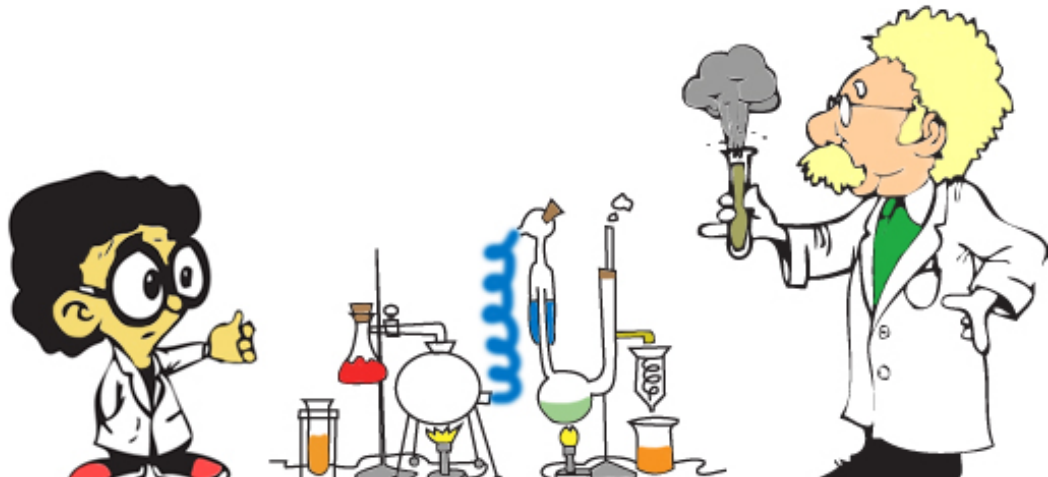
Embedded Interactions Lab, Department of Design



NaCl



Fun with Chemistry Embedded Interactions Lab, Department of Design



System Design Consideration

For Indian students

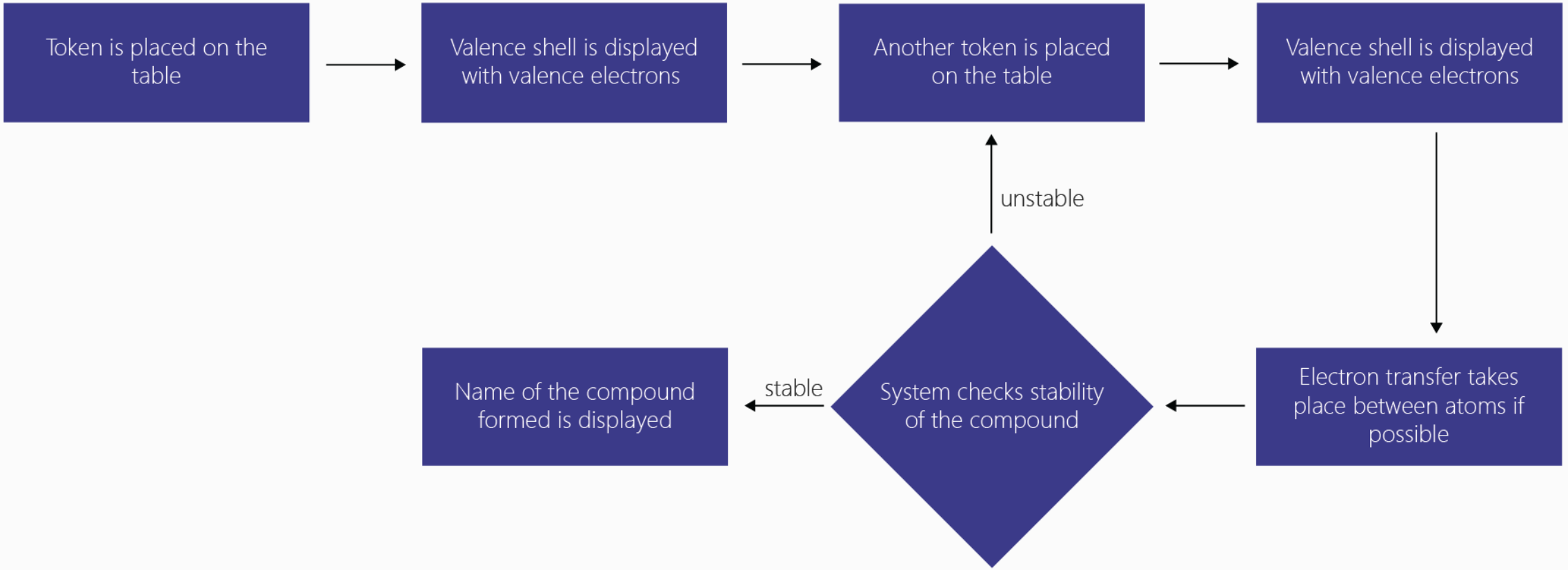
Learning through exploration, trials and failure.

Collaboration

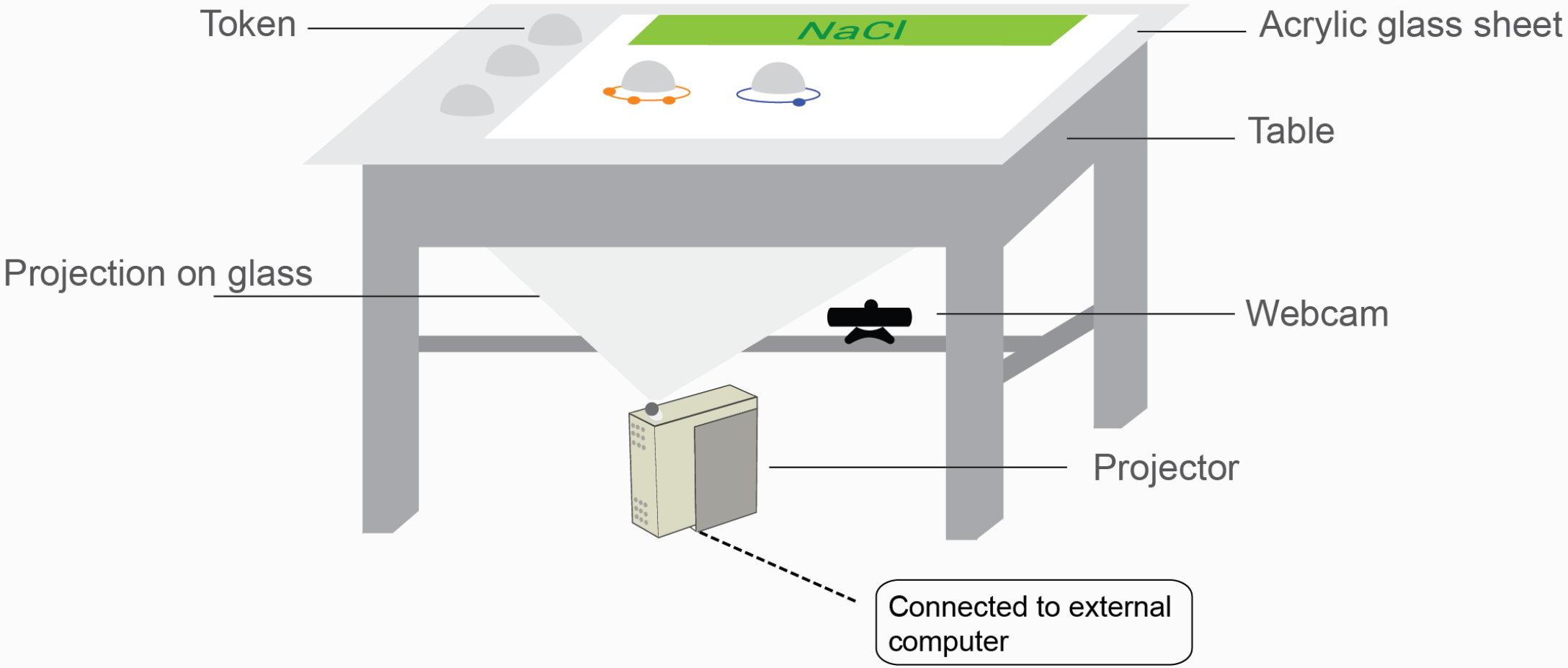
Proceed in small steps

Feedback

Task Flow


Token is placed on the table
Valence shell is displayed with valence electrons
Another token is placed on the table
Valence shell is displayed with valence electrons
unstable
Electron transfer takes place between atoms if possible
System checks stability of the compound
stable
Name of the compound formed is displayed

Basic Setup of ChemicAble



User Testing

Aim of the testing was to observe and measure ease, engagement and understanding of the system for students of grade 8-10.

4 point likert scale was used in the questionnaire to be answered by the students and detailed observations were made.

Interaction with Dr. LN Gupta

It was presented to Dr L.N. Gupta, the chemistry teacher at Kendriya Vidyalaya.

He found it very useful and suggested addition of covalent and co-ordination compound formation to the system.

He also suggested showing a real ionic compound formation visually as opposed to showing that just through text and colour based feedback.

Discussion (positive points)

Collaboration- Students enjoyed exploration and they grasped the method of interacting with the table better when in groups than when alone.

Exercise Tool- Students used their prior knowledge of chemical bonding taught in class to figure out which atom to bring next.

Display penultimate shell in metals

Students found problems in deciding whether a metal had become stable or not.

The cause for this was that only the valence shell of the atoms is displayed on the table. So when a metal loses electrons its valence shell becomes empty and the octet stability of its penultimate shell is not visible.

Future Work

Addition of covalent and co-ordination compound.

Multi-modal feedback – accompanied by haptic and auditory response.

Transfer dependent on proximity of atoms.

Thank You!!

Department of Design, IIT Guwahati