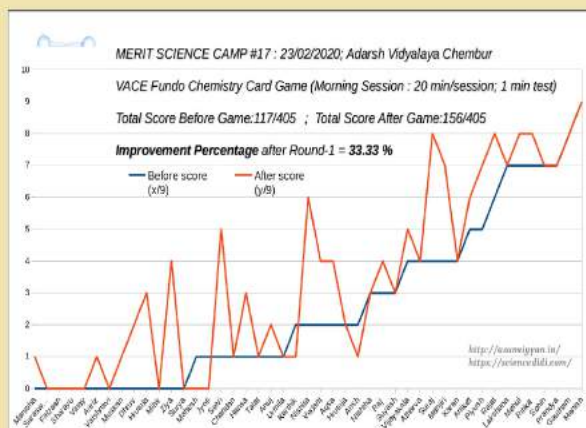
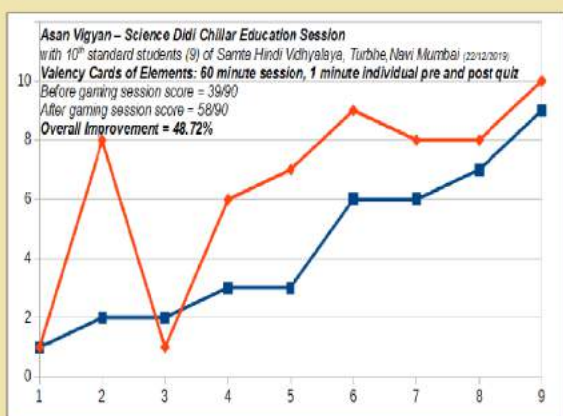


ASAN VIGYAN SCIENCE EDUCATION JOURNAL -1

A scientific inquiry into innovative education methods



FUNDO Card Games



Available @

Play 'N' Learn



- 3b Elements
- Atomic Number
- Electronic Configuration
- Symbols
- Valency
- Groups & Period
- Chemical Properties
- Chemical Behavior



For Workshops, Teacher Training and Product
 Contact:

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Introduction

“If we teach the same way to today’s students as we taught yesterday’s, we rob them of tomorrow”, was quoted by Professor John Dewey in the early 20th century of USA, a renowned professor of philosophy, promoter of rationality, pragmatism, reflective thinking, functional psychology, education and democracy. For feeling his impact we need not look to far, Dr B R Ambedkar who drafted the Constitution of India, and many serious students of history would arguably consider him the father of modern (millennial) India, is one among his many remarkable students!

Inspired by their lives and lessons, *Asan Vigyan Jigyasa Science Journal aims to provide a platform for share the excitement of inventing novel methods of learning and testing it out in the field, collecting results and reporting it in an as-unbiased-as-possible manner.*

Our first journal consists of novel card games based methods for learning the periodic table. This method is basically about learning the rules of very popular and well known playing card games, creating new rules and then applying the same to unlock the patterns and informations hidden within, arguably, the most beautiful puzzle ever solved by humankind, the modern periodic table.

The methodology applied is that of micro-learning and spaced repetitions to boost learning and memory, more of that is discussed here (<http://asanvigyan.in/2019/10/24/micro-learning-and-spaced-repetition-and-revision-to-boost-learning/>).

We also wish to emphasize collaborative non zero sum game based approach, (<http://asanvigyan.in/asan-vigyan-a-collaborative-non-zero-sum-game-approach-to-science-education/>) and encourage teachers and learners of all ages to create a playful atmosphere for learning science where making mistake is not a crime, and request more “serious educators” to implore and ask, “Why so serious?”

Methods to learn and assess the learning are provided for educators to test them and maybe develop their own methods and share it back! We invite all scientists and science educators to contribute their educational and scientific methods of progressing in the journey of science.

Bon Voyage!

New learning and assessment games based methods to report the effectiveness of VaCE Fundo card games for learning the periodic table of elements: From Hydrogen-1 to Krypton-36

Nikhilesh Nisarg (<http://asanvigyan.in/>), Linsha Prakashan & Jogitha Josey (<https://sciencedidi.com/>)

This communication is to share the encouraging results of two sessions of card games based learning and assessment developed at Asan Vigyan Start Up Idea Lab (<http://asanvigyan.in/science-start-up-idea-lab/>) in collaboration with women-empowerment oriented science education start-up, Science Didi (<https://sciencedidi.com/>).

The “Play n Learn” cards is an in-house science education product, manufactured and sold as Fun-do Chemistry Card Games: Valency Cards of Elements.

Amazon link: (<https://www.amazon.in/Fundo-Chemistry-Card-Games-Elements/dp/B082Y3XGTG/>)

Images of the same are given below.



Using these card games two educational sessions were carried out with protocols aimed for maximizing learning and memory. To study the effectiveness of the new card game based methods of ‘Play n Learn’, new assessment methods were also developed. The same were tested with students of Samta Hindi Vidyalaya, Turbhe, Navi Mumbai and Adarsh Vidyalaya, Chembur, Mumbai.

1) With 10th std students of Samta Hindi Vidyalaya, Turbhe, Navi Mumbai (22/12/2019)



A total of 11 students from Samta Hindi Vidyalaya, aged 13 to 16 years, participated in the study to assess the effectiveness of playing Chemistry Fundo Card Games: Valency Cards of Elements, for learning and remembering the name, symbol and atomic number of the first 18 elements of the periodic table correctly. 2 groups of 4 and 1 group of 3 were made and parallel learning sessions were conducted separately.

Method: Prior to the learning session, a pre test was carried out, one candidate at a time individually. The test methodology used was a rapid round quiz of 10 elements whose atomic numbers will be revealed for which the student should give the right answer within 5 seconds. One marks for each right answer and none for wrong or no answer. After the pre test, a 1 hour long parallel learning sessions were carried out using 36 VaCE fundo cards, which included the following as learning games:

- 1) More the Merrier
- 2) Less is More
- 3) Special Someone
- 4) Two on the top
- 5) Periodic Pairs Memory

The rules of the games can be found in:

(<http://asanvigyan.in/2020/03/07/valency-cards-of-elements-10-in-1-rules/>)

Play ‘n’ Learn Protocols for improving the effectiveness of learning: Some rules were developed so as to maximize learning of chemistry to add more layers of learning over seemingly

just for fun card games. Some more rules were developed to keep intact the fun part of the game so that these sessions give them a sense of being in play room and not bear resemblance to a “serious” classroom in any possible way. These are as follows:

- **The Cardinal Rule of element name-calling:** Irrespective of the game, the cardinal rule of VaCE cards was emphasized *that atomic number and element name has to be called out together in each and every turn or else the “turn” won’t be counted*. Reiterating this rule seemed necessary as early learners have tendency to play the games using atomic numbers only (in a way learning basic arithmetic and number line!) and if given a chance, would dilute or delay their pursuit towards learning of chemistry.
- **The playful power of score-sheeting:** In each game, a score sheet was maintained by one of the gaming participant. Each participant took turns to write down the cards and element names for the players and conduct the game. The objective of making the learners maintain the scoresheet was to first increase the residence time of each round of elements revealed through the game and attach a gamified point system which makes the process more emphasized by writing it out. Taking turns to write was something everyone agreed to, if not for the intent to learn, but for obviously sharing the tedious work! Score-sheeting also means generation of data, which provides rich and fresh content for teaching some statistics and graph plotting!
- **The emotional objective of Play ‘n’ Learn:** One often neglected part in many traditional schooling system is the emotional aspect of learning. Here we wish to clearly emphasize that we believe in a learning atmosphere which involves low level competition and higher level co-operation, with fair amount of focus on independent student centric assessment and learning over exam centric competitive approach.

Each group during learning session included both advanced learners and beginner learners, i.e. advanced learners are students who fairly know the atomic number and names already and who scored more than 5 in the rapid round test out of 10, and the beginner learners are those who need more training and scored less than 5 in the pre-test.

Results and Analysis:

The genuine need for pre and post session data: Each and every educator goes through what one may call an “edu-phoria”, a feeling that the new learning method developed will be highly effective for all learners, every learners eyes will sparkle after learning this method and attain Buddha like nirvana, its the best learning method in the world! In order to impose and reinforce a sense of reality and rationality to the whole process, pre and post assessment studies were carried out for grounding our edu-phoria over hard facts than fiction.

The post assessment test was the same as pre-assessment, rapid round of 10 atomic numbers quiz. The graph of the learners are plotted below. Out of 11, 2 students did not give the post session assessment test, so comparative study on only 9 students can be made. Some patterns were observed when determining the improvement percentage independently for both advanced and beginner learners.

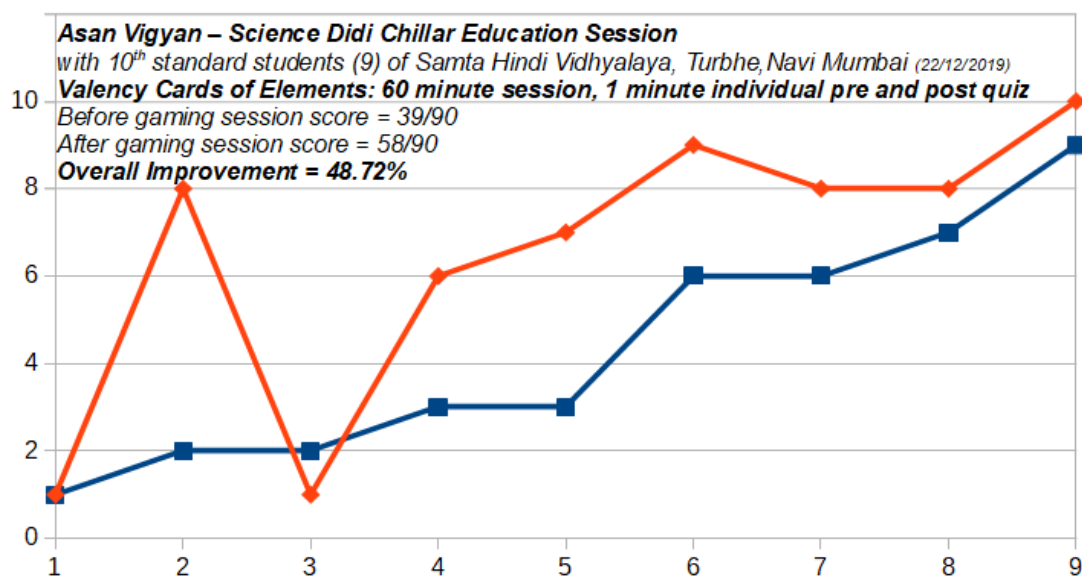


Figure 1: Points gained by students pre and post game session in ascending order of their pre-session score

Before VaCE session score / After VaCE session score

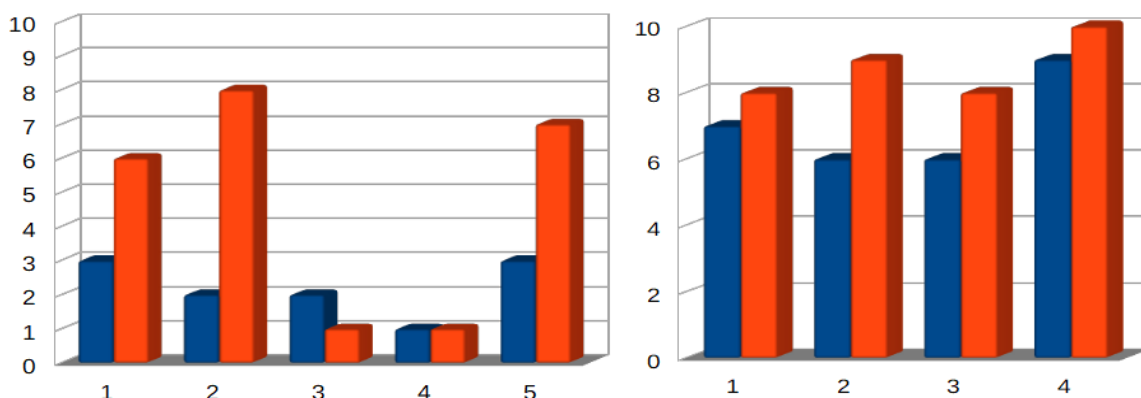


Figure 2 (a & b). Comparison of points of “Element Detective Quiz: Atomic Number” scored by 10th standard students before and after the VaCE Fundo Chemistry Card Game session at Samta Hindi Vidhyalaya, Turbhe, Navi Mumbai

From the above data we report a consistent improvement in the scores of 7 out of 9 students with overall improvement of about 48 %. In Figure 3 (a), there are 3 examples of those who showed remarkable improvement to score > 5 from their initial points of < 5. Among students who already knew about some elements, improvement is seen in all the students, with one student attaining mastery by scoring 10/10.

2. Fast, multiple Play ‘n’ Learn VaCE card games session with 8th, 9th and 10th students of Adarsh Vidyalaya, Chembur at MERIT Science Camp, Tata Institute of Social Sciences (21/02/2020)



Our next study was carried out during MERIT Science Camp at Tata Institute of Social Sciences, Chembur with students of Adarsh Vidyalaya.

The MERIT camp: Mumbai Education Research and Innovation Training (<http://meritmumbai.org/>) is a field action project of Tata Institute of Social Sciences which provides a platform for school students to be educated about science using experiments carried out by professionals from their respective field. The MERIT camp follows a method of organizing the children in groups of 7 to 8 and forming 6 such groups where turn by turn simultaneous sessions on science experiments and methods are explained by professional scientists and science educators in the city. One such stall was assigned to us for gaming session of Fun-do Valency Cards of Elements.

Quick written Quiz Assessment: In order to develop a method to teach and assess more number of students simultaneously, the assessment method was changed to short 30 seconds written exam format wherein the learners should fill the symbols of either the even or odd atomic number elements of the periodic table.

QnA	Atomic Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	Symbol	H	He	Li	Be	B	C	N	O	F	Ne	Na	Mg	Al	Si	P	S	Cl	Ar
Even- Q	Atomic Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	Symbol	H		Li		B		N		F		Na		Al		P		Cl	
Odd- Q	Atomic Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	Symbol		He		Be		C		O		Ne		Mg		Si		S		Ar

Figure 3: Pre and post session quiz element symbol quiz for the VaCE Chemistry Card game learning session

The game session included 1) More the merrier 2) Less is more 3) Special Someone 4) Two on the top 5) Periodic Pairs Memory. Rules of the same can be found here:

<http://asanvigyan.in/2020/03/07/valency-cards-of-elements-10-in-1-rules/>

After a 15 minute session, the same test was repeated.

Everyone gets full set of cards: In these sessions, each individual gamer was given and gifted their own set of cards to play with in order to given them more familiarity and help build friendship with the elements.

Results and Analysis: A total of 45 students participated in the gaming session, and their results pre and post session is given below.

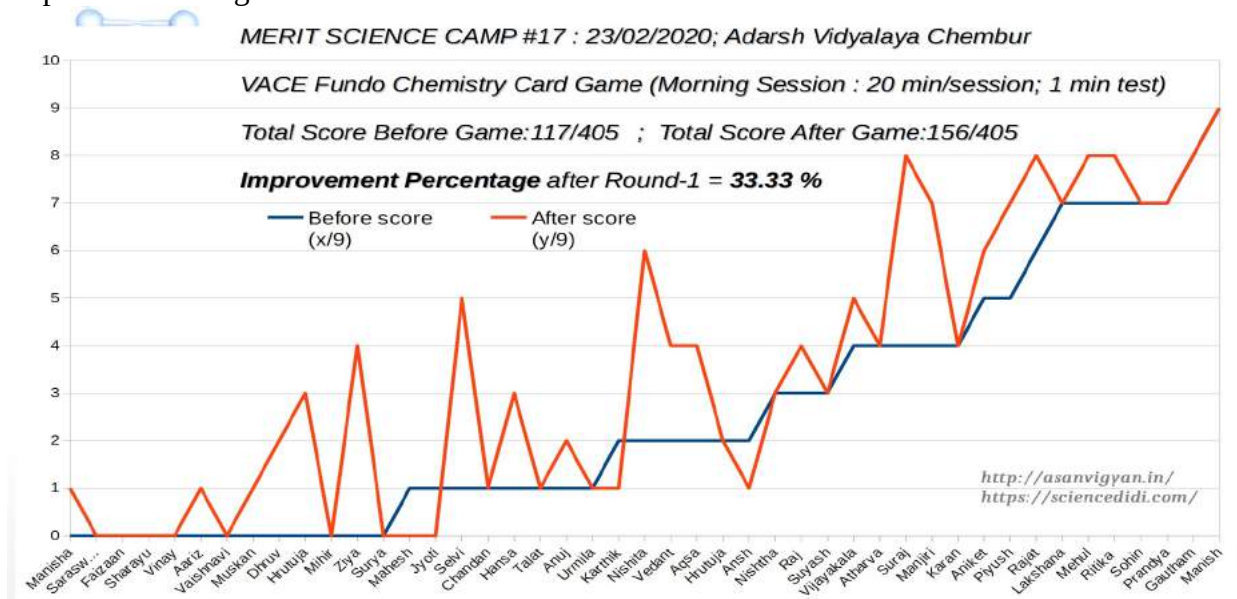


Figure 4. Points gained by students of Adarsh Vidyalaya arranged in ascending order of pre-session score

Herein we report an overall improvement of 33.33%, indicating effectiveness of even short sessions of gaming. One objective of Science Didi and Asan Vigyan is to address the issue of low representation of women in the science stream in India. Another objective is to break the age old myth like “Science is for boys”/”Arts are for girls” and prove that under proper guidance every human can attain mastery in any field irrespective of their gender.



Figure 5: Gender wise distribution of scores mapping growth area for students of Adarsh Vidyalaya

A classic comeback: The above bright yellow colored graphs in Figure 5 (a and b) adds weight to latter. Here we see the region shaded in yellow, is the growth region where there is improvement in the score of learners after the session. Grey area indicates dip in the score after session.

Initial average, final average and improvement % have been tabulated separately for girls and boys. If we see the initial average, it indicates boys had a huge upper hand than girls, with their averages being 3.125 and 2.0 differing by 1.125 unit out of 9. But the scores after the session can be seen as a classic comeback! When boys achieved a decent 18.67 % growth, girls recorded phenomenal improvement of 59.5 %, a lions share of the overall collective improvement of 33.33%

What it seems to indicate is that boys in general read more science, as seen from their pre and post scores, and girls here proved to be more attentive during the session and took the most advantage, as seen by their remarkable growth.

Further similar 3 sessions are to be conducted for more data collection and better accuracy of our analysis.

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