
VISUALIZATION TECHNOLOGIES, COGNITION AND LEARNER**Harsh Poddar*¹, Jaimin Singh*², Kaushal Vir Jain*³, Mansij Kaur*⁴, Rajat Kumar*⁵**^{*1,2,3,4}Student, Department of CSE Engineering, DGI, Greater Noida, UP, India.^{*5}Asst. professor, Department of CSE Engineering, DGI, Greater Noida, UP, India.

ABSTRACT

COGNITION, refers to the process of thinking, comprehension, judging the problem solving methodologies and various aspects of human mind and intelligence. Human intelligence is, not mere perception but inexplicable roles played by all the five senses. In rationalising the role of all these senses there is another important, rather most important of all sixth sense. The basic role is visualization which is the basis of all the hunches and inspiration within the realm of human being. Now, cognition has various effects on the education of humans. In fact, the visualization technology can be used for helping learners in understanding, implementation and prototyping of various algorithms using different data structure in Computer science and technology. This can be very helpful in real-time implementation in classrooms and in various web applications, including the implementation of various fun 2-D and 3-D characters. These methodologies not only helps in cognitive learning of various data structures and algorithms but also built a rapport for visualization technology and cognitive learning. Thus, visualization technology prototype can be innovation at a psychological level and be helpful in long run.

KEYWORDS: Visualization, Cognitive Abilities, Learning, Thinking, Comprehension, Cognition.

XXXVI. INTRODUCTION

Since the inception of all kinds of interrelated and interdisciplinary fields that involves mind and the processing behind that complex network of neurons, there stood a strong and firm place for studying how cognition helps us in learning and how we humans perceive things and think. The human brain perform various functions involving some high-level functions such as imagination, perception and planning. From the last 30 or so years, the psychologists have been trying to understand and implement various learning techniques that is in agreement with the minds and cognitive abilities of humans. Anyone who can perceive things, comprehend them according to their own cognitive abilities like thinking, learning, remembering, deducing from past experiences can use this technique. These various learning techniques resulted in a tail-end conclusion, visualization. Scientists have been trying to find a way to use this and connect all the dots leading to our conscious and subconscious part of brain.

Visualization is an important aspect human lives, especially when it's about anything that is rationally easy to understand but reasonably not so easy to comprehend. Whenever there is any emotion, sensation or perception involved in any situation, we generally process it subconsciously and invincibly stores that information in the temporal lobe of cerebrum. Now, using visualization for learning various aspects of technical education including various data structures, algorithms and the implementation of these in the real time environment involves a big relational understanding between educational policy makers, innovators, teachers, learners and entrepreneurs. The understanding of various things are done with the help of cognitive abilities of the human being. Various factors are involved in understanding the cognition and how it can be helpful in getting professionally sound in this highly competitive world which at the same time technologically advancing. Cognition involves various thoughts and intelligence which sometimes uses previous thoughts and knowledge about it, to help the conscious in making it easy to comprehend. Since we are talking about visualization, imagine the line for receiving gifts, during Christmas. You'll see in your mind that the person who is first in line receives them first and then next one and so on and so forth. This is exactly what you were taught to visualize when you were first taught about the queue, in your initial days of technical education. Even after so many years of learning we still remember how we used CDs in a good old fashioned stack, Last in First Out (or LIFO) order. This is just visualization helping us in learning some of the basic data structure hence, the cognition. We prefer the use of as charts, graphs, lines in better understanding of thousands and thousands of data rather than seeing them in excel sheets. Visualization technologies makes it very easy for the learners to visualize and cognitively affects learning capabilities. The E-Learning capabilities, at the time of writing this has made it

further easy to implement the idea of visualizer in technical education. It's not only about the visualization and learning but also about the effects of competitiveness on the cognition of the learner. The use of friendly 2-D and 3-D characters by the user end of the application makes the learning easier and at the same improve the productivity of humans.

Whenever there is any learning involved with humans, the cognitive power is bestowed with the difficulties of competitiveness of real-time learners with different cognition. Instead of competing with the outside world if we humans do a competitive cycle run with oneself, it uses the cognition to the best of its abilities. Tolerance level involved in competing is as high as it can be without hampering cognitive abilities. There are various technologies that uses the cognitive abilities and visualization techniques for learning about various aspects of education and technology. Cognition tends to help anyone in comprehending the reality and thinking with the intelligence. Adding a level fun makes the cognition more aware of self. The visualization of idea, desire of growth, imagining the path or outlining of plan that anyone, let alone the innovators, the educators, the learners or the elite needs to follow is the most basic ideation of project.

XXXVII. METHODOLOGY

Traditionally, learning involved more of verbal interaction and less of virtualization as well as use of technology. The late 20th century called for the innovation in the conventional methods of learning, reason being the efficacy in learning. With the boom in the IT world and innovation deemed in the wrath on the conventionalism, the visualization came into fill the gaps in learning. The legacy of visualization included only a possibility in learning. The building block of virtualization depend upon the concreteness of the graphical representation.

With the increasing usage of technology, making the world an exploration of innovation, virtues came in handy. The benign virtues of technology includes what is understood to be one of greatest innovation of all, learning from home and more importantly the representation of all the theoretical concepts of technical education. The algorithms, different data structure, the usage of kernel in implementation of all the processes in the operating system, the system time usage concepts and the basic quants that helped the user interaction with the computer. The interaction of human with graphics, was based on the understanding with which innovators and researchers uncovered the basis of cognitive abilities of humans. The cognition in human being involves comprehension and thinking as well as knowing and remembering. Unless there is any activity involved on the learner's end, any level of virtualization not necessarily, can be of any use to the user (or learner). Our idea of implementation can be involving:

- Deduced learning based implementation
- Graphical representation of algorithm and data structure
- Theoretical views based on execution history
- Technical learning core idea of team based learning
- Multitude of thoughts and discussing forums

Largely, any technical based learning can be profound in its way of dealing with challenges faced by the industry in form of team based learning. Any learner, no matter the level of experience faces a challenge posed by improvisation in technology and learning. The peer to peer learning can be an improvement in the reality and the comprehension is excelled by this. There is an old saying, everything is in interconnection which circumnavigates the idea of cognition and visualization in learning, just like the tip of the iceberg.

Whenever the learners engage in use of cognitive abilities to think, understand and learn something new, it compounds itself. The result of this compounding is what we call innovations.

With the review of the idea, interactions, research and discussion we navigate a way for innovation and improving the efficacy and realities of the learning. Now the ideation can hit us just as hard as any of the realities. But it is the plan that need to be well thought of and researched upon that makes it a go-to plan, the plan to realism. Socialization was thought of as conventional get together of the people we know, but some guy in a dorm room of Harvard thought of making socialization, less defined by the boundaries of realities but more of thoughts. The desire to learn was first, of all the steps that led to the greatest innovation of all time, but it really was the imagination, the planning, personalised knowledge in form of experience and observation that made all the difference and the unconventional approaches that lead to innovation.

BACKGROUND:

The importance of understanding the concept, not just remembering mere facts can be a job no one wants to be in and preceded by traditional methods of studying in technologically advancing world and calling for innovation in each and every aspect of our life, cannot be amounted. While studying lots of different data structures and methods which will be helpful in developing the skills required in any field relevant to the technical education, we are receiving a basic static level of information that doesn't appeal to our senses, very highly. The learner's perception of peer to peer understanding is unanswered, as experienced from our own personal experiences. This aspect lead to our ideation of a platform that is based on the challenges that is faced by learners and teachers. The visualization platform for understanding the algorithms. Whenever we observe any of the platforms available for e-learning, there exist a dilemma of competition among peers, the unending race of defeating each other. The undivided focus that is needed for learning and thinking about the subject in hand, shifts leading to a decreased and poor understanding of concepts. So, on our way of solving problems, the gist of learning is lost. The enthusiasm anyone feels, when learning anything depends on firstly, the mindset of the learner while understanding the concept. Secondly, the underlying cognitive abilities of the learner. This dependency makes it even harder for learners to grasp the concepts, the algorithm, the working of the algorithm, and above all its usage in real time situation that is the core responsibility of any kind of education, irrespective of language we speak. The visualization and graphical representation of various algorithms makes it easy for understanding and help in its usage in future.

XXXVIII. MODELLING AND ANALYSIS

Within the taxonomy of the visualization, viewing can be considered as the core of the various forms of visualization. Viewing can be inclusive of various structures, graphs and charts. The ideation being pursued involves a long and rigorous research and a thorough analysis of all the various platform available. The work that's needed in the field of education, regarding the learning and comprehension. There is availability of various platforms that educates us about:

- Data structures, such as array, linked list
- Algorithms such as sorting, searching
- Dynamic programming such as N-queen, water jug
- Trees and graph based algorithm such BFS, DFS

In the realm of the reality the usage of charts, along with JavaScript is done for developing a platform that is based on the visualization technology but has its own unique feature that involve what we call the cognoa. The idea to development involves various ranches, including the prototyping of the basic idea upon which the feedback is taken from various students of technical education. The feedback is used for the carving the perfection upon the prototype, into an actual platform that helps any interested learner in getting education, levelled up by the innovation and improving by the data analysis of the relevant data obtained from the users. The cognoa is basically the using of cognition analysis of various user, not just based on their progress in the platform but on the responses of the user. The inclusion of forums is also very important whenever talking about the technical education. The most important and interesting part is in the progress tracking. The progress tracker will have an unconventional character that so much tells about the progress of the learner along with some constraints. The important aspect of any learning environment is community. Keeping that in mind the community available can be more if a team, rather than being competitive in nature. The hindrance in growth that is caused by any sort of competition, can outnumber the positives of a healthy competition. The discretion of prototyping and real model depends on user, the test-case data, raw datasets, psychological understanding of the user as well as that of the developer while seeing the datasets involving various learners with varying cognitive abilities.

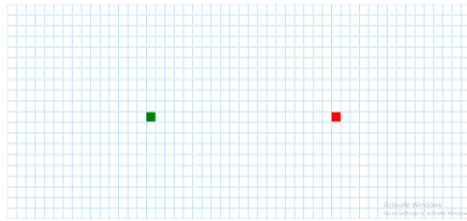


Figure 1: visualization of two points for djikstra algorithm

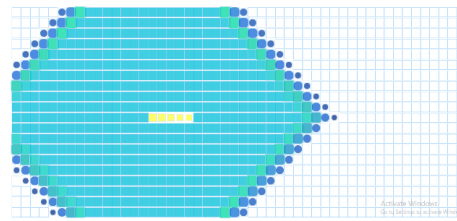


Figure 2: working model of the proposed platform idea

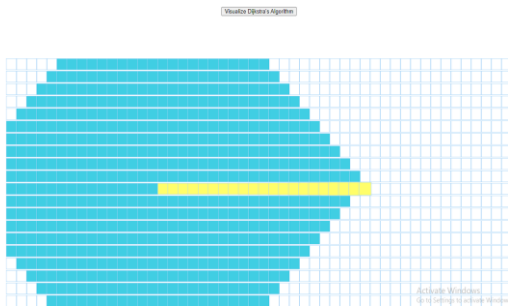


Figure 3: simple path studying description

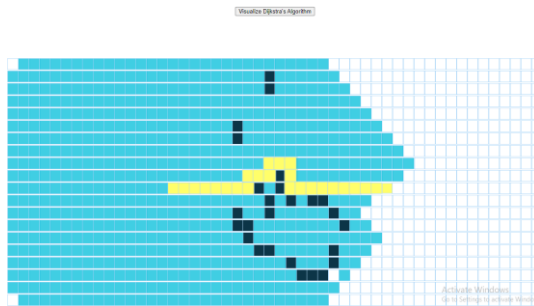


Figure 4: shortest path traced in the platform

The results of all these research and feedback questionnaire were description to what was expected and what appeared as the outcome and are discussed in the next section.

XXXIX. RESULTS AND DISCUSSION

This section of the paper discusses with results that were obtained after the controlled experiment which were carried out on the different volunteers, within different groups. For the purpose of looking at the working and user reaction toward the prototype of the platform developed, we chose to perform various tasks required for understanding the cognition as well as the changes in the result that are occurring. The following description of the prototype and the delegation of the various data into different sets. Based on the sets, the user is then asked for a feedback questionnaire to understand the fallacies that affects the result.

With all the research done and prototype of the idea ready, it was now time for user testing of the idea. The prototype included registration process to the platform, the section of the username and the favourite character. We recorded some of the videos for teaching about any particular algorithm, let's say djikstra algorithm. Followed by the visualization and quizzes in some cases whereas, normal static teaching with quizzes and no site of any visualization for some users. This simple partitioning of the users, gave us the datasets for various analysis during the development.

The survey was conducted keeping mind all the different sorts of people, including the educators as well as students. The conduct of survey was not only the questionnaire, regarding the work the prototype is doing but also, the future. The feedback is taken from different volunteers, data available from the relevant psychological and cognition researches. The surveys was divided within the following frame:

- Demographic of the learner or educator (depending on the choice)
- Details entailing the level of user (novice, advance, pro)
- Age of the user (16-18, 18-24, >24)
- The purpose of learning particular topic
- The reaction and feedback while taking quizzes and results
- The activities within the community forum

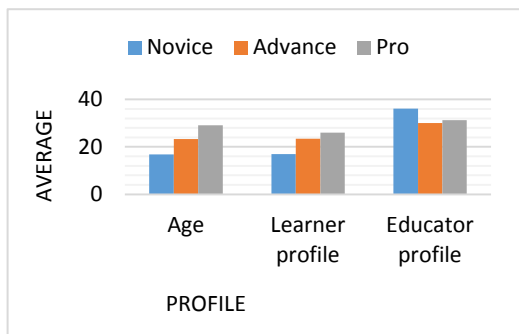


Figure 5. Graph showing profile of users

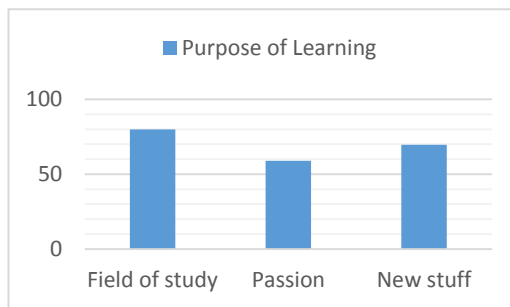


Figure 6. Graph showing purpose of user

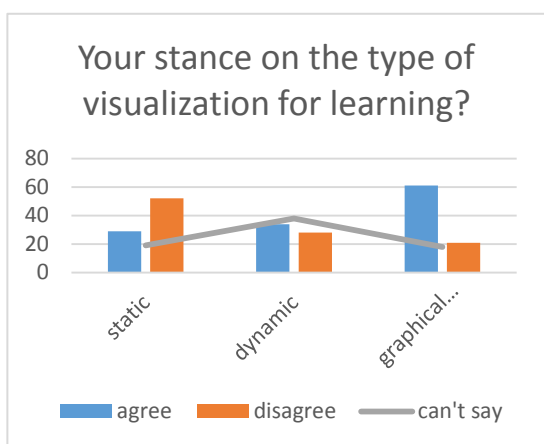


Figure 7. Graph using various tools in visualization

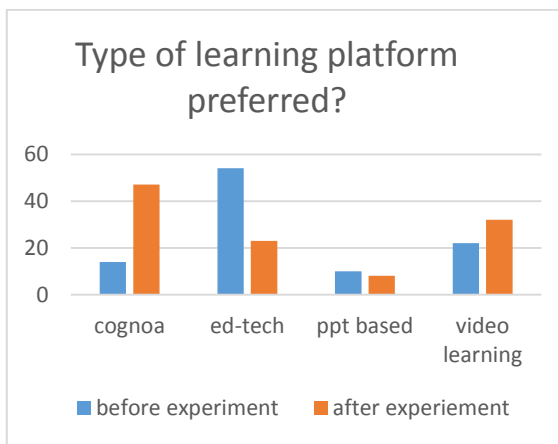


Figure 8. Graph for user preferred platform

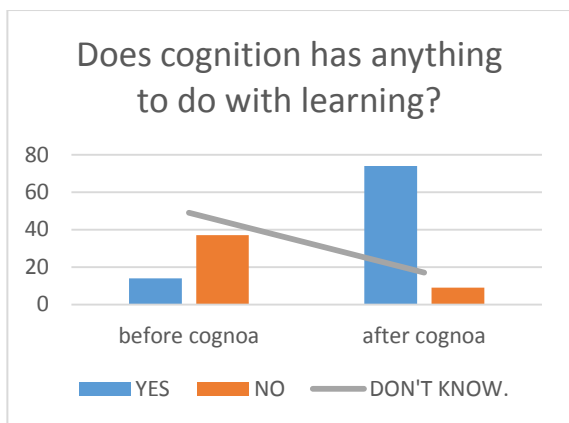


Figure 9. Graph description of user's answer

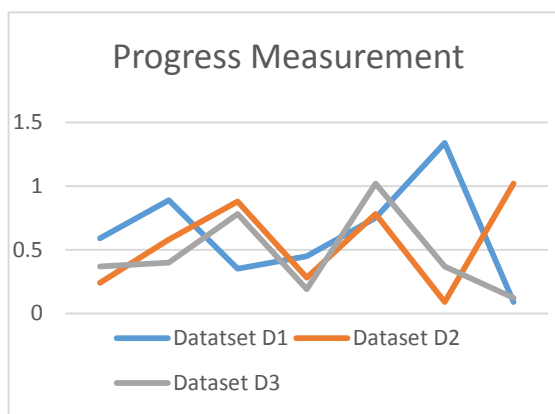


Figure 10. Graph of variance of user's answer

Based on the above data collected, users are delegated to different sets of data. The feedback asked some of the question which can be differentiated based on:

- The results of the quizzes that were asked just after the teaching of any particular topic
- Their response to the community help
- Feedback of the user regarding the effect of visualization on studies

Different types of charts, graphs and structure represented above gave us the perfect description and the idea about the feedback questionnaire and the questions that were asked in it. As described in the charts named, Progress management, there were datasets D1, D2 and D3. The dataset D1, contained all the volunteers who were learning the algorithms and data structure without any type of visuals and graphics. The dataset D2,

contained only the users that were using video learning and Ed-tech applications and platform for learning. While, dataset D3 is containing all the user that uses any type of learning platform that is considered to be using visualization as the basis of learning.

Some of the feedback that user gave were:

- Use the character more promptly
- The video and platform to be merged into one
- Community forum improvements

XLI. CONCLUSION

The tools and platforms for learning anything, literally anything, are **abundant**. It's the desire to learn that that's so much **scarce**, that's what the scariest. [-anonymous]

In the world so jinxed with the expectation vs reality, a feeling of not so worthy self, reluctantly faints upon the soul with the out of the box ideas that you are bound to listen to. And not just listening that makes the ideation turns to a reality, it's the hard work you do. The passion you have about the development, the integrity of a team, the compassion that one needs to have about changing the world.

With all the research going on the usage of visualization technologies and extending its accessibility with a view of the cognitive abilities, there stands a picture with plausibility for the fastest growing aspect of science to allow its extension to the most complex of all the sciences, psychology and cognition.

The research is not about some out of the box idea that is tested upon machines. We are humans, we like voluntary support, as much as we like the innovations. But there is one more thing that we like more is the feeling of being in control. Included in this, there is the hostility that one feels with a wry to change. The growth is like, finding gold mine. The feeling one has while searching for it has to be proportional to the hard work, that's needs to be done. But apart from the realities and the goal, it's just not true. While work is required, it's about the desire. Desire is like the mother of all the innovation, right from the era of Charles Darwin, father of evolution to Charles babbage, father of computer to the long back era of Thales, father of ancient science. Working on the hypothesis of world changing around is like, picking rabbits out of hat. Unless there is some kind of illusion involved, you have to be reciting realities.

Studying and learning are like two peas in a pod. Most of the times they are confused to be the same. But studying involves basically what we read, write, sometimes hear or see. Learning is more like size of the pod in which there is a pea named studying. Learning is more about thinking, comprehension, judging, questioning, imagination and use of the cognitive abilities.

There still remains a question that is left unanswered, are we the first advocating the usage of visual learning and the cognitive sciences? Are we the first of all the great minds even discussing about the psychology of about innovation in the fields of education? Didn't this crossed the mind of one of the greatest psychologist of the century, Dr. Daniel J. Kahneman, who talks about prospect theory and the fallacy of judgment and decision making? Well, the answer might not be to our condescending for many of readers but it is rationally reasonable. The bug in the human system needs patching just as much as the innovating technologies. But the bug appears faster than the methods to patch them. Innovation is one of best example of compounding in the common appearance. We might not be the first advocating the technologies of visualization for learning. It's the accessibility to a friendlier approach and less exploitation of the behavioural fallacies in the face of the platform which leads to one step more towards the perfect way of learning.

Thinking is the mother of growth.

XLI. REFERENCE

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