The impact of training on Creative and Critical skills to students via Reverse Engineering Process

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***Abstract* —** The purpose of this research to measure and prove the Reverse Engineering Style of Teaching mechanism for two entirely different students environments with Creative thinking model of animation and Critical thinking model of Game development. The motivation behind the research is to invent a way to empower the differently abled students with employability skills at media industry and to use the Micro-moments concept proposed by Google can be extended to not only for online businesses but also to promote any value based services as well. As the contribution in this research, first a group of Hearing handicapped school students and then, after a time-break, another group of engineering students were carefully studied from the spirit of Reverse Engineering idea with a few time-frame based empirical strategies to find facts to implement few better ways to support academic and industrial domains.

Keywords—Creative Skills, Critical Skills, Reverse Engineering, Animation, Gaming.

I. INTRODUCTION

Technical students always learn best through repetition model of improving skills for solving problems. They attempt, learn skills with great struggles, re-use techniques in a different manner every time and hopefully learn some new ways out of the whole process but this process of making them groomed is not that easy and not all students can succeed in this mechanism. Instead, after the thorough exercises of the Pre-production, the expert style of training the students in acquiring skills is to provide a small piece of somewhat similar product design or code related to the desired content creation and making them to realize the technical or creative concepts provided behind. A choice is given to students as well for generation of their own ideas into problem statements which are identical or related to the concept given in class, and throw a light on possible solutions to generate a new project as per the requirements derived. The proposed solution or idea behind achieving the resultant output should be broken into fundamental blocks, which all-together builds the complete model. With the dissection of problems in this style, students' problem solving abilities will sharpen and cognition of principles and patterns underlying the mechanism can be open-up. The whole process is referred to as Reverse Engineering process to engage the students to study prototype models and to make them understand the logical part behind the design and development of the project. For example, if we take a car assembly process, mechanical or automobile students learn to break it down first and understand each working part thoroughly to understand the dynamic of the parts and engine and then they can be able to re-design the concepts on their own and try out the assembly, after understanding the core [1].

Fundamentally Reverse Engineering (RI) process can be described as keeping a working piece from an equipment or code in front of students so that students work on breaking it into proper parts and analyze the broken divisions in order to learn the purpose of every part, what is called a module and then the study of modules go in-depth with individual elements encapsulated in such modules. In this way, students can be able to research the functionality of each block of code or working part and then can be able to understand the communication process that is hidden within the connectivity part between each module and can be able to connect every module to make the final working project.

This concept is not only useful for the Engineering range of technical students but also useful for grooming the differently abled school students too! My research journey has gone through several experiences of experimenting Reverse engineering process and achieving great results in improving creative and cognitive abilities in students, after which the careful study is documented in this research paper.

There are a lot of exercises that in the industrial sector for training but a lot of them lack creative efforts which is essential for imagining and designing something new from scratch with whatever critical knowledge they acquire in the whole process [2].

Learning Dimension	Learning Style	Corresponding Teaching Dimension	Corresponding Teaching Style
Perception	Sensory	Content	Concrete
	Intuitive		Abstract
Input	Visual	Presentation	Visual
	Auditory		Verbal
Organization	Inductive	Organization	Inductive
	Deductive		Deductive
Processing	Active	Student Participation	Active
	Reflective		Passive
Understanding	Sequential	Perspective	Sequential
	Global		Global

Table.1. Dimensions of Learning and Teaching Styles [3]

II. ACTIVE LEARNING PROCESS

Critical thinking and Creative thinking are the two types of skills required for anyone for Problem solving. The way of critical thinking is convergent and applying of already accepted principles and creative thinking is divergent and usually deviates from the proven principles where innovation takes place, but both creative and critical thinking skills are crucial and synergetic [4].

In this ideology, student assumes learning methodology than a trainer since learning is a combination of individual and collaboration of team where the exploration compliments the support of a trainer but doesn't replace any expert training [5].

This Reverse Engineering methodology can be considered as Active Learning (AL) technical process where the following principles can be considered into account [6]:

1. Students must get insights of new phenomena and the conceptualization has to happen by themselves alone, based on the knowledge acquired previously.
2. The key driving force in RI mechanism of study is Motivation.
3. Individual exploitation with discussion among the peers along with integration of one's own design with the other members' designs promotes team work strongly.
4. Standard techniques of learning as Problem Based Learning (PBL) and Project Oriented Learning (POL) can be established promoted via this model [7], [8].
5. Students have the environment to increase their skills and capabilities that demand active participation from the team members.

III. FIRST RESEARCH OBJECTIVE

For the research, we have taken a 2D Animation making as primary objective with differently abled students from a Govt. school of hearing handicapped and once the results were noted and the film was promoted and succeeded, it has been now getting documented in this research paper, and a Game development as a secondary objective from an Engineering college, after a careful study and preparation of required ground work with respect to selection of concept, selecting an environment, choosing the technology, etc.

A 2D animation was focused to be built using Adobe Flash as the platform and the team was taken from a Govt. higher secondary school for Hearing handicapped in which students cannot talk, cannot hear, cannot understand English and weren't not aware of any kind of Information Technology (IT) or Animation industry related tools. So, the challenge was to pick seven students in total out of 49 students to whom basic designing sessions were assigned by Prakasam Dist. Collector of Andhra Pradesh state for a period few 90 days. After the basic digital interface training and awareness, we have chosen 7 students out of 49 as targeted and kept six weeks of time duration as deadline to complete the training and a model project as well, which was targeted to nominate for several National awards. Here, in order to make those students understand 2D animation software tools and environment, we have adopted Reverse Engineering mechanism by breaking up the whole task into achievable break-ups of animation that can together render output, after explaining the following standard animation principles:

The 12 principles of animation proposed by Walt Disney:

1. Squash and stretch
2. Anticipation
3. Staging
4. Straight ahead action and pose to pose
5. Follow through and overlapping action
6. Slow in and slow out
7. Arc
8. Secondary action
9. Timing

10. Exaggeration
11. Solid drawing
12. Appeal

After the challenging production is complete after 6 months, then the film was sent to several film festivals and bagged three national awards, gifted me Dadasaheb Phalke Film Festival awards-13 for the experiment done with differently abled students. Another side of the production is, every dimension of understanding is carefully documented in statistical detail forms provided at the last section of this research paper. Below are some of the screen shots from Film making and Film as well that was named as 'Antimation' – a story of three ants who were friends and how they overcome the obstacles together. The entire story was rendered in the form of an English song sung by another locally available school students.

IV. GAME PRODUCTION CYCLE

Software Game is an interactive virtual application, which can be developed using methods derived from various models of Software Development Life Cycle (SDLC) but not exactly the same in the process and practice of a pure Information Technology (IT) project. SDLC models help us understand as a base to extend the functionality of building the games in addition to various creative production pipeline scenarios that are to be added on top of the classical cycle. But when the traditional software development process circle is clearly understood by the game development teams, more complex tasks can be easily achieved due to the interconnected knowledge of Artificial intelligence they possess. Game development is not only helpful in entertainment areas but also give a great impact on educational, medical and business sectors with their distinct means of rich interactive offerings. Software Game development task is very complex affair due to multidisciplinary activities that are involved within the design and development phases like art, control, sounds, decision making via Artificial Intelligence (AI) are involved along with various human factors involved within.

The Entertainment Software Association (ESA) facts (2014; 2015) highlights several cutting edge trends of the software game industry in which the job profiles are highly dynamic, challenging, and not only creative but also profitable (Liming and Vilorio, 2001). But the ability to manage complex environmental tasks can be achieved with number of decent practices in order to achieve profits. Several cross-functional man power from not only designing and development teams, but also from script and screen play writers, character artists, 2D or 3D artists, game specific modeling and texturing artists, animators, editors, audio experts, and many more members are involved in the game production scenario, where success does not come by chance.

Game Development Software Engineering (GDSE) process life cycles differ from traditional practices in which it is mainly classified into three phases of entire process. 1. Pre-production, 2. Production and 3. Post-production, in which the post-production of game software development is somehow - somewhat getting neglected in terms of scientific procedural study.
Planning and Documentation, along with Testing and Implementation are done in a different style from traditional software engineering process. Same kind of development models are used as software engineering but in game software development, particularly when AI plays a vital role today, Agile development cycle methods are getting adopted in most of the studios in real-time to produce Software Games or what we refer to as Game based virtual graphic apps.

V. SECOND RESEARCH OBJECTIVE

Various creative technologies are taken at after school hours for this experiment to impose some practical awareness on Production scenarios along with Incubation-model training in a remote engineering college environment for initiating an innovative research oriented self-learning based leadership approach via 'learning through reverse engineering process'.

The research paper is focused to be written from a careful case-study of micro-moments (proposed by Google) in a group of interested students by introducing a Game development project model as a value-added service in the engineering college in order to understand how several selected groups of students behave every day in a particular pre-defined time-frame, and the detailed analysis is taken into account in empirical style of approach to achieve research study result and to build interest in the group as well, and also to produce the desired game 'Balloon Fly'. The game's actual source was developed in Adobe Flash long back but due to the discrete nature of the software, no software code is available except finding the similar logic in a robust example models and students are motivated for re-designing the whole structure on their own, and with a proper team work, they have to merge the open code to achieve the newly getting developed game. Unlike the closed architecture of the original flash game, we have encouraged students to develop an open architecture using html5 and Javascript technologies. Blocks of working code in the form of several examples were taken from enormous sources of internet and teams split the examples for case study purposes.

VI. METHODOLOGY IN A MICRO-ENVIRONMENT

In this a unique experimental model where psychological study is included with respect to what students prefer to check online and how they react when and then they feel something to search/opt for before introducing a proper goal-oriented learning tasks to them and after motivating the groups towards competition specific tasks.

This first of its kind experiment was conducted on a group of 180 engineering students residing in the college campus - hostel of Buchepalli Venkayamma SubbaReddy Engineering (BVSR) College, Andhra Pradesh, which was selected due to its down to earth level service oriented care and great amenities at low cost for the students coming from surrounding villages; the place where latest laboratories exist, which support high level experiments as well. The research samples of case study were taken to

estimate the pinpoint context of mindsets of the next generation aspirant engineers. To identify their interests and shifting interests, both boys and girls were taken into consideration and divided into several teams for collecting the average statistical data that was finally computed to study micro moments so that to estimate existing skills and also to impart interpretation and reproduction skills suitable for their mindsets by implementing the success story model of DELA: funeral insurance company from Netherlands [8], by making or involving consumers (here, students) as brand live ambassadors to achieve the vision.

In the flow of capturing the intent driven moments of sample set of students, best possible way was to motivate and mentor the group after college hours. Thus in order to understand their collective and individual interests in a particular time period, two and half hours duration of time was taken on daily basis after college hours, that is 5 PM to 7.30 PM, including Sundays for 45 days.

As this generation users' experience is involuntarily forced to change their behavior rapidly to 'at the current moment search' to acquire what they need at a particular moment in order to fulfill their fast-shifting needs of seeking information, maximum possible level of micro-moments were recorded in implementing this case study on frequent basis along with subsequent monitoring of their web searches, mobile app usages, daily history with different e-commerce mobile apps, and other whatsoever interests while introducing five different technologies to choose from after a mega orientation program on first Sunday, in the interest of incubating them up to certain levels of skillsets we all. The group has exhibited considerable interest in using the PCs and Mobiles almost in a similar manner, though 'on-the-go smart device users' have increased in this era since everyone is in urge to make use of most of the moments they spend digitally every day.

Some students were interested in building mobile games while some are in social media marketing strategies, and some students shown interest in short-film making while some others chosen to search for knowledge and share the same on fellowships and internships available via a new website. Very few have shown interest in entrepreneurship models study but all of them were treated equally for a few weeks while grooming them to create or derive distinct special interests on the given five areas, and then separated into groups for more detailed study.

Also special mode of Communication training was also included to provide best services to the group to make them expressive to present their ideas effectively in a specific manner that was useful for research study, along with trying few methods to habituate to live in current moments instead of past or futuristic thoughts to derive clear details.

Since catching the behavior patterns of the users in the form of minute moments can be referred to as a fundamental step to perform Micro moment study, and to apply the same concept for this different experiment in nature was helpful through which a parallel mode of training on different trends for all the collected group of students for a particular period of time was also implemented; not only based on the interests exhibited by them, but also via measuring the optimality of search and many other points involved in selection process based on their interests, capabilities and behavior patterns towards the given technologies and reaction to the assignments given. While giving two different mind-shifts in particular: creative and technical areas of interests, the differences were clearly understood with respect to what their minds seek and what they are actually suitable for. Realities of their choices surprisingly differed from their cognitive abilities and capabilities of learning and expressing via digital media. All the searches and digital moments, along with the other required observations were statistically noted down and represented in the form of a graph by taking 15 days as average time-line, which was derived from their areas of interests that were searched for in order to satisfy different requirements or interests. Daily statistics of searches via their smart phones' and search history in desktops were monitored while in a computer laboratory and noted down.

While days were passing, students mind sets starting drifting from what they actually think they can do and what skills they actually started exhibiting. Individual and group's reactions, time-to-time shifting of interests, and attention levels of all students were carefully marked each day until the sufficient data was collected to be used for deriving an intelligent model of identifying various behavioral patterns of users at a taken sample time slots everyday day and all the observed shifts in the interests of individuals and the group were noted and average information is portrayed in the form of graphical representations to achieve best possible results.

Fig.1. Portrays the Research Study of Micro-moments in a group of 180 students with several activities in distinct areas of interest - on the name of Creative Club and also training model plus bagging International award of differently abled students.

This kind of surveillance helped the research in exploring how many members are attending on daily basis, which student is attending for a pre-announced session on a particular theme or technology, how many attend irrespective of pre-announcements with enthusiastic mind-sets, who are interested to express themselves and who are not open to the group but exhibit their hidden interests via their searches while exploiting the statistics of smart mobile-usage in the daily statistics and how different engineering discipline students reacted to our services as end users. All the collected research data was interpreted by means of empirical outputs processed as output with the information from various interests of users in different time slots or day schedules.

VII. INTERPRETATION OF USER EXPERIENCES

The reactions of all the students while attending a properly planned session and while attending a discretely handled surprising sessions with tiny agendas were taken into special case study to study their actual spontaneous mind-shifts, which helped us to motivate the students via different training strategies that really helped them to expose to new levels of knowledge based skillset and also in a careful study of how they behave in terms of stability and shifting concentration levels as well so that to study about their shifting of interests by means of their reactions in mobile or desktop environments while absolute freedom is given to them to focus on whatever they wish to at any particular moment in the classroom.

VIII. CONVERTING UNSTRUCTURED DATA INTO STRUCTURED

Every day we had to gather huge number of human-generated input data out of our observations in the format of notepad files, Ms-Excel sheets to preserve the Google and other Web searches, Social media, YouTube, e-Commerce buying apps usages, which is absolutely unstructured data to store and process with. Noting down every datum in terms of digital format is one phase and converting all the data by classifying it based on User-defined tags by using XML is another phase where a newly appended data is getting stored every day in XML files and then each record was converted into Ms-Excel format, along with the data collected from several surveys done, for creating a graphical representations of the statistics. We had to build an all new unnamed algorithms to collect, save, convert and represent all this unstructured data into properly processed information.

No big data methods were required as the amount of data is not that huge due to the count samples taken for research study, and resumes from all the students, along with time to time SWOT analysis were taken and converted the unstructured data into structured as in [10].

IX. GRAPHICAL REPRESENTATION OF DERIVED STATISTICS

The use-cases that were derived to understand the shifting interests of the group on average to fulfill both the research objectives, but the differently abled students school training environment is entirely different and difficult to conduct survey directly on them, so we have recorded and processed the entire making of the film video for the research purposes and Game learning based model statistics are properly taken into consideration and provided as empirical results below:

Fig.2. How many members are attending without break?

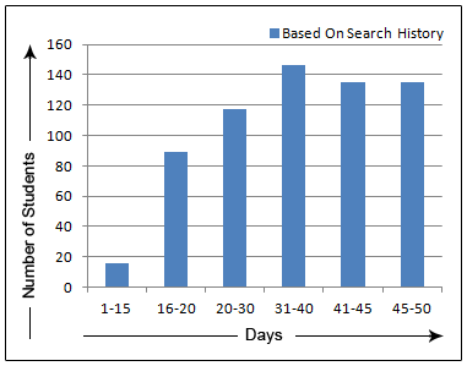

Fig.3. Search-histories and Mobile apps usage on average (Observation based on the need of search after joining club)

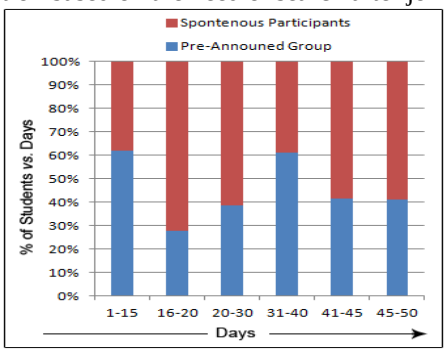

Fig.4. Pre-announced group activities participation *vs.* spontaneous participation of members in several events.

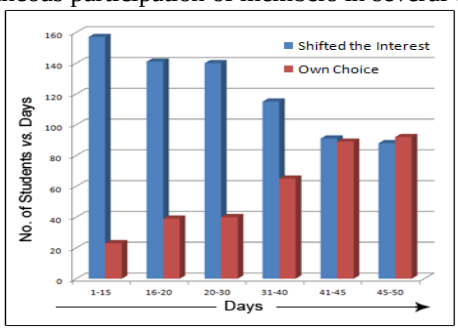

Fig.5. Expressed shifting-interests of students after a given standard time-period *vs.* their own choices of time.

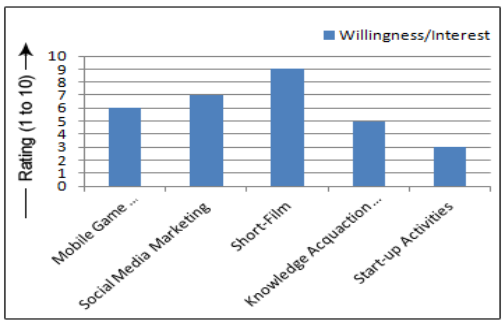

Fig.6. Expressed interests before exposed to technologies

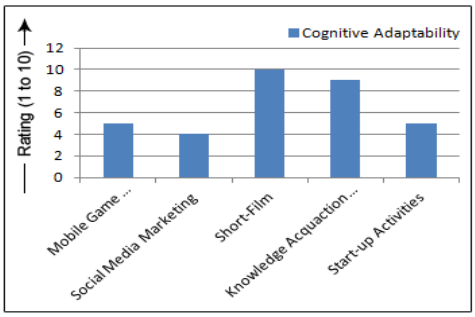

Fig.7. Actual Cognitive abilities of club members after a few experiences on distinct skill-sets

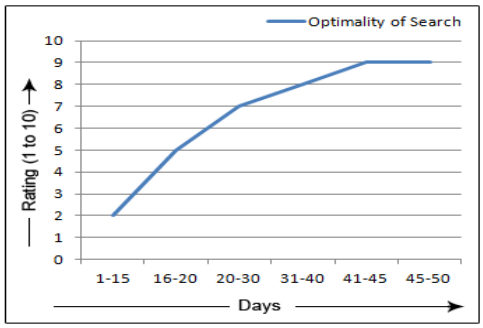

Fig.8. Change in the way of searching in web for specific knowledge or skill set.

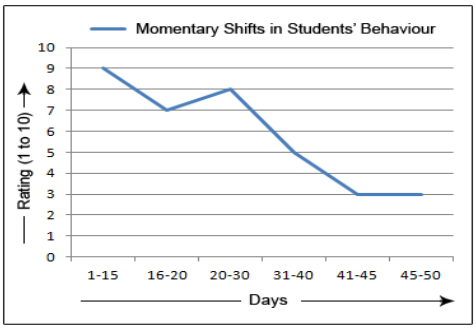

Fig.9. To recognize the psychological behavioral changes: Shifts in their interests, i.e. Momentary behaviors

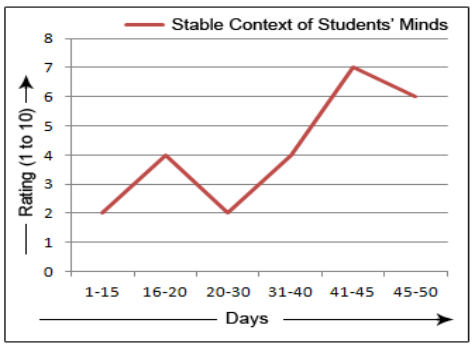

Fig.10. Settlement in stability-context of minds.

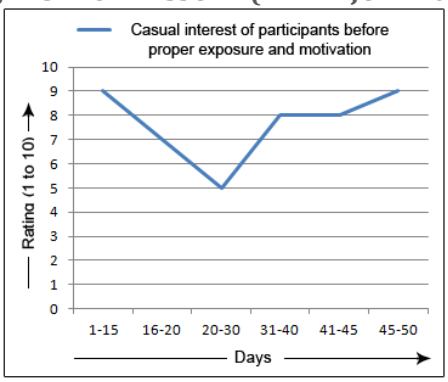

Fig.11. Casual interactions and participation of various groups of students.

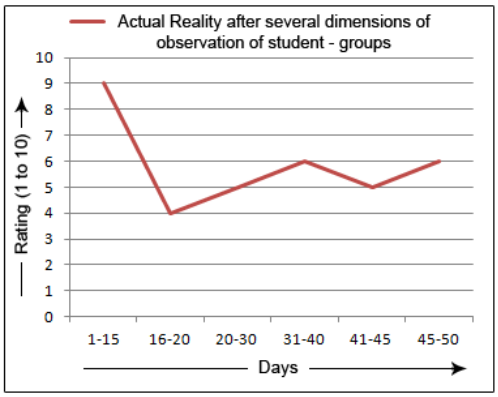

Fig.12. Actual realities noted after careful observation of the uploaded posts in Social media with respect to others' reactions in the form of links/comments.

X. MAIN CONCLUSIONS

The samples taken were lesser when compared to the samples in [10], so no big data model was required in this research, while after studying various methodologies like mentioned in [16].

After checking various micro moment areas from [17], this research helped us to understand the micro moments in the taken environment and to innovate a new strategy than existing literature with the same concept for imposing attention grabbing marketing methods with an idea of understanding the localized, repetitive and fast shifting search-patterns of targeted students acted as consumers herein.

The research also helped us to create better ways of incubation training and this case study can also be extended to any level of empirical data from various groups for considering their individual and community interests as inputs to make the consumers as brand ambassadors while building new ways of digital marketing where:

1. Psychological status of users to whom the specific service is provided can be derived.
2. Providing any life-changing value based service is possible with this kind of study, rather than just considering it as a business flow.
3. The interests of a local group in a particular domain can be studied well to simplify the imposition of new global marketing methods.
4. Considering the trendy needs of aspirant consumers helps to provide immediate access to the dynamic services they opt for via mobile technology.
5. Enabling the consideration of age-factors of a group to make a roadmap for understanding their essential needs as a group is helpful to design and promote provocative advertisements/methods via micro moments that can be exploited to establish long term bondage on brand image of products or services among consumers' minds.

Hence it is proven that this method of micro moments study is extremely helpful to apply for educational environments in a proactive manner while we motivated the specific five sets of students to act as Ambassadors for each of the technology chosen by including Human emotion as an element of attachment to the process of learning, enjoying the outcomes of their incubation, and also in promoting the results with methods in their college annual festival to attract more students towards an improved incubation model.

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