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Digital Evaluation and Outcomes: Effect of Interactive Evaluation tools on Learning Outcomes

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Abstract:

Examinations cause a huge amount of worry in students. Although the purpose of examination is to gauge a student's knowledge in a subject area, just the mere thought of an examination causes frustration and stress. Contrarily, when students play a mobile game on a network, to prove their ability of expertise in that game, they are thrilled and excited. One key aspect of the experience of gaming in today's time is its interactivity. Players from different locations log on to the same game and compete against each other in real time. This adds to the excitement of playing a game and each gamer looks forward to meeting their competitors online when they play these games. In this research paper, the authors have addressed the motivation and cognition based challenges associated with taking an exam, and propose a technology based examination tool that can make examinations fun filled and exciting. This research paper uses the cognitive learning framework called ICAP (Interactive, Constructive, Active, Passive). The research concludes that students feel enthusiastic about answering an exam, a phenomenon which is similar to that the one that they experience while playing a game, when the interaction level is increased and the scenario of gamification is introduced.

Keywords: *Behavioral aspects, Gamification of examination, Motivation and cognition based challenges, ICAP*

I. INTRODUCTION

Educators have long identified that students learn better through active learning in comparison to receiving information passively (Bonwell and Eison 1991). Since active learning involves student engagement, several factors, for example, motivation and cognition can affect learning behaviour and outcomes (Blumenfeld, Kempler, &Krajcik, 2006; Pintrich& De Groot, 1990; Zimmerman, 1990)., a students' appetite for thrill, adventure and cognitive or sensory stimulation will determine their pursuit in raising their individual optimum stimulation level (OSL). Their OSL will determine the level of engagement that students have in learning. This research paper advances a cognitive framework called ICAP (Interactive, Constructive, Active, Passive) that posits increased student engagement and learning, when cognitive engagement strategies move from passive (e.g. listening in class) to active (e.g., taking free form notes) to more interactive, (e.g., interpreting something with peer) (Chi and Wylie 2014). Extending the same concept to an evaluation, the paper posits that students are better engaged when the evaluation is interactive and non-threatening as compared to individual stress-based evaluations. In congruence with the concept of prior learning assessment (Hutchinson et al., 2019), the evaluation method proposed in this study can be used in all kinds of digital classrooms. The study finds that individuals (students) prefer and engage in an exam as they do in a fun-filled digital game and their level of stimulation raises to the optimum level. This makes the examinations to be fulfilled and not stressful.

II. REVIEW OF LITERATURE

A. The Blooms Taxonomy

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A trusted framework which helps teachers to teach better and students learn in a much better fashion is the Blooms Taxonomy (Blooms et.al 1956). The Blooms Taxonomy fundamentally has hierarchical ordering of cognitive skills and the original framework was proposed with the sequence of cognitive skills being Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation. This framework was revised in 2001 by Lorin Anderson and David Krathwohl, and the revised Bloom's Taxonomy framework has Remember – Understand – Apply – Analyze – Evaluate – Create (Anderson&Krathwohl 2001)

The first level of the revised Blooms taxonomy focuses on the ability to remember and recollect. This is the first level of learning where the objective is to memorize and re produce. For example, when the expectation from the student is to remember specific formulae or the capitals of the countries which could be of use then this level is the focus. The second level of revised Blooms taxonomy focuses on those aspects which expects the student understand the learning. For example, the student must be able to organize geometrical shapes based on the directions given to them or must be able to create a one-page summary after reading hundred pages of a story. The third level is to apply the learning in a useful manner. For example, the learning helps a student to apply a formula or a learning from a specific subject to solve a real time problem on hand then the it is the third level of learning.

The fourth level focuses on Analyses. The analyses aspect focuses on the ability to solve problems by analyzing the root cause and effects. The fifth level is synthesis and gauges the ability to relate and correlation one area to another which can help in solving business and technological problems. The sixth level of revised Blooms taxonomy is to evaluate. For example, a learning which helps in deciding / judging on ethical dilemma or the learning that helps in demonstrating the relative value of an innovation in a specific business scenario can be placed in this level. The sixth level of revised Blooms taxonomy focuses on creation of knowledge. If the students are expected to create / propose an innovative solution to a business or a technical problem, then this level is the focus for teaching and learning.

The current examinations that are conducted by the schools, colleges and universities focus on the cramming capacity of the student and their ability to reproduce their learning on a piece of paper. This hence takes only the first level of blooms taxonomy into consideration. As the expectation is to remember the formulae or the theory and reproduce the same in the examination, the level of stress that student experience is very high.

B. ICAP Framework

There are several frameworks for learning but only a few of them take the behavioral aspects into consideration. The Interactive, Constructive, Active, and Passive (ICAP) framework (Chi & Wylie, 2014) takes cognitive engagement activities into consideration. Based on the engagement activities and the engagement level the behavior of a student can be categorized as Interactive, Constructive, Active, and Passive. The ICAP framework suggests that students have a high engagement level with the course and the learning happens in a better fashion when the learning helps them move from just being passive to becoming active and also from being constructive to interactive.

The ICAP framework can be explained as follows. The learning is said to be at the passive level when the learning effectiveness is considered poor. For example, if the students are just made to read an article multiple number of times so that they learn the article, then according to the ICAP framework the learning is Passive. The learning can be classified as Active if the learner is engaged a little higher, Taking the previous example, if the learner is made to underline the text that he or she is reading then it is an active learning experience. Active learning is considered to be better than passive learning. Further, if the learner is made to answer questions based on the teaching and if this happens during the teaching learning process, then it is said to be constructive learning. Going with the same example of reading the text, if the learner is asked questions and is then asked to read the text and find answers to the questions then it's a constructive learning. In Interactive learning the learner is made to discuss the answers and views with his or her peer. The example taken would become interactive if the learner is given questions and is made to discuss the answers / views about the question with his / her peers, and if the text given becomes an aid for the discussion then according to

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ICAP framework it would be interactive learning. Learning effectiveness is said to highest when the learning is interactive.

C. The Stress Factors and The Need for Research

The stress experienced by the students during their examination is due to several factors. Their ability to deal with a scenario where their cramming ability is tested and their ability to deal with the psychological or physiological aspects make them stressed (Larson, 2000; Lou & Chi, 2000). The academic stress experienced by the students is a problem across all counties and irrespective of the culture and their ethnic background students experience stress (Wong, Wong, & Scott, 2006). Literature also shows that students experience high levels of stress during the examination and also a few days before the final examinations. Such stress also has an adverse impact on the mental health of the students (Larson, 2000; Verma& Gupta, 1990). Another major aspect in developing countries like India and China is the fact that the worth and ability of students is generally gauged by the academic performance and not by any other parameter or yard stick (Verma& Larson, 1999). Hence there is an imperative need for research to find if the existing scenario can be changed and if alternative aspects of making examination fun filled can be explored.

D. The Mobile Phone Usage and Mobile Games

In the recent past the use of mobile phone usage amongst teenagers and adolescents has been rampant (Hoffner, Lee, & Park, 2016). Mobile devices have become ubiquitous in the lives of youth and this has started affecting their behavior (Okazaki, Skapa, & Grande, 2008).

For the millennial of today, system based gaming - especially mobile games and web based games have become one of the main entertainment activity. According to research literature the level of satisfaction that the youth get by involving themselves in playing mobile games is very high. Mobile games and web based games are always interactive. This makes the youth get involved and engrossed to these games. Hence it is worthy to study and find if the examinations can be made enjoyable if gamified thus reducing stress levels.

E. Gamification in Education

Educators have increased the use of games inside and outside classrooms to build engagement and increase learning (Osatuyi, Osatuyi, & De La Rosa, 2018). Gamification has been used widely in varied disciplines ranging from nursing to engineering to English language and management studies (Osatuyi et al., 2018). Both online and offline games are gaining popularity. An offline gaming devise that has caught the attention of management educators is the Lego Serious Play games (McCusker, 2019). Platforms like Kahoot and Questionify are digital platforms that allow educators to conduct evaluations online (Lin, Ganapathy, & Kaur, 2018; Kasinathan, Mustapha, Fauzi, & Rani, 2018). While the usage of these platforms is increasing, their effects are yet to be understood fully. Some recent studies find that these games have been able to increase motivation of the students and increase their engagement with the course. However, the results are inconclusive and researchers recommend additional research in the area to strengthen its scholarship.

III. OBJECTIVES OF THE STUDY

Based on the framework of ICAP and literature on examinations in higher secondary schools and colleges, we test whether a fun-based approach to evaluations enhances the effectiveness of evaluations, especially when students have different levels of motivation (e.g., intrinsic versus extrinsic), and the evaluation involves different levels of cognitive engagement (e.g., active versus interactive). We posit the following research questions:

1. Does the level of student motivation and cognition engagement type influence evaluation outcomes, namely ‘better learning’ and ‘sense of fun’?

2. How does the construct of optimum stimulation level (OSL) relate to the eye gaze data for different types of cognitive engagement?

Based on the above research questions these hypotheses were formulated
H1: Type of motivation (intrinsic v/s extrinsic) has an effect on better learning

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H2: Type of cognitive evaluation (active v/s interactive) has an effect on better learning
H3: There is a significant interactive effect of motivation type and cognitive engagement type on better learning.
H4: Type of motivation (intrinsic v/s extrinsic) has an effect on fun (in evaluations).
H5: Type of cognitive evaluation (active v/s interactive) has an effect on fun (in evaluations).
H6: There is a significant interactive effect of motivation type and cognitive engagement type on fun.

For study 2 the following hypotheses were formulated
H7: OSL is positively related to fun in evaluation
H8: Type of cognitive evaluation is positively related to fun in evaluation
H9: There is a significant interaction effect of OSL and cognitive engagement on fun in evaluation.

IV. RESEARCH METHODOLOGY

Two cascading laboratory experiments were conducted in order to fulfill the objectives of the study.
Study 1 measured the effect of motivation and cognitive engagement on outcomes like better learning and sense of fun. A 2 (motivation: intrinsic versus extrinsic) x 2 (cognitive engagement: active versus interactive) between subjects' design laboratory experiment was developed for this study. Both independent variables were manipulated. All students went through an online video explaining a core concept as part of their consumer behavior course. Then, cognitive engagement level was operationalized by asking students to take a traditional online quiz that was non-interactive (active evaluation task). The other group were asked to take an interactive online quiz (interactive evaluation task). The interactive quiz also had the same questions as the traditional quiz. However, in the interactive quiz students were able to view a quick summary of their result with respect to the result of the rest of the class. Additionally, they were also able to see the top scorers for the question that they just answered. While the results were visible, the identity of the scorers were camouflaged with nicknames or fun names. This allowed students to find out their position in a non-threatening environment. The key dependent variables were better learning and sense of fun.

Study 2 used the eye tracking methodology to delve into the underlying process, i.e. students eye movement using heat maps and gaze plots while engaging with the cognitive engagement task (active quiz v/s interactive quiz). This was done using Tobii Eye tracker available in the behavioural laboratory at Symbiosis Centre for Behavioural Studies. Along with this the OSL levels were also be measured using an existing scale (Steenkamp & Baumgartner, 1994). This combination of eye tracking data with the emotional response to the evaluation quiz will give a deeper understanding of the effectiveness of
the quiz as a fun-based arousal inducing tool.

V. RESULT AND DISCUSSION

For study 1, a 2 x 2 factorial design was administered on higher education students of a consumer behaivour class (N=132) with a gender representation of approximately 38% women and 62% male. The students were randomly assigned to test conditions of active quiz or interactive quiz after manipulating for motivation levels of intrinsic or extrinsic.
Thus four groups were tested with the independent variables for effect on better learning outcomes and fun in evaluation.
There was no significant effect of motivation type on the outcome better learning, $F(1, 132)=1.519$ $p<0.220$. This means that irrespective of intrinsic or extrinsic motivation, students had similar learning experience. However, the evaluation type had a significant effect on learning $F(1, 132) = 36.901$, $p< 0.000$. Also the mean scores for interactive learning (4.18) was significantly higher than that of active learning (M=3.26) on a 5-point scale.
With regards the interactive effect of motivation type and cognitive engagement type on better learning, there was a significant effect $F(3, 132) = 5.338$, $p< 0.022$. The effects are summarized in a bar graph provided in Figure 1. The figure shows that students who were extrinsically motivated and answered the interactive quiz showed better learning than any other group. What is also important to note here is that the mean values for interactive evaluation are higher for both intrinsic and extrinsically motivated students, indicating a

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preference for interactive tools over active tools for evaluation.

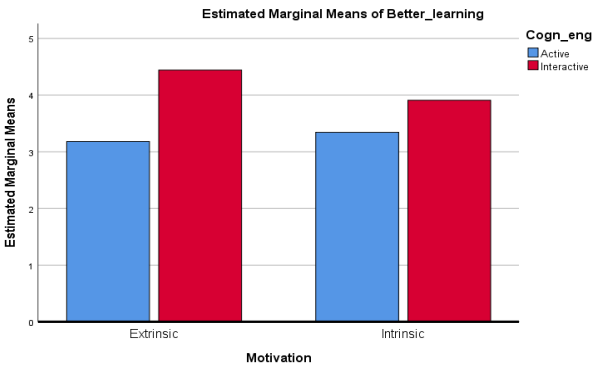

Figure 1: Interaction Effect on Better Learning

Similar effects were also checked for fun in learning. The idea was to find out if students found if there were main effects for motivation and cognitive engagement on fun in evaluation.
Here both motivation, $F(1, 132) = 22.697$, $p< 0.000$ and cognitive engagement, $F(1, 132) = 173.783$, $p< 0.000$ had significant main effects, albeit no interaction effects, $F(1, 132) = .476$, $p< 0.491$. This means that irrespective of motivation type, all students found interactive evaluations to be more fun than the traditional quiz which was given as active evaluation.
Table 1 is a snapshot of the results of Anova for fun in evaluation.

Table 1: Anova Results for Between Subject effects on Fun

Source	Type III Sum of Squares	df	F	Sig.
Corrected Model	103.320[a]	3	65.783	.000
Intercept	1308.784	1	2499.873	.000
Motivation	11.883	1	22.697	.000
Cogn_eng	90.983	1	173.783	.000
Motivation * Cogn_eng	.249	1	.476	.491
Error	67.013	128		
Total	1494.000	132		
Corrected Total	170.333	131		

Figure 2 is a bar graph that represents the results in a figure format.

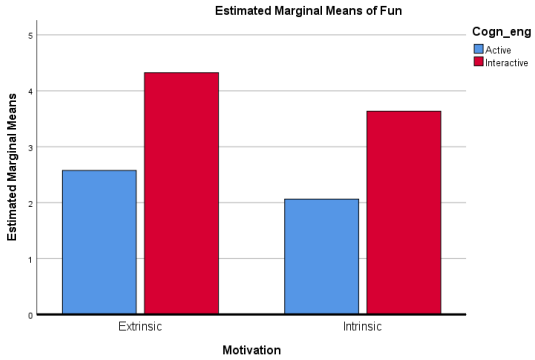

Figure 2: Interaction Effect on Fun

Study 2 conducted an eye tracking study for both kinds of congnitive engagement exercises, active evalauation and interactive evaluation.
In active evaluation students were given a traditional quiz, where they had to answer questions related to a topic taught in class. The interactive quiz was conducted through online freeware Kahoot that allowed students to log in with nicknames or fun names. They were also able to see the results of each question in real time and were also able to see the others who had answered it correctly from their group. Figure 3 and figure 4 are heat maps gathered from the eye tracking study. It is visible that in the interactive quiz, students were interested in the answer of their group mates as much as they were interested in theirs. Thus generating heat maps around it. Also since the quiz was timed they also had an eye on the time while they answered the questions. While the active evaluation has concentrated heat maps, the interactive quiz has students looking at various elements of the quiz while answering it.
Additionally, data related to Optimum Simulation Level (OSL) was also collected (Baumgartner& Steenkamp, 1994). The scale is a balanced 5-point scale with values ranging from -2 to +2, and having 7 items to the scale. Results revealed that OSL has a significant effect on fun. Additionally type of cognitive engagement i.e. active or interactive evaluation also had significant results. The interaction effect of OSL and cognitive engagement also had significant results. Table 2 shows the results of regression with dependent variable fun and independent variables OSL and cognitive engagement.

Figure 3: Heat Map for Active Evaluation Quiz

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Figure 4: Heat Map for Interactive Evaluation Quiz

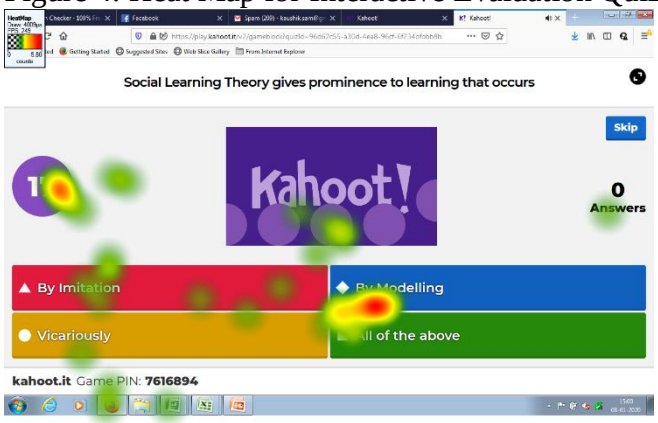

Table 2: Regression results of Study 2

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	4.255	.633		6.719	.000
	Cog_EngReg	-.879	.460	-.412	-1.908	.064
	OSL_AVG	-2.482	.435	-1.350	-5.712	.000
	osl_congeng	1.765	.299	2.067	5.911	.000

a. Dependent Variable: Fun

Table 3 is the model summary, which shows a value of R square = 0.786. The adjusted R square value stands at 76.9 percent indicating the explanatory ability of the model.

Table 3: Regression Model Summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.887[a]	.786	.769	.518

a. Predictors: (Constant), osl_congeng, Cog_EngReg, OSL_AVG

V. CONCLUSION

This study is a demonstration of how students' perception of examinations change when it moves from active to interactive methods. In current times when exams are viewed as tedious and fearsome, this new interactive method to conducting exams brings about a positive change in student attitude towards exams as well as the learning outcome. When students engage in exams that are interactive and fun-filled, not only does the attitude towards the exam change, but it also affects the learning outcome positively.

The study can be replicated with different sets of students to create external validity. For instance, school going students. Furthermore, gender differences can also be looked at by future researchers. Another extension of this study is consider the theory of technology acceptance and use amongst higher education students and its moderating effect.

Universities that hope to engage with students and enhance their learning experience benefit from the results of this study. Interactive evaluation techniques seem to win hands-down as compared to active learning techniques like traditional quizzes. Researchers also benefit from this study as it is a one-of-its-kind demonstration of how evaluation can be made fun filled and exciting. It extends the theory of ICAP by considering it in the context of motivational theories and thus provides an enhanced understanding of what students expect from an evaluation process. This study also contributes to a larger social good of reducing the stress and tension of evaluations, providing an alternative method that is cheap and effective.

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