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An Examination of Gamification Elements and Apps in Teaching & Learning

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***ABSTRACT**--Gamification is implementing game elements in non-game environments to increase motivation. [1], [2]. Education is one such domain where gamification has proven its potential by maximizing the motivation among students. In this paper, we carefully selected and analyzed 15 journals from the existing gamification articles of the education domain which were published from the year 2013-2020. The apps and game elements used for gamification were further weighed and highlighted the gaps. This journal also offers insights on the future development of gamification in education domain.*

***Keywords**--Classroom, Collaborative Learning, Education, Extrinsic Motivation, Flow Theory, Gamification, Game elements, Intrinsic Motivation, Learning Environment, Motivation, MDA framework, Self-Determination Theory*

I. INTRODUCTION

Education is a domain where Gamification plays an effective way of improving motivation. As per the Self-Determination theory [3] competency, autonomy and relatedness are the three psychological needs of human. Self-Determination theory proposes two essential types of motivation namely intrinsic and extrinsic motivation, where the three needs lead to intrinsic motivation. Gamification induces the learner to learn through extrinsic motivation, where motivation arises from the outside world. In intrinsic motivation, motivation arises from their inner self.

1.1 MDA Framework

A familiar framework called MDA (Mechanics, Dynamics and Aesthetics) [4] which explains how a game functions and connects the gap between developers, designers and users. Gamification relies on the same features which are formulated in MDA.

- Mechanics is considered as the rubrics or rules of the game.
- Dynamics is the system that acts at run-time when the user interacts with the Mechanics.
- Aesthetics is the emotional response that the learner receives as feedback by playing the gamified course content.

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Figure 1. MDA Framework

The designer creates the game with the mechanics to make the player interact with the game as dynamics. The emotional feedback that the player receives from the game is called to be aesthetics. In the traditional learning system, students often lost interest in the learning activity and get de-motivated. With the novel pedagogical approach of gamification, learning became engaging and interactive with immediate feedbacks [5]. Many studies have proved that gamification as an effective medium improves the learning outcome. Gamification engages the students in a fun way and motivates them utilizing extrinsic rewards such as points, badges, Leader boards, Levels, Achievement system and Rewards. [6]

Table 1. Game Elements of MDA framework

Game Mechanics	**Game Dynamics**	**Aesthetics**
Points	Rewards	Sensation, Fantasy
Leader boards	Status	Narrative, Challenge
Levels	Competitions	Fellowship, Discovery
Achievement system	Altruism	Expression, Submission

II. MOTIVATIONS AND NEEDS

2.1 Maslow's Hierarchy of Needs

To know about the hierarchy of needs and what drives human, we need to consider the Hierarchy of needs by Maslow. [7] Maslow mentioned in his study that some needs are to be fulfilled before other needs, as per his theory, it's essential for a human to focus on Physiological, safety and belonging first, then esteem and self-actualization.

2.2 Self Determination Theory (SDT)

Edward Deci & Richard Ryan after several years of research have proposed three human needs, which are Relatedness, Autonomy and Competence [3]

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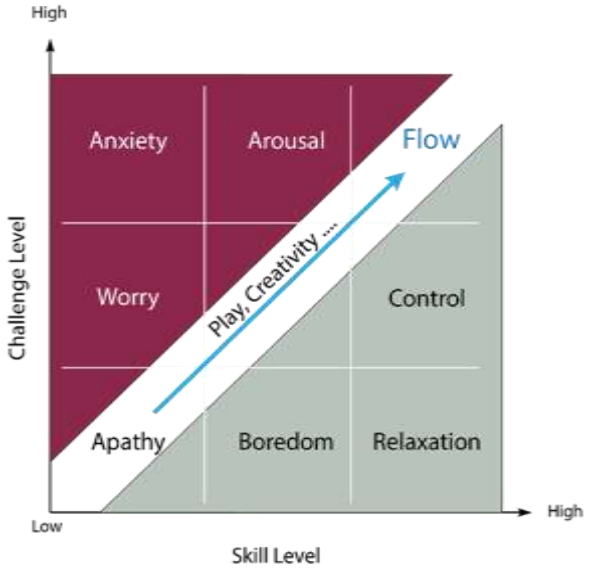

Fig. 2. Edward Deci & Richard Ryan's Self Determination theory

2.2.1 Relatedness

People feel relatedness when they are connected socially in a way, through family and friends. the relatedness desire will be met when they connect with them. There are tools and social networks where people are allowed to connect by creating teams to play multi-player games. Similar collaborative learning is encouraged in gamification through teamwork and competitions. To avoid the unpleasant change in students' behaviors, team collaborations are proven better than one to one competition.

2.2.2 Autonomy

Autonomy is about making independent choices of their own. In gamification, students will be given autonomy in making their own decision such as choosing their preferred level of the learning environment and preferred time. One of the best methods is perceived autonomy, where the student can perform a learning activity in gamification because the student is interested to perform it rather than forced by other people.

2.2.3 Competency

Competence is to achieve a master level in a particular subject by overcoming challenges. Any new skill that we acquire for knowledge can fit into mastery. In the gamified classroom setting, mastery can be achieved after proving their perceived skillset in the subject.

2.3 Flow theory

To create a fun experience in learning through gamification, Challenges for the students increases when their skillset increases. The student will be frustrated if the gamified course content is too easy or too hard. In 1975, [8] Maslow proposed a flow theory, in which he mentioned that flow as an experience where a finite balance is required between challenge and skill. Boredom occurs to students when challenges they face are easier for their skill set. Frustration occurs to students when the challenges they face are difficult than their perceived skill set.

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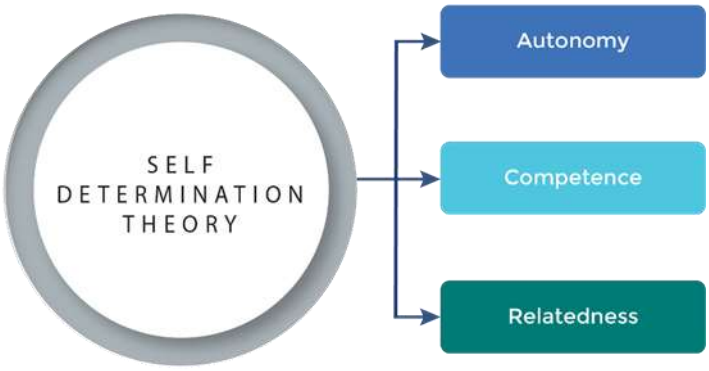

Figure. 3. Mihaly Csikszentmihalyi's Flow Theory

III. METHODOLOGY

Here we have searched and accessed literature regarding Gamification from Scopus, Sage Journals, Web of Science, IEEE, ACM, Taylor & Francis and Springer published in the years (2013 – 2020). We identified the relevant terms in the field of Gamification by carefully observing the existing literature and identified the keywords to use as a search string in the electronic database. The keywords used were 'Gamification', 'classroom', 'education' and 'learning'. We shortlisted the articles where gamification was applied for the education environment and listed in Table 2. The majority of papers considered for this survey are journals. To ensure whether the paper is apt for the gamification research, we have observed how the keywords were used in the paper and their relativity with classroom and education environment. In this review, we framed 2 research questions as given: 1) why certain game elements are widely used for Gamification in the education environment? 2) What kind of new gamification tools are needed for the education environment?

IV. RELATED WORK

From all the journals of the year 2013 - 2020 after scrutinizing, we got 15 journals which were selected from various categories. A detailed review is given in Table 3 below. All of these journals were using the MDA framework. We offer existing literature reviews in this section. The core needs which facilitates motivations are Autonomy, Competency and Relatedness, these needs were fulfilled by the gamified classroom learning system. [9] conducted a study in an Indonesian school, and found that Student's learning performance and their motivation were assessed between gamified and non-gamified flipped classroom and found that students' performance was improved in the gamified flipped classroom than the non-gamified flipped classroom learning system. Students were motivated by competing with peers and secured badges and points in the gamified flipped classroom. In another research, [10] gamification was used to induce postgraduate students to involve actively in out-class activities rather than in-class flipped classroom learning. Quasi-experimental methods were used to implement the gamification procedure-GAFCC model in the flipped classroom step by step. [11] In a group of 136 undergraduate year 2 students' Personal Professional Development course were facilitated with

gamification, Students who used gamified systems were found with improved performance than the students who used non-gamified systems. Online gamification activity was developed using the Institution's VLE- Moodle course with Essential Learning (EL) and Super Learning (SL) methods.

Table 2: E-database used for survey

Electronic database	Web Link	Years chosen for the survey	Total articles
Scopus	https://www.scopus.com	2013-2020	108
Sage Journals	https://journals.sagepub.com/	2013-2020	16
ACM	https://dl.acm.org/	2013-2020	123
Taylor & Francis Online	https://www.tandfonline.com/	2013-2020	272
Springer	https://link.springer.com/	2013-2020	156
IEEE	https://ieeexplore.ieee.org/	2013-2020	57
Web of Science	https://mjl.clarivate.com/	2013-2020	0

Game elements are used to motivate the students in an education environment. [12] Students from an Asian university were divided into two groups namely Experiment and control groups who have undergone an education-related course, wherein which one group used game mechanics and another without game mechanics through a quasi-experiment method. The study proved that the students who used game mechanics have contributed much in the discussion forums with increased motivations. To make the learning process an easier and enjoyable one, Gamification is widely used in Language learning courses, Mathematics and science courses of universities and schools. [13] In game-based learning, prize-only reward and forfeit-or-prize patterns considerably improved learning performance. 180 adult e-learners who enrolled for English course in Beijing were involved in this study, the findings proved that the implementation of gamification generates effective learning and improves performance among the students. Focusing on the game strategies are important than focusing on the advanced tools.

We can also use a mixture of game elements to keep the students engaged in the gamified learning. [14] gamification learning activities were introduced in primary mathematics class students. The students' performance was not only improved by the result of single-game element but also by the amalgamation of game elements. It's evident from the research that the students found motivated after seeing their contribution in gamified collaborative learning environment. [15]. Performance and collaborative annotating behaviors of elementary school students were studied using gamified WCRAS in north-eastern Taiwanese Elementary school. The findings stated that students were motivated and their performance was enhanced.

There are few cases, where the game elements couldn't make any possible motivation with students, A study conducted on higher education students [16] using Badges as a game element resulted in low motivation and less performance. Students who keep their badges to themselves rather than sharing with others have shown significant improvement in performance and motivated more than the students who share their badges with other students and the students without Badges. Badges have shown no significant improvement in students' grades and quiz.

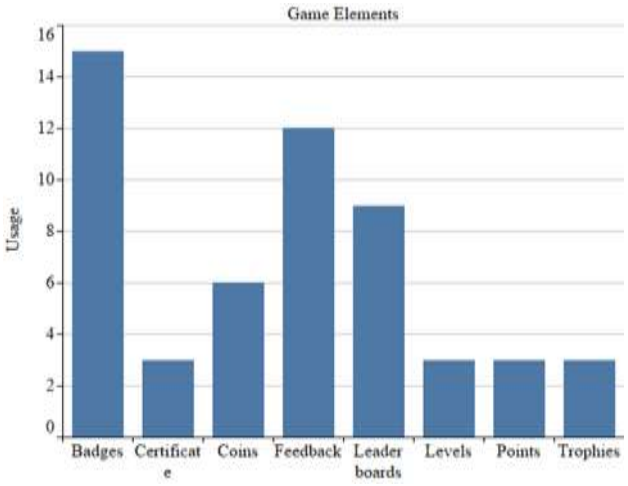

Figure. 4. Game elements in the reviewed journals

V. FINDINGS & DISCUSSIONS

The selected journal articles with their elaborate discussions are listed in Table 3. The data in the table listed that the students of various domains were subjected to Gamification and both genders were benefitted from it, which helps us to answer our Research Questions.

RQ1: why certain game elements are widely used for Gamification in the education environment.

The usage of game elements as per our review is listed in Figure 4. Badges have been widely used and recorded as in the chart. Badges are used as an indicator for skill, the accomplishment of a particular event or action. [17] Even though Badges are short term rewards, it acts as a huge motivation for the students. After getting rewards for every successful event, the students stay motivated and engaged in learning the gamified content. [18] Through an extrinsic reward, there is a possibility that the student can be intrinsically motivated.

Next to badges, Feedbacks has reached 12 in the usage chart. [19] Feedbacks are an essential system which allows the students to know their performance in the education setting. It's also a kind of self-assessment tool. Unlike the badges, where the students receive it only when accomplishing a task, feedback will be shown to students either he accomplishes or unaccomplished a task.

Leader boards stand next to the feedback. Leaderboards are a social engagement tool to present the rank and position of the player online. [20] Leaderboards in such gamification environment lists all the players' position in an activity with their name on it. Unlike feedback, Leaderboards show the entire ranking of students to all the students. So, everyone can see others' position in the rank list. On a positive note, students feel competent and try to achieve a better score or perform well to achieve the highest rank.

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Table 3 : Descriptive Analysis of journals used in this study

Author	Institution	Gamified course	App used	Participants	Outcome of the research	Game Elements used
[23]	Indonesian school students	Science Class	Socrative Quizizz, ispring Learn LMS	94 students	Implementation of gamified e-quiz was fruitful in assessing the learning performance of students.	Badges, points, leader board and certificate.
[24]	City of Calgary school	English & Mathematics	Game-based system	126 students	Students' learning skills were increased and their mastery of skills and relevant knowledge were identified using the gamified feedback system.	Feedback system
[25]	Calamba City college	Physics class	G-Class	27 students	Students were encouraged and felt competent by the gamified e-learning material.	G-Exp and G-Coins (Rewards)
[26]	European university	Geospatial information systems course	Moodle-open source. (Computer App)	215 students	MOOC course with Gamification proved as an effective learning method.	Challenges and Rewards
[27]	U.S College	Spanish course	Mobile-assisted language learning (MALL)	82 students	Motivational engagement of student learning is increased.	Feedback system
[21]	University of Spain	Applications and protocols of current TCP / IP	Gamification framework	25 students	Increase in students' efforts was found in gamified learning.	rewards

		networks.				
[28]	University of Alcala	Android programming class	The gamified platform using Elgg engine	27 students	Gamification is found to be an effective method to improve the learning outcome of the student.	points, leader boards.
[29]	Universidad Carlos III de Madrid (Spain)	C Programming Language	Q-Learning-G Platform (Computer App)	22 students	Gamification has good outcomes in terms of Knowledge acquisition and cognitive engagement	Badges
[16]	German university	Mechanism of computer-mediated communication	Moodle-open source. (Computer app)	324 students	Badges neither motivates nor de-motivates the students. In time it's found that the students are less motivated than the non-gamification users.	Badges
[30]	Public School	Geometric Designs	Computer App	61 students	Gamification has positive results on improving the engagement level of the students.	Badges
[31]	Health Professions Education	OPEN (Observational practice educational networking)	Social website	100 students	Implementation of Gamification in OPEN was expected to increase effective learning and might produce valuable outcomes.	Feedback mechanism (point system, social feedbacks, modules)
[32]	Mid-western	Communication	Computer App	80 students	Students used Gamification are	Badges, coins,

	university	course			less motivated than the non-gamified learning students over time.	leader boards (these harms motivation)
[33]	Sul Ross State University	Mathematics	Math Dungeon (Computer App)	30 Students	Learner's confidence level was increased using Gamification and Intelligent tutoring system.	Rewards, Levels and feedback system
[34]	App tested in Brant skills centre, Brantford, Ontario	Adult Literacy	Homophone App, punctuation App, Comma App (Tablet App)	27 students	Learner's engagement was significantly improved by implementing Gamification Adult literacy	Rewards (short, medium and Long)
[35]	K6 learning environment	Social Learning	Schoooools.com. (Social networking Website)	K6-students.	Applied social gamification in education and also assessed.	Rewards and Trophies.

In our survey, Coins have reached 6 in the usage of game elements in the chart. [21] Coins are like rewards for short term goal achievements. By offering coins to the student for answering every correct question, the student will remain motivated and engaged in gamification. Coins keep the learner engaged in the gamified learning content and at the end of one event, the learner will earn a badge. There's one advantage in coin which is not available in other reward is, User can earn and also spend it in the gamified learning system. So, students have the liberty to spend in other ways in the gamification system.

Points, Level, Trophies and certificate have secured low in the graph. There's a choice of using the game elements, where some gamification tools preferred Points, some preferred coins, some preferred batches. [22] Levels, Trophies and certificates usually be given when they complete the first stage or level. The mixture of game elements was not addressed because of the limitations in targeted platforms and gamification tools.

RQ2: What kind of new gamification tools are needed for the education environment?

For science classes, Socrative Quizizz, ispring Learning LMS, G-class Apps were used based on their requirements and the education setup. When it comes to language learning applications, Mobile Assisted language learning App is used.

To gamify students in computer language courses, Gamified platform made of Elgg Engine; Q-Learning-G platform apps were used. Schoooools.com and OPEN apps were used for social learning and healthcare learning.

Most of the gamification tools are computer Apps and they are all online-based. The education institution preferred existing gamification computer Apps and social apps because of the difficulty involved in designing their gamification Apps. To tailor the needs of different students, gamification tools with custom features and more autonomy such as extended reality has to be designed and integrated.

VI. CONCLUSION

From the detailed review conducted with 15 journals of education domain, gamification elements are found to be a motivational among university and higher education students. The game elements used in the institutions are limited because of using the existing gamification tools, where most of them target on the computer platforms rather than smartphones. Immersive and interactive next-generation technologies can be used to increase engagement in the classroom with gamification. Future studies may focus on increasing autonomy for the students with the use of such Extended reality technologies.

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