



Gamification as an Effective Learning Tool in Healthcare Education: A Review

¹Surajit Goon*, ²Shreyashi Kundu, ³Debarati Roy

¹Computer Science Department, ^{2,3}Pharmacy Department,

^{1,2,3}BCDA College of Pharmacy & Technology, Kolkata, West Bengal, India

Abstract— *In this review article, a World Wide Web based survey has been conducted to find the efficacy, benefits and compatibility of “Gamification” as an excellent learning tool in healthcare studies. Here some figures from the survey have been provided for the better knowledge and evidence to our topic’s relevancy. The use of distinctive elements of game designing or playing (e.g. point scoring, competition with others, rules of play) to other areas of activity like medical science, pharmaceutical sciences and so on healthcare fields has been described in a beneficial manner. It has perfectly described the huge permeation of gamification or game designing elements into education or the conventional learning procedure as a far greater future emergence.*

Keywords— *Gamification, healthcare education, pharmacy, nursing, medicine, education, e- learning.*

I. INTRODUCTION

We have visualized so many changes in Healthcare education like pharmacy & medical fields for last decades all over the world. Usage of imitations and digital games in learning and valuation is likely to upsurge over the next decades^[5]. The prompt permeation of progressively refined skills into every aspect of our society is causing noteworthy modifications in where, when & how people work, how the companies, individual persons, and even the nations comprehend and unify themselves, and how educational systems should be planned to apprehend students effectually for life in this century. Gamification is the use of fundamentals of game design to hike user engagement^[2]. Gamification has been magnificently merged into medical and scientific endeavors in recent years, from health, fitness, medicines, to education applications^[6]. It’s mentionable that Kai Huotari and Juho Hamari define gamification from the service marketing perspective because, as said, most of the gamified executions aim for marketing benefits. According to them gamification refers to a process of enhancing a service with affordances for gamely experiences in order to support user’s overall value creation. The definition emphasizes the goals of gamification; previously introduced definitions are based on the idea that gamification is all about the game elements. In this article we’ve surveyed the works going on medical fields on the basis of gamification in such issues like enhancement of the productivity of medicines, efficacy of the treatment, success rates of the medications, market study on what patients and their family are actually looking for etc. We chose internet as the source of information, reports and have done a comparative study on how many implementations of gamification in the major healthcare fields of Doctors, Pharmacists and Nurses have been done. From the cloud source we studied other works of researchers, survey reports and concluded how efficiently gamification can be a learning tool for healthcare educations.

II. REVOLUTIONS OF GAMIFICATION IN EDUCATION

Students have been scrutinized their educational ability in school through assignments and projects since the year 1700^[1]. Reward management programs have been developed since the year 1900 when the psychological analytical assessment technique was introduced and can still be seen in schools^[2]. Though it has been used in education for many years^[3] but the term "gamification" was bit condemned then for being simply a new name for a practice. The term “gamification” was coined in the year 2002^[4], and gradually acquired its popular place by 2007^[4]. History says it considers a range of intricate factors which can make one decide to perform; it is a multidimensional approach which puts lights on psychology, design, strategy, and technology^[6]. One main reason for the present popularization of "gamification" is that modern advancements in technology and to be more precise the mobile technology have allowed for the explosion of a variety of gamification initiatives in multiple contexts^[6]. So, we see it is difficult to pinpoint when gamification, in the strict sense of the term, came to be used in educational contexts, although through our cloud survey we noticed examples shared online by classroom teachers begin appearing in 2010^[2]. The word “Gamification” was supposedly first used by British coder and inventor **Nick Pelling** in the year 2002^{[1][2]}. Needless to mention that though Pelling’s ideas were still far from what gamification is considered to be in today’s concept because of the marvelous advancement of technology yet the budding seed which he sowed then, had turned out to be a big tree today. Table 1^[7] shows some serious games in history.

Table I Some Serious games and its application field

YEAR	SERIOUS GAMES	APPLICATION
1970	Serious games book by C. Abt.	Academic book
1972	Maganavox Odyssey	Education
1980	Battle zone	Training
1981	The Bradley trainer	Training
1982/83	Pole position/ Atari VCS 2600 console	Training
1996	Marine doom	Military
2002	America's army	Military
2003	DARWARS	Military
2005	VBS1	Military
2006	Bilat	Interpersonal communication
2009	VBS2/ Game after ambush	Military
2012	X plane 10	Training

III. IMPACT OF VIDEO GAMES IN HUMAN BRAIN

From the researches going since decades, we already have an idea that human beings learn from experiences^[8]. Human brains can store every experience we're passing through and that's what informs our learning process. We're also aware that an audio- visual media can be a best aid to gear up the learning process of human brain^{[9][8]}. So, we can say that well designed experience can result the best form of learning, like video games. A good motivation, clear goals, interpreted outcomes, and instant feedback- all of these can be the essential part of well-designed experience to feed the learning process^[9]. Video games have all these components. When a kid plays video games for fun but he/ she has the goal of moving ahead to the next level and finally conquering the opponent, whether that's another player or the computer. This urge to progress makes the player efficient. Why? Because he/ she learns through the experience. In addition to that the social aspect — sharing the gaming strategies, experiences, and explanations, helps to reinforce what they've learnt. In our education system teachers each to test and the word "test" is like a haunting nightmare for the students. Now what does a video game do? A video game indicates a different way of thinking about assessments^{[9][10]}. Learning or gaining knowledge and valuation is exactly the same thing. If one designs the process of learning so the learner can't get out of one level until the last one is completed, test is simply not needed. Fundamental part of acquiring knowledge is the ability to apply the previously learnt to the new one. Video games allow the players to do that. Some students are not motivated to study and learn. Here the use of video games or gamification has an ultimate victory because it tempts the students to get involved into learning process through its exciting, rhythmic and pictorial system^[8]^[9]. Research shows, when it comes to problem solving, if students are taught and tested the facts and formulas, they learn facts and formulas but this hardly make them able to correlate to solve problems^{[9][10]}. If they are taught through problem-solving, they acquire problem-solving ability and in addition to that they learn the facts. Games make the players put in problems and they are to solve the problems by themselves. Thus their problem solving ability is increased as well as the self confidence is boosted up^{[9][10]}. If a student fails in a test in school or college he/ she may lose one academic year. So, we see the cost of failure is high and thus students feel obligated to take risks. If the cost of failure is made lower to moderate, such as in video games in which the player "dies" but gets chance to start over again, students are enthused to indulge into all their challenges more. Keeping eyes on the goals they try and think of new strategies over and over again, they themselves find their flaws and rectify to success. In this way they gain intense knowledge which can't happen if the cost of failure is so high that they be afraid of taking challenges.

IV. EFFECTIVENESS OF GAMIFICATION IN EDUCATION

From the research^[11] work of Domínguez and colleagues about gamifying learning experiences suggests that common beliefs about the benefits obtained when using games in education can be challenged. They summarized: 1) Students with the game aided educational involvement got better scores in practical assignments and in overall score, but these students performed poorly on written assignments although their initial enthusiasm was developed. 2) The researchers indicated that it is not negligible to achieve potential effect to increase student motivation using gamification in e-learning platforms, as a big involvement is required in the game designing and implementation of the experience for it to be fully enthusiastic for participants. 3) Qualitative analysis of the study suggests that as reward systems and participative social tools seem to be motivating for the students, gamification is to surely have a great emotional and social impact on them. 4) A Quantitative analysis suggests that the cognitive influence of gamification on students is not very noteworthy. Students who followed traditional exercises performed similarly in overall score than those who followed gamified exercises. 5) Disadvantages of gamified learning were reported by few students who were not willing to participate in the gamified experience. The most frequent cause argued by students was 'time availability'. The second most important point argued was technical problems.

Health care is a field where serious games are used to improve learning. Petit ditDariel, Raby, Ravaut and Rothan-Tondeur (2013)^[12] investigated the development of serious games potential in nursing education. 1) They reported that few nursing students had long-term experience to home-care and community situations. 2) They found, to prepare nurses satisfactorily and dependably for the skills they will need to care for patients outside acute care settings, new instructional tools are needed. 3) Laboratories with high reliability mannequins have become an integral element in many

health care curriculums. They also stated evidence suggesting that the use of mockup models noticeably upgraded three outcomes important to clinical reasoning: knowledge acquisition, critical thinking and the ability to detect deteriorating patients.

V. DIFFERENCE BETWEEN MODERN GAMIFICATION AND TRADITIONAL GAMING METHODS

As we conducted a survey about the application of gamification in healthcare education, the difference between traditional game methods and Methods using gamification is a relevant topic. The following Table 2 describes the differences clearly.

Table 2 Traditional Games Methods Vs. Gamification Methods

Traditional game methods	Methods using in modern Gamification
Clear but short duration of beginning to end of game.	Offer challenges after completion of one level, another level starts.
Importance of user and computer relationship by so called input- output devices.	Importance of user relationship through various communications by real life sensors like eye movement sensor, activity sensor etc.
Tiresome progress to the result.	High retention/ achievement due to process and reward sustainability.

VI. COMPARATIVE DISCUSSIONS ON ADVANTAGES AND DISADVANTAGES OF EDUCATIONAL GAMES

Let us put a light on the pros & cons of using games in education- 1) as per the definition of gamification, the main advantage that can be mentioned is the provision it offers for interactive participation of the students and their excitement while playing ^[9]. 2) We can say that including games as a learning tool can produce interest and motivation in students towards study ^[13]. 3) An educational game offers a less hectic environment for students. It is a mentionable advantage because worrying often obstructs full engagement ^{[13][14]}. 4) Games allow students to not only learn but to practice what they have learned in lectures or in books and make them to compare with realistic situations and achieve mastery skills ^{[9][13]}. 5) Games have been successfully reported to improve students' confidence as well as the performance. 6) In other hand, however, in some studies, students reported games to be not so advantageous ^[2]. 7) Even though studies say games are less stressful, some students as exceptions may feel strained because they need to play games memorizing their studies ^{[9][10][13]}. 8) We see games as a learning tool may be unsuccessful for students who do not enjoy playing games or less interested to modern technologies ^[13]. 9) Another mentionable drawback is that Moderating and applying games required assistance and even special training of faculty members or facilitators, which needless to mention that increased their workload ^{[2][9]}.

VII. CONSIDERATIONS FOR DESIGNING AN EDUCATIONAL GAME

In spite of being a hypothesis that needs to be tested, some features that we should keep in mind while designing video games, which are simply related to the well-known principles of effective learning and promote efficacy and a sense of mastery, are: 1) Reciprocal interaction: While playing a game, player should feel himself/ herself as a decision maker and not just a consumer of the game designer's decisions or provisions. He/ she should have all the scope to implement his/ her mastery skills, tricks, ability to think outside the box ^[2]. 2) Personalization: Players should be provided customized options as per their ability or choices they want to make because it increases the interest as well as involvement towards the game. Hence, personalization is a key principle of learning in many contexts supplying a variety of learning styles and providing multiple routes to success ^[12]. 3) Heavy-duty identities: Providing a strong identity to the gamers lead them to engage more enthusiastically. In other hand, it increases the sense of responsibility and risk taking ability, enhancing the efficacy to compete into more challenging situations ^[10]. 4) Perfectly categorized problems: An important feature of a good game is the perfectly sequenced or categorized problems. It provides a gradual increase in the player's self-motivation which leads to solve problems more efficiently one after another ^[2]. 5) Moderate challenges: The path to success in games should not be so difficult that the player loses his/ her interest to play. Success, rewards, appreciation increases user involvement ^[10]. 6) A cycle of expertise: Repeated cycles of extended challenges and practice make the player to gain expert ability and mastery in a particular subject. Important feature of a good game is to build and maintenance what has been called as the 'cycle of expertise' (Bereiter & Scardamalia 1993) ^[9] in the science of learning.

VIII. OBSERVATIONS-DATA ANALYSIS STATISTICS FROM THE INTERNET

We searched for some percentages over the internet from which we could support some statistics on gamification in education. Here are the data provided that we obtained. 1) According to one survey ^[15]: 62% of participants say gamification would be enthusiastic by leader boards and will increase competition between students. 89% said that this system can upsurge their involvement with an e-learning application. 82% were showed to be in favour of a numbers of difficulty levels and challenging contents. 79% of the reviewers said that they would be more prolific if their university/institution or work was more game-like. 2) Another survey ^[16] report on healthcare education games says: 98% of the participants liked the idea of using technology to enhance healthcare education. 96% of them felt that education should make better use of new media technologies. 80% agreed that video games can have educational value. A majority

as in 77% would use a multiplayer online healthcare simulation on their own time, provided that it helped them to accomplish an important goal. 97% of the Men and women agreed that they were most inclined to use multiplayer simulations if they were fun. 90% were more likely to use gamified tools to develop skill in patient interactions.

Survey data: After searching for the games related to healthcare study field, precisely “games for students to be doctors”, “games for students to be nurses”, “games for students to be pharmacists”, we had the following result which is listed below and data charts (fig. 1 & fig. 2) are given.

Games for students to be doctors: Reflexion Health^[18], Cogcubed^[19], Respondwell^[20], Cohero Health^[21], Syandus^[22], Akili Interactive Labs^[23], Interactive Body^[24], Personal Hygiene^[25], Human Skeleton Game^[26], Whack-A-Bone^[27], Poke-A-Muscle^[27], Match-A-Brain^[27], Anatomical Terminology-Word Search^[27], Muscle Anatomy Game^[28], Mommy Pregnant Check Up^[29], Knee Surgery^[30], Nose Surgery^[30], Tom Hospital Recovery^[31], Rollerblade Accident^[31], Cure My Baby Animals^[31], Santa At The Hospital^[31], Cold & Flu Invasion^[31], Amy’s Hospital^[31], Elsa Eye Treatment^[32], Broken Bone Rescue^[32], High School Clinic^[32], Sofia The First Tree Accident^[32], Elsa Ear Emergency^[32], Talking Ginger Doctor Care^[32], Olaf Nose Doctor^[32], Baby Elsa Skating Accident^[32], Baymax Eye Care^[32], Hipster Boy Ear Infection^[32], Facial Skin Doctor^[32], Broken Nail Doctor Care^[32], Barbie At Anatomy^[32], Crazy Brain Doctor^[32], Captain America Eye Care^[32], Injured Monster Doctor^[32], Baby Juliet At Doctor^[32], Skin Doctor^[32], Denis Hand Surgery^[32], You Had One Job^[32], Minion Eye Care^[32], Soccer Doctor^[32], Crazy CAT Scan^[32], Heart Attack^[32], Angel Of Battlefield^[32], Dr Joe^[32], Dr. Wise-Medical Mysteries^[33], Elizabeth Find M.D.-Diagnosis Mystery^[33], Kevin At The Dentist^[34], Talking Tom Dentist Appointment^[34], Dentist Clinic^[34], Subway Surfers Tooth Injury^[34], Dentist Fear^[34], Dracula’s Dentist^[34], Animals Dentist^[34], Shoulder Surgery^[35], Eardrum Surgery^[35], Tonsil Surgery^[35], Scoliosis Surgery^[35], Pacemaker Surgery^[35], Epilepsy Surgery^[35], Dental Surgery^[35], Leg Surgery^[35], Stomach Surgery^[35], Arm Surgery^[35], Battery Quiz^[40], Coffee Quiz^[40], Cash Stack Quiz^[40].

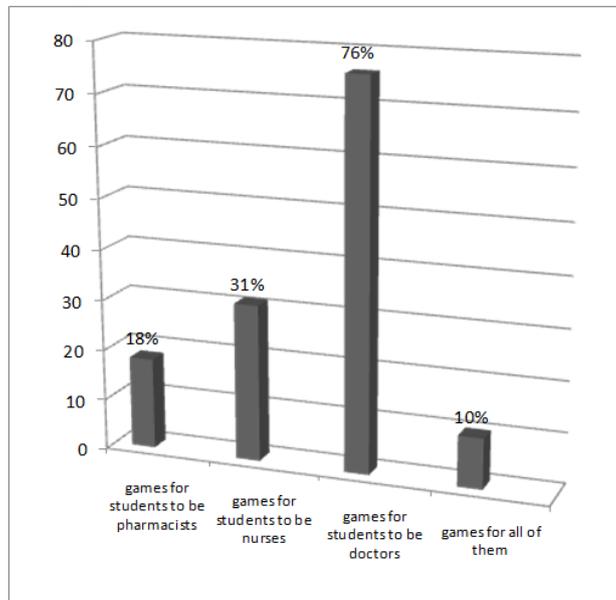


Fig. 1 Learning Games Trends

If the survey data is categorized according to the type of the games, then we get fig. 2:

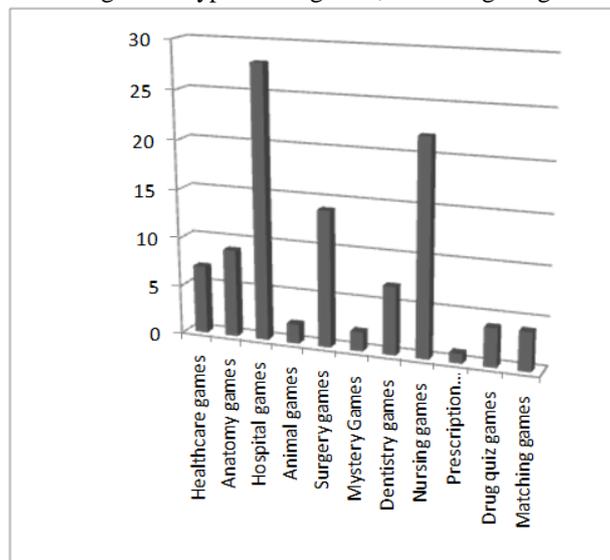


Fig. 2 Games Classification

IX. OBSERVATION DATA ANALYSIS, CONCLUSION AND FUTURE PROSPECTS

From the above data we can analyze that among the total 100 numbers of games we found, 78 of them were for students to be doctors, 31 games were for the students to be nurses and the rest only 18 games were for the students to be pharmacists. So pharmacy needs to be considered as a field where the gamification as an effective learning tool is to apply. Throughout the survey, case studies, researches have scrutinized to identify and investigate concept of Gamification in healthcare studies and the benefits and future impacts as a prospective progressive method of learning has been sufficiently found. Moreover, our review article proposes design elements and utilization area of Gamification model from the analyzed content, and compares and analyzes it with traditional game methods. Obviously we should keep in mind that the method should be such developed so that the purpose of learning and studies should not get lost with the flow of gamely experience and also the game should be adequate enough to let all kind of students to take part into without the hesitation or the fear of result. As being an advanced technology proposals it can be abused in many ways too.

REFERENCES

- [1] Reisner, E. H. (1922). Nationalism and Education since 1789: a social and political history of modern education, retrieved from <https://archive.org/details/cu31924032694006> on 17/02/16
- [2] Deterding, Sebastian, Dixon, Dan, Khaled, Rilla, Nacke, Lennart (2011), "From game design elements to gamefulness: defining 'gamification'. 15th International MindTrek Conference. NY, USA: ACM. pp. 9–15.
- [3] Kirk, Terry, Harris, Christopher (2011). "It's all fun and games in the library". Knowledge Quest 40 (1): 8–9.
- [4] Katie Larsen McClarty, Aline Orr, Peter M. Frey, Robert P. Dolan, Victoria Vassileva, Aaron McVay, June 2012, "A Literature Review of Gaming in Education: Research Report" retrieved from <http://www.bookagreeable.net/book/a-literature-review-of-gaming-in-education.html> on 10/02/16
- [5] Christa R Nevin; Andrew O Westfall; J Martin Rodriguez; Donald M Dempsey; Andrea Cherrington; Brita Roy; Mukesh Patel; James H Willig, "Gamification as a Tool for Enhancing Graduate Medical Education", Postgrad Med J. 2014;90(1070), pp. 685-693.
- [6] Hee Jung Park, Jae Hwan Bae, "Study and Research of Gamification Design" International Journal of Software Engineering and Its Applications, Vol.8, No.8 (2014), pp. 19-28.
- [7] Obtained from: <http://ww2.kqed.org/mindshift/2011/02/24/ten-surprising-truths-about-video-games-and-learning/> on 2/01/2016.
- [8] Fetched from <http://time.com/4051113/why-playing-video-games-can-actually-be-good-for-your-health/> on 23/02/2016.
- [9] James Paul Gee, "Are Video Games Good for Learning?", Curriculum Corporation 13th National Conference, Adelaide, August 2006
- [10] Eichenbaum, Adam; Bavelier, Daphne; Green, C. Shawn, "Video Games: Play That Can Do Serious Good", American Journal of Play, retrieved on 23/02/2016.
- [11] Adrián Domínguez, Joseba Saenz-de-Navarrete, Luis de-Marcos*, Luis Fernández-Sanz, Carmen Pagés, José-Javier Martínez-Herráiz, "Gamifying learning experiences: Practical implications and outcomes". Computers & Education 63 (2013) pp. 380–392.
- [12] Petit dit Dariel OJ, Raby T, Ravaut F, Rothan-Tondeur M., "Developing the Serious Games potential in nursing education": Nurse Education Today. Vol. 33, (Jan, 2016) Issue 12, pp. 1569–1575.
- [13] Andrew Stott, Carman Neustaedter, "Analysis of Gamification in Education": School of Interactive Arts and Technology, Simon Fraser University, 250 – 13450 retrieved from <http://clab.iat.sfu.ca/pubs/Stott-Gamification.pdf> on 21/02/2016
- [14] Linda Ross, Brett Williams, Paul Jennings, "The effectiveness of educational interventions designed to improve health care student behaviors and/or attitudes toward older people: a systematic review protocol": JBI Database of Systematic Reviews & Implementation Reports 2015; 13(7), pp. 13 – 23
- [15] Hee Jung P, Jae Hwan B, "Study and Research of Gamification Design": International Journal of Software Engineering and Its Applications Vol.8, No.8 (2014), 19-28.
- [16] David R, Bill K, Adam D, "Gamification for Internet Based Learning in Health Professions Education": July 7, 2014 to July 10, 2014 ISBN: 978-1-4799-4038-7, 281-282.
- [17] Michael Z, "From visual simulation to virtual reality to games": Computer 38.9: 25-32 (2005).
- [18] <http://reflexionhealth.com/>- fetch on 21.2.16
- [19] <http://www.cogcubed.com/>- fetch on 21.2.16
- [20] <http://respondwell.com/about/> fetch on 21.2.16
- [21] <https://angel.co/coherohealth>- fetch on 21.2.16
- [22] <http://syandus.com/> - 5 fetch on 21.2.16
- [23] <http://www.akiliinteractive.com/> - fetch on 19.2.16
- [24] <http://sciencenetlinks.com/interactives/systems.html> - fetch on 23.2.16
- [25] <http://www.turtlediary.com/game/personal-hygiene.html>- fetch on 23.2.16
- [26] http://www.bbc.co.uk/science/humanbody/body/interactives/3djigsaw_02/index.shtml?organs- fetch on 23.2.16

- [27] <http://www.anatomyarcade.com/games/games.html> - fetch on 23.2.16
- [28] <http://www.realbodywork.com/articles/game-muscles-1/> - fetch on 23.2.16
- [29] <http://www.hospitalgames.co.uk/hospital-games/mommy-pregnant-check-up-> fetch on 23.2.16
- [30] <http://www.a10.com/puzzle-games/> fetch on 23.2.16
- [31] <http://www.hospitalgames.co.uk/hospital-games/> - fetch on 23.2.16
- [32] <http://www.hospitalgames.co.uk/doctor-games/> - fetch on 23.2.16
- [33] <http://www.gamehouse.com/download-games/> - fetch on 23.2.16
- [34] <http://www.hospitalgames.co.uk/dentist-games/> - fetch on 23.2.16
- [35] <http://www.agame.com/game/> - fetch on 23.2.16
- [36] <http://www.hospitalgames.co.uk/nurse-games/> fetch on 23.2.16
- [37] <http://www.girlgames.com/> fetch on 23.2.16
- [38] <http://www.mydoctorgames.com/> fetch on 23.2.16
- [39] <http://action.gamesxl.com/flu-epidemic.html>- fetch on 23.2.16
- [40] <http://denalirx.com/study-games-pharmacy-technician/> fetch on 23.2.16
- [41] <http://www.hospitalgames.co.uk/hospital-games/pharmacist-rx-> fetch on 23.2.16