Impact of Implementing Game Elements in Gamifying Educational Environment: A Study

F Durin, R Lee, A Bade, C K On and N Hamzah

1Mathematics, Graphics and Visualization Research Group (M-GRAVS), Faculty of Science and Natural Resources, Universiti Malaysia Sabah, 88450 Kota Kinabalu, Sabah, Malaysia

2Mathematics and Computer Graphics, Faculty of Science and Natural Resources, Universiti Malaysia Sabah

3Center of Excellence in Semantic Agents Universiti Malaysia Sabah Sabah, Malaysia

Email: ferwan95@gmail.com

Abstract. Gamification is the use of game elements in a non-gaming environments. The aims of implementing game elements in gamifying educational environment is to make the learners engaged and motivated in the learning process. But, some of the research result giving bad impacts in implementing gamification in education. The objective of this research is to study the impact of implementing game elements in education. The aim of this research is to study which game elements is most commonly used in gamifying educational environment. The study is done by reviewing previous research on impacts of implementing game element in education from 2008 until 2018 to see whether the elements giving positive or negative impacts on education. The results shows the most common game elements used in gamification is rewards, feedback, challenge, quest/mission/goal, level/stage, point/score, avatars/players, task, character, time-limit, narrative/dialogue, leaderboards, progress bars, and badges. Majority of the research on gamification in education reports positive impacts by introducing gamification in education. In conclusion, by implementing game elements in the gamifying educational environment is a good method to create a good adjustment in learners’ behavior and assertiveness in the learning process, it can develop engagement and motivation of the learners’.

1. Introduction

Student’s engagement and motivation are important in teaching and learning process. Educators used many techniques and mechanisms in their teaching as an effort to keep the student engaged and motivated throughout their learning activities. But, it shows that with the conventional method of learning it is not an easy task to keep student’s engaged and motivated. Gamification is one of the ways to rise engagement and motivation of learner. The basic definition of gamification is implementing game elements into something for other purposes such as in education, not just for entertainment purposes. The main reason of gamification in education is to make student engaged and motivated and at the same time creates an effective learning environment. This research aims to study the game elements and its impact on student engagement, motivation, and educational performance. Based on earlier research and experiment on gamification, typical game elements that were implemented in the current educational environment are points, badges, leaderboards, progress bar,
level, prize and rewards, storyline, and feedback. It revealed that by implementing these elements in education learning curve, it can make student engage and motivate in their activities, and, it gave positive impacts on student’s result and their understanding.

2. Gamification

Gamification can be defined as “the use of game design elements in non-game contexts” [35], in other word, game elements are used not just for entertainment but being used for another purpose. According to Deterding, Dixon, Khaled, and Nacke [35] understand the origins of the term gamification from the digital media. They stated the use of this term is around 2008. By using ScienceDirect to identify the scientific document by filtering the keyword to use of game in education and gamification in education, there is increasing interest in gamification in education from 2008 to 2018.

![Gamification in Education research from literature review](image)

**Figure 1.** Research in gamification in education 2008 to 2018 from past research.

Gamification also has been added to the Web Courseworks 2018 eLearning predictions. Web Courseworks group state “gamification attempts for corporate training are still the worst thing, but board-prep apps that help learners study for high-stakes certification exams using adaptive quiz algorithms are surprisingly gamelike and very popular with highly paid professionals” [36].
Figure 2. Web Courseworks 2018 eLearning predictions set in terms of Gartner’s hype cycle.

According to Kiryakova [19], there are five types of games used in gamification and the definition between still not clear definition boundaries between this terms:

- **Game inspired design** - practice the ways and ideas that already exist in the game and make use full of fun design instead of focusing on game elements.

- **Gamification** – use of game elements in a non-gaming environment to influence user performance.

- **Serious games** – created not just for fun but for a serious resolution such as training, game like and using all of game elements, however the purpose is to attain something that already been set.

- **Simulations** - like serious games, use for training by simulating the real situation environment.

- **Games** – use all mentioned above and the purpose is for amusement
2.1. Game Elements

The most common game elements used in gamification are rewards, feedback, challenge, quest/mission/goal, level/stage, point/score, avatars/players, task, character, time-limit, narrative/dialogue, leaderboards/dashboards, progress bars, and badges/achievements.

![Figure 3. Game elements used in gamification in education from 2008 to 2018.](image)

From figure 3, based on our study, the most common game elements used in gamification is rewards, feedback, challenge, quest/mission/goal, level/stage, point/score, avatars/players, task, character, time-limit, narrative/dialogue, leaderboards/dashboards, progress bars, and badges/achievements.

2.2. Gamification Impact in Education

![Impacts of gamification in education](image)

- **Positive** [1, 2, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 19, 20, 21, 23, 24, 25, 26, 27, 29, 30, 31, 33]
- **Negative** [17, 32, 34]
- **Mixed/recommended** [2, 5, 16, 18, 22, 28]
Figure 4. Graphical representation of gamification impacts on education.

Based on our study, figure 4 shows the majority research on gamification in education reports positive impacts by introducing gamification in education. Specifically, researcher found:

- Gamification enhances student’s attitude towards learning and enables them dealing with learning tasks easily.
- Gamification increases student’s motivation and engagement towards learning.
- Gamification increases student’s understanding towards the subject and increases their performance in class and test.

But, some of the research reports negative impacts after they introduce gamification in education. Specifically, they found:

- There is no progress in quality of their experience and performance [17].
- There is no significant impacts [32].
- Student motivation decreased continuously [34].

And, the mixed/recommend impacts is where the research report the negative and positive impacts, and recommend the practice of gamifying educational environment.

3. Conclusion

The impact of implementing game elements in education may vary towards other factors such as the user age, personality, and psychology. Also, the type of game elements that used for gamification in education also can affect towards user engagement, understanding, motivation and fun in learnings.

In conclusion, by implementing game elements in the gamifying educational environment is a good method to create a good adjustment in learners’ behavior and assertiveness in the learning process, it can develop engagement and motivation of the learners’. Also, gamifying educational environment can create conditions of effective learning process then give effect on student understanding on educational content. But, some of the factors need to be considered before implementing the game elements into learnings environments such as learning mechanism, audience’s age, and duration to make sure the gamifying educational environments is effective.

All of the impacts are measure by using statistical method based on results from the game or by using survey and questionnaire. Therefore, our future research direction will be implementing eye tracking technique for engagement measurement in gamification.

4. References

[1] Ke F 2008 A case study of gaming for math: Engaged learning from game play? Computer & Education 51 pp 1609-20
[2] Hamalainen R, Oksanen K and Hakkinen P 2008 Designing and analyzing collaboration in a scripted game for vocational education Computer in Human Behavior 24 pp 2496-506
[3] Moreno G P, Burgos D, Martínez O I, Sierra L J and Fernández M B 2008 Educational game design for online education pp 2530-40
[4] Akkerman S, Admiraal W and Huizenga J 2009 Storification in History education: A mobile game in and about medieval Amsterdam Computers & Education 52 pp 449-59
[5] Costu S, Aydin S and Filiz M 2009 Students' conceptions about browser-game-based learning in mathematics education: TTNetvitamin case Proced Social and Behavioral Sciences pp 1838-52
[6] Tüzün H, Yılmaz S M, Karakus T, Inal Y and Kızılkaya G 2009 The effects of computer games on primary school students’ achievement and motivation in geography learning Computers & Education pp 68-77

[7] M’unz U, B’ohm C, Eck J, Reble M, Schumm P and Allg’ower F 2010 A Matlab-Based Game for Advanced Automatic Control Education Institute for Systems Theory and Automatic Control IFAC Proceedings Volumes 42 pp 140-5

[8] Burguillo J C 2010 Using game theory and Competition-based Learning to stimulate student motivation and performance Computers & Education 55 pp 566-75

[9] Huang W H 2011 Evaluating learners’ motivational and cognitive processing in an online game-based learning environment Computers in Human Behavior 27 pp 694 – 704

[10] Hainey T, Connolly T M, Stansfield M and Boyle E A 2011 Evaluation of a game to teach requirements collection and analysis in software engineering at tertiary education level Computers & Education 56 pp 21 – 35

[11] Kerfoot B P and Baker H 2012 An Online Spaced-Education Game to Teach and Assess Residents: A Multi-Institutional Prospective Trial Journal of the American College of Surgeons 214 pp 367-73

[12] Rutten N, Van Joosling W R and Van Der Veen J T 2012 The learning effects of computer simulations in science education Computers & Education 58 pp 136 – 53

[13] Routarinea S and Ylirisku S 2012 Video Card Game as a learning design for teacher education Proced Social and Behavioral Sciences 45 pp 370 – 80

[14] Nag S, Katz J G and Saenz O A 2013 Collaborative gaming and competition for CS-STEM education using SPHERES Zero Robotics Acta Astronautica 83 pp 145 – 74

[15] Sailer M, Hense J, Mandl H and Klevers M 2013 Psychological Perspective on Motivation through Gamification Interaction Design and Architecture(s) Journal 19 pp 18-37

[16] Eastwood J L and Sadler T D 2013 Teachers’ implementation of a game-based biotechnology curriculum Computers & Education 66 pp 11 - 24

[17] Moroianu M and Dumitr M 2013 The influence of the sporting game (basketball) on the general education of children aged 9-11 Procedia - Social and Behavioral Sciences 89 pp 88 – 93

[18] Simkova M 2014 Using of Computer Games in Supporting Education Procedia - Social and Behavioral Sciences 141 pp 1224 – 7

[19] Kirkyakova G, Angelova N, Yordanova L 2014 9th International Balkan Education and Science Conference (Edirne Turkey: Gamification in Education Conference)

[20] Faghih U, Brautigam A, Jorgenson K, Martin D, Brown A, Measures E and Maldonado B S 2014 How Gamification Applies for Educational Purpose Specially with College Algebra Proceda Computer Science 41 pp 182-7

[21] Sung H Y, Hwang G J and Yen Y F 2015 Development of a contextual decision-making game for improving students’ learning performance in a health education course Computers & Education 82 pp 179 – 90

[22] Müllera B C, Reisea C and Seliger G 2015 Gamification in factory management education – a case study with Lego Mindstorms Procedia CIRP 26 pp 121 – 6

[23] Carlson K J and Gagnon D J 2016 Augmented Reality Integrated Simulation Education in Health Care Clinical Simulation in Nursing 12 pp 123-7

[24] Taspinara B, Schmidt W and Schuhbauer H 2016 Gamification in education: a board game approach to knowledge acquisition Procedia Computer Science 99 pp 101 – 16

[25] Kayimbasioglu D, Oktekin B and Haci H 2016 Integration of gamification technology in education Procedia Computer Science 102 pp 668 – 76

[26] Kidı N, Kanigoro B, Salman A G, Prasetio Y L, Lokaadinugroho I and Sukmandhani A A 2017 Android Based Indonesian Information Culture Education Game (2nd International Conference on Computer Science and Computational Intelligence 2017 Bali) vol 116 (Indonesia: Procedia Computer Science) pp 99–106
[27] Vrugte J T, Jong T D, Vandercruysse S, Wouters P, Oostendorp H V and Elen J 2017 Computer game-based mathematics education: Embedded faded worked examples facilitate knowledge acquisition Learning and Instruction 50 pp 44-53
[28] Verkuyl M, Romaniuk D, Atack L and Mastrilli P 2017 Virtual Gaming Simulation for Nursing Education: An Experiment Clinical Simulation in Nursing 13 pp 238-44
[29] Calderón A, Ruiz M and O’Connor R V 2018 A serious game to support the ISO 21500 standard education in the context of software project management Computer Standards & Interfaces 60 pp 80–92
[30] Yasin A, Liu L, Li T, Wang J and Zowghi D 2018 Design and preliminary evaluation of a cyber Security Requirements Education Game (SREG) Information and Software Technology 95 pp 179-200
[31] Harits A R, Palmerlee M and Chen K 2018 Deploying learning materials to game content for serious education game development: A case study Entertainment Computing 26 pp 1–9
[32] Severengiz M, Roeder I, Schindler K, Seliger G 2018 Influence of Gaming Elements on Summative Assessment in Engineering Education for Sustainable Manufacturing Procedia Manufacturing 21 pp 429–37
[33] Whalen K A, Berlin C, Ekberg J, Barletta I, Hammersberg P 2018 ‘All they do is win’: Lessons learned from use of a serious game for Circular Economy education Resources, Conservation & Recycling 135 pp 335–45
[34] Van Roy R and Zaman B 2018 Need-supporting gamification in education: An assessment of motivational effects over time Computers & Education 127 pp 283-97
[35] Deterding S, Dixon D, Khaled R and Nacke L 2011 From game design elements to gamefulness: defining gamification Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments (MindTrek ’11) pp 9-15
[36] Web Courseworks group Blog release 2018 2018 eLearning Prediction –Hype Curve

Acknowledgments
The authors would like to gratitude Mathematics, Graphics and Visualization Research Group (M-GRAVS), Faculty of Science and Natural Resources of University of Malaysia Sabah (UMS) and UMS for their funding (SDK0021-2017) and providing the facilities to conduct this research.