Adaptive Gamification: User/Player Type and Game Elements Mapping

Ryan Macdonell Andrias[1,2], Mohd Shahrizal Sunar[1,3(✉)], and Stephen Laison Sondoh Jr.[4]

[1] Media and Game Innovation Centre of Excellence, Institute of Human Centered Engineering, Universiti Teknologi Malaysia, Johor, Malaysia
ryan@ums.edu.my, shahrizal@utm.my
[2] Faculty of Computing and Informatics, Universiti Malaysia Sabah, Kota Kinabalu, Malaysia
[3] School of Computing, Faculty of Engineering, Universiti Teknologi Malaysia, Johor, Malaysia
[4] Faculty of Business, Economics and Accountancy, Universiti Malaysia Sabah, Kota Kinabalu, Malaysia
jude@ums.edu.my

Abstract. Gamification is defined as the use of game design elements in non-game contexts. It is noteworthy that a user preference towards a game mechanic and game element is different as an individual. A common approach to satisfy user expectations is to include multiple game elements to accommodate all the user/player types. However, this approach may cause the user interface to be crowded with irrelevant game elements. This research proposes a method for adaptive gamification design with proper mapping of user/player type and game elements. 915 questionnaires (HEXAD user type) were analysed. Using matrix multiplication/matrix product, we can use correlation analysis to generate two primary relationship output: 1) HEXAD user type with game elements, 2) Six HEXAD user types. The game elements are grouped following Self-Determination Theory (SDT); Competence, Relatedness and Autonomy. Rewards are the fourth category, as extrinsic motivation. The fundamental game components that need to be given extra attention during gamification application development are learning, social comparison/pressure, non-linear gameplay and point features. In the meantime, less attention to leaderboard and creativity tools. The adaptive user types and game elements mapping can be used as a clear guideline for the gamification designer to develop an engaging application.

Keywords: Gamification · Adaptive gamification · User type · Player type · Self-Determination Theory (SDT)

1 Introduction

Gamification is commonly defined as the use of game design elements in non-game contexts [1]. The main reason to add game design elements in a non-gaming context is to motivate and engage the user to act continuously. Bounty Tasker, Beeminder and

Z. Lv and H. Song (Eds.): INTETAIN 2021, LNICST 429, pp. 242–256, 2022.
https://doi.org/10.1007/978-3-030-99188-3_15

Duolingo are some of the gamification applications available in the market. It is noteworthy that an individual personal preference towards game mechanics and game elements is different [2, 3]. Therefore, a gamification application should be designed to fulfil a particular user preference [4]. However, most of the gamified applications available in the market are being developed with fixed game elements such as points, badges, and leaderboards without the adaptivity approach [2]. A recent trend in gamification research is moving towards an adaptive approach [5–7]. The adaptive system can be either towards the game features or the content to suit individual needs.

Many user/player type topologies are available, such as Bartle's taxonomy, BrainHex, HEXAD and Ferro's classification. Most of the player type can be identified using the questionnaire as an instrument, and it can be mapped with specific game features. As an example, by using the HEXAD questionnaire, output, as shown below, can be derived (Table 1).

Table 1. Example of hexad user type classification.

User type	Percentage
Achiever	18%
Disruptor	4%
Free spirit	22%
Philanthropist	26%
Player	14%
Socialiser	16%

From the table above, it is challenging to design and develop a gamification application that suits a specific player type as the user comprises a combination of different types. A common way to satisfy user expectations is to include multiple gamification features to accommodate all the player types. However, this approach has a high risk of over-burdening the application user interface [2, 8].

In this article, we propose an approach to map HEXAD gamification user types with suitable game elements. Our goal is to create an adaptive gamification application with proper mapping of user/player type and game elements.

2 Related Works

2.1 Player/User Type

Bartle's Taxonomy is one of the most common gamers classifying approaches, categorising players according to the playing style. Richard Bartle has identified four types of players; Achiever, killer, socialiser and explorer [9]. Achiever: a player who strives to perform and accomplish an objective involves collecting points and level up. Killer: a hostile player that likes to create chaos either toward the games or other players.

Explorer: a type of player that keen to explore the games freely. Socialiser: a player that prefers to interact with other players while playing the games. However, Yee's [10] has validated Bartle Taxonomy with empirical data using factor analysis. The result has revealed only three major components: achievement (Achiever), social (Socialiser) and immersion (Explorer).

Another type of player classification is the Four Fun Keys Model [11], which comprises easy fun, hard fun, people fun and serious fun. Demographic Game Design model (DGD1) game player model is based on Myers-Briggs taxonomy (MBTI). There are four types of players in DGD1: Conqueror, Manager, Wanderer and Participant. Demographic Game Design 2 (DGD2) model is the extension of DGD1. It is based on Barens's Temperament Theory [12]. Meanwhile, the BrainHex Player Taxonomy [13] was formulated based on the neurobiological result based on earlier demographic game design models (DGD1 and DGD2). Seven types of players are identified: Seeker, Survivor, Daredevil, Mastermind, Conqueror, Socialiser and Achiever. HEXAD user type [14] has identified six gamification users: socialiser, free spirit, Achiever, Philanthropist, player and disrupter. Table 2 is the mapping between game player/user type and Bartle's taxonomy.

Table 2. Game player type and Bartle taxonomy mapping.

Bartle's taxonomy				
	Achiever	Socialiser	Killer	Explorer
Yee's	Achievement, immersion	Social		Immersion
4 fun keys	Hard fun	People Fun		Easy Fun
DGD1	Conqueror, manager	Participant		Wanderer
DGD2	Strategic, logistical	Diplomatic		Tactical
BrainHex	Achiever, conqueror, mastermind	Socialiser		Seeker
HEXAD	Achiever	Socialiser	Disrupter	Free spirit

2.2 HEXAD Gamification User Type

HEXAD gamification user type is based on user intrinsic and extrinsic motivational factors. There are six user types: Socialiser, Free Spirit, Philanthropist, Player, Achiever and Disrupter. Socialiser is a type of user that seeking social connection and relatedness as motivation. The free spirit is interested in autonomy and self-expression. Meanwhile, Achiever is motivated to gain mastery status by completing challenges and obstacles. A philanthropist user is inspired by a sense of meaning, purpose and altruism. The player user type is driven only by external rewards. Finally, the disrupter prefers to create chaos within the gamified environment.

2.3 Adaptive Gamification

A comprehensive table to relate between personality types, traits, player types with game features (game elements and game mechanics) has been proposed [15, 16]. The

authors compiled findings from various researchers in the area of psychology, game and Gamification. The table can be used as guidance for the gamification developer. However, to include all the game elements will make the application interface messy and crowded. As an example, for Achiever and Disrupter players, each type has six features. Kocadere and Caglar [17] stressed that a specific game element might positively impact a user but negatively impact another user. For example, teamwork elements will negatively impact the achievers, free spirit and disruptors but positive towards Socialisers.

Monterrat, Lavoué [18] have proposed an adaptive game feature system based on the individual user's interaction. The adaptive system captures two types of interaction: turning on and off the game feature and how often the user interacts with the feature. It is implemented by using a trace analysis system and Ferro's player classification as a design guideline.

Aldemir, Celik [20] have conducted a case study that involved 118 respondents. Students use the gamification application and, at the end of the course, been interviewed to record game mechanics and game elements' effect on their learning process. Nine main themes were identified and suggested to design an educational gamification application. The themes are narrative, reward, constraints, points, win-state, leader board, badge and teams. Although this approach can be used to develop the gamification application; however, it does not offer an adaptive capability to suits individual users and biased to game features that already pre-selected.

Kocadere and Caglar [17] conduct a similar case study as Aldemir, Celik [20]. However, it started with distributing Bartle's Taxonomy Questionnaire to identify the student's player type. Then, for seven weeks, the 41 selected students will use and experience an educational gamified application. At the end of the case study, one prominent participant for each player type is interviewed to capture game mechanics and elements either positively or negatively impact the learning process. However, according to Kotsopoulos, Bardaki [21], it is impossible to categories a user to a specific player type, which the authors point out that a user has a combination characteristic. Furthermore, Kocadere and Caglar [17] case studies are based on pre-selected game features.

Lavoué, Monterrat [2] have conducted a case study to derive an adaptive model from linking learners with game features using the matrix calculation method. The authors are using the BrainHex questionnaire to identify the player type. Two approaches are used to obtain the matrix of game elements and the player type; expert judgment (6 people) and student ranking. A comparison between experts and students' assessment reveals that expert evaluation correlates with the BrainHex player profile. One of the authors' problems is that the students' rating value does not match the player type's game feature. An example of a linear model, R = B A. This example comprises four users (u1–u4), three-game features (f1–f3) and a 2-factors player model: Conqueror (C) and Socialiser (S) (See Fig. 1).

Table 3 below shows Expert A-matrix, which comprise of game feature and BrainHex player type.

Kotsopoulos, Bardaki [21] approach is similar to Lavoué, Monterrat [2] to find the relationship between player types and game elements. Two questionnaires are distributed among students to identify HEXAD player type and the importance of game elements based on individual ratings. The authors use SPSS software to analyse the responses using

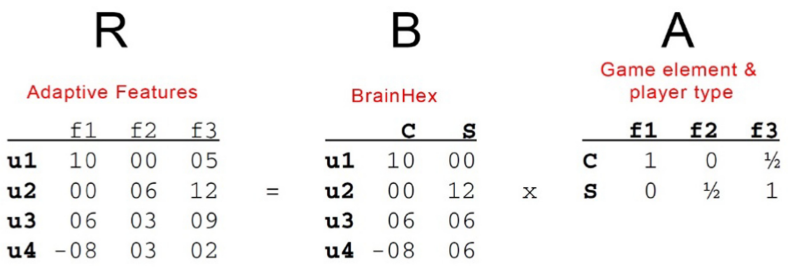

Fig. 1. Example of matrix multiplication/matrix product calculation.

Table 3. Example of expert A-matrix.

	Stars	Leaderboard	Tips	Walker	Timer
Seeker	0.5	0	0.75	0.88	0
Survivor	0.13	0.5	0	0	0.38
Daredevil	0.63	0.63	0	0.13	0.88
Mastermind	0.63	0.63	0.38	0.25	0.25
Conqueror	0.75	1	0.13	0.38	0.75
Socialiser	0.13	0.13	1	0.25	0
Achiever	1	0.75	0.13	0.88	1

descriptive statistical analysis and correlation analysis. Achiever and Philanthropist were the most extensive characteristics; however, the author's result cannot map Achiever with any game elements. It most likely shares a common problem with Lavoué, Monterrat [2], students giving a mismatch value to represent a game feature rating.

3 Methodology

3.1 Respondents Profile

Nine hundred fifteen undergraduate students participate in this experiment, which comprises 656 females and 259 males; age is between 19–26. The questionnaire is distributed via online using google form to University Malaysia Sabah students.

3.2 Process

The process of creating user/player type and game elements mapping followed these steps:

Step 1: Produce game element and user type-Matrix

The game element and user type-Matrix table is created based on an article written by Tondello, Wehbe [14]. The game element's effect on HEXAD user type is coded with a specific value according to the reported correlation value.

Step 2: Date Collection
Distribute the HEXAD questionnaire, consisting of 24 items among the students via an online URL.

Step 3: Data Analysis
After the responses have been collected, the data were analysed using Statistical Package for the Social Sciences (SPSS) and SmartPLS to identify:

- HEXAD user type distribution.
- User type and Game elements matrix
- User types matrix
- Relationship between types of users and game elements.

The approach to generate the matrix was adopted from Lavoué, Monterrat [2].
Step 4: Data Interpretation
Interpret the analysis result.

4 Result

4.1 HEXAD User Type

The HEXAD user type distribution for the experiment is shown in Table 4. The free spirit and philanthropist type are the highest, and disruptors are the lowest percentage, similar to Andrzej Marczewski's finding from the Gamified.uk website.

Table 4. Example of hexad user type classification.

User type	Percentage
Achiever	17%
Disruptor	12.4%
Free spirit	18%
Philanthropist	18.2%
Player	17.1%
Socialiser	17.3%

4.2 User Type and Game Element - Matrix

Table 5 below is the User type and Game element - matrix table created based on Tondello, Wehbe [14] research finding. The number is based on the correlation value identified in the article.

Table 5. User type and game element – matrix.

User type	Achiever	Disruptor	Free spirit	Philanthropist	Player	Socialiser
Challenges	0.463	0.207	0.412	0.212	0.317	0
Quests	0.266	0	0.236	0	0.245	0
Learning	0.215	0	0.391	0	0	0
Progression	0.239	0	0.204	0	0.302	0.17
Certificates	0.229	0	0.2	0	0.228	0.142
Social comparison	0	0	0	0	0.239	0.152
Social competition	0.161	0.32	0.249	0	0.239	0.216
Social discovery	0	0.179	0	0	0.217	0.205
Social network	0	0.197	0	0	0.143	0.15
Teams	0	0.169	0	0	0.192	0.179
Knowledge sharing	0	0.167	0.138	0.352	0.231	0.184
Creativity tools	0	0.252	0.23	0	0	0
Exploratory task	0	0	0.352	0.139	0.152	0
Nonlinear gameplay	0	0	0.221	0.179	0	0
Badges	0.208	0	0	0	0.271	0.164
Leaderboard	0	0.17	0	0	0.276	0.199
Points	0.172	0	0.201	0	0.259	0.168

4.3 Correlation Between HEXAD User Types

Table 6 shows the correlation between the six types of users in HEXAD. Based on the results, we can state the following:

- All types of users have a statistically significant linear relationship ($p < .01$) except the association between disrupter and socialiser as well as disrupter and Philanthropist (no correlation).
- Philanthropist and Socialiser have a strong correlation ($r > .5$)
- Moderate correlation ($.3 < |r| < .5$) between Achiever, Free Spirit, Philanthropist and Socialiser.
- The is no strong and moderate correlation between disruptors with other user types. It is either weak ($r < .3$), or without relationship.

Table 6. Correlation between HEXAD user types

User type	Achiever	Disruptor	Free spirit	Philanthropist	Player
Disruptor	.182**				
Free spirit	.449**	.200**			
Philanthropist	.474**	0.048	.447**		
Player	.245**	.149**	.307**	.220**	
Socialiser	.374**	0.043	.357**	.572**	.218**

** **Correlation is significant at the 0.01 level (2-tailed).**

4.4 Relationship Between Game Elements and HEXAD User Types

Table 7 shows the relationship between game elements and HEXAD user types. This table is essential as it will describe the game element that correlates with user type. Based on the results, we can state the following:

Positive Relationship

- Achiever is having positive relationship with all competence game elements (Challenges, Quests, Learning, Progression and Certificates).
- Player and Socialiser have positive relationship with all relatedness game elements (Social comparison, Social competition, Social discovery, Social network, Teams and Knowledge Sharing).
- Free Spirit is having a positive relationship with all autonomy game elements (Creativity tools, Exploratory task and Nonlinear gameplay).
- Player and Socialiser have positive relationship with all rewards game elements (Badges, Leaderboard and Points).

No Relationship

- Achiever and Socialiser have no relationship with all autonomy game elements (Creativity tools, Exploratory task and Nonlinear gameplay).
- Philanthropist does not have any relationship with all rewards game elements (Badges, Leaderboard and Points).

Table 7. Correlation between game elements and hexad user types.

	Game elements	Achiever	Disruptor	Free spirit	Philanthropist	Player	Socialiser
Competence	Challenges	0.41	0.27	0.34	0.19	0.32	0
	Quests	0.47	0	0.39	0	0.49	0
	Learning	0.43	0	0.72	0	0	0
	Progression	0.39	0	0.31	0	0.44	0.28
	Certificates	0.35	0	0.28	0	0.5	0.29
Relatedness	Social comparison	0	0	0	0	0.76	0.51
	Social competition	0.19	0.54	0.27	0	0.32	0.29
	Social discovery	0	0.54	0	0	0.5	0.49
	Social network	0	0.7	0	0	0.39	0.42
	Teams	0	0.32	0.17	0.45	0.34	0.28
	Knowledge sharing	0	0.57	0	0	0.49	0.47
Autonomy	Creativity tools	0	0.8	0.46	0	0	0
	Exploratory task	0	0	0.67	0.28	0.35	0
	Nonlinear gameplay	0	0	0.64	0.53	0	0
Rewards	Badges	0.41	0	0	0	0.6	0.38
	Leaderboard	0	0.48	0	0	0.6	0.44
	Points	0.29	0	0.31	0	0.49	0.33

5 Discussion

5.1 Designing a Gamification Application

The player and user type research show that a person is not inclusive to one user category. In other words, a player can have characteristics from a combination of either all types [22]. Therefore it is essential to carefully consider a well-balanced as an overall combination [23]. The player type analysis provides useful information on the prevalent user type for a developer. It is a valuable tool for a specific group of people, such as in an organisation or students with a particular demographic group. For example, in a study conducted at a workplace, for energy saving to become a daily habit, the gamified application should include progression, level and points game design elements [21]. Table 7

above clearly indicates that certain game elements affect users with either strong, weak or no correlation.

One of the most popular motivation theory which often been used in gamified education is Self-Determination Theory (SDT) [24, 25]. The SDT focuses on intrinsic motivation to improves performance, increases sustainability and encourages growth [26, 27]. Intrinsic motivation can be defined as an activity purely performed by an individual for pure internal satisfaction. A person feels excited about doing any task when that person is motivated internally.

SDT consists of three fundamental human needs: competence, autonomy, and relatedness. Competence represents the feeling of being able to handle the task at hand successfully. Autonomy means the more an individual can manage a situation, the greater the probability that he will succeed. Lastly, relatedness is the feeling of social connection with others. Figure 2, 3, 4 and 5 shows users preferential game elements based on the average value. It is structured in four primary categories; competence, relatedness, autonomy and rewards. Rewards such as badges, points, certificates and leaderboard can induce extrinsic motivation.

Learning, social comparison/pressure, non-linear gameplay and point features are the fundamental game elements that need to be given extra consideration. Meanwhile, less attention is paid to leaderboard and resources for creativity tools.

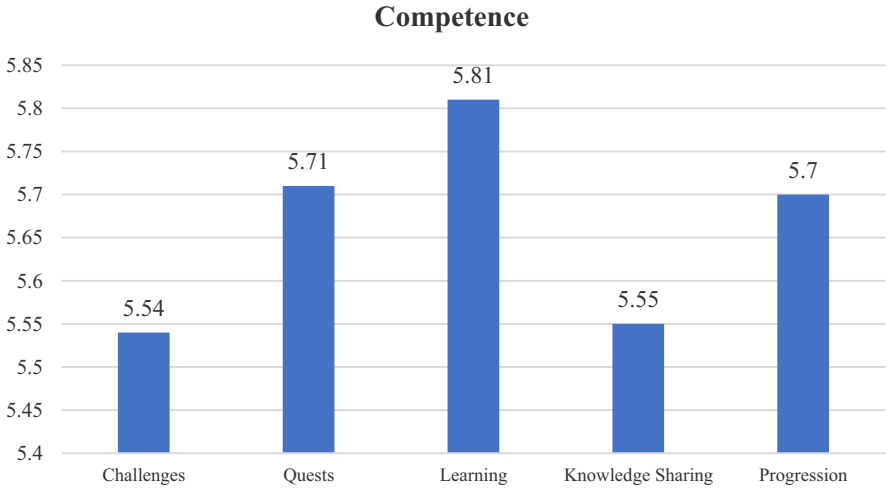

Fig. 2. Competence game elements.

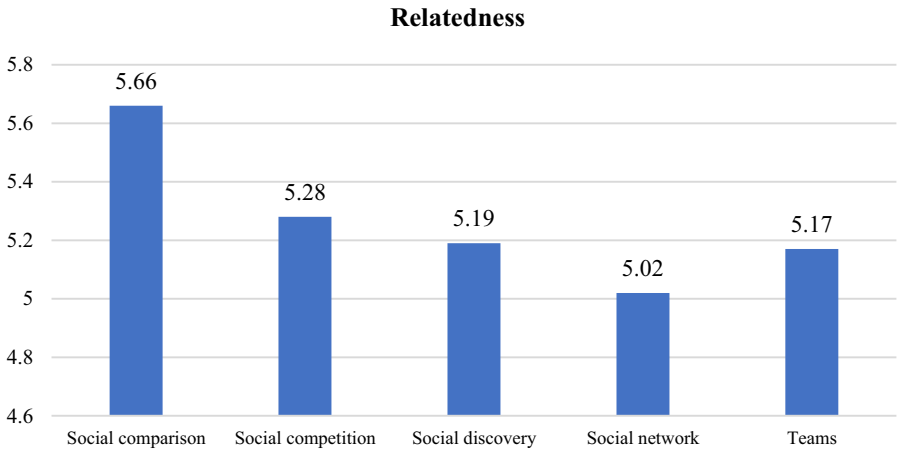

Fig. 3. Related game elements.

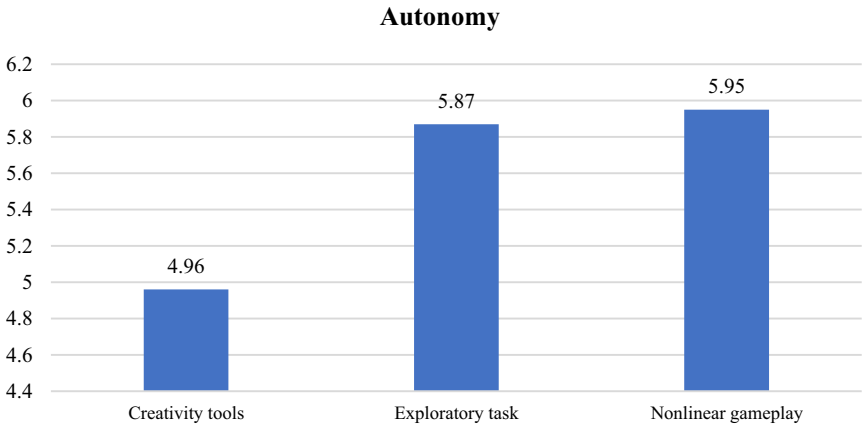

Fig. 4. Autonomy game elements.

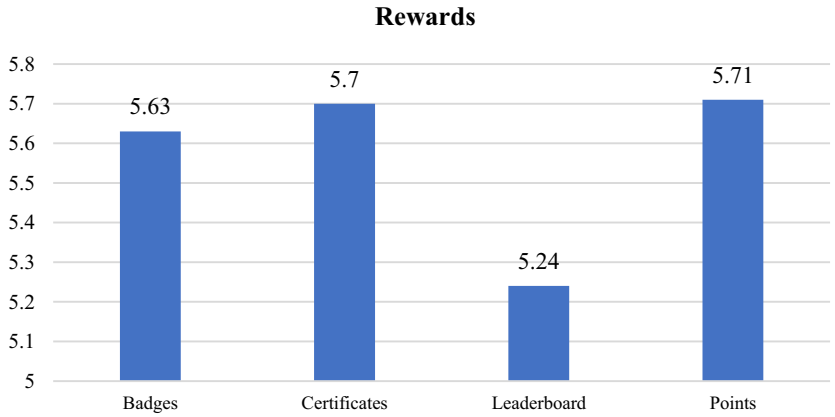

Fig. 5. Rewards game elements.

In the end, we can reduce game elements selection to accommodate all user types and basic human needs, according to SDT. This approach can prevent a high risk of over-burdening the user interface [2, 8]. We can also control the inclusion of a game element that harms a user [17].

5.2 Adaptive Gamification (User Type and Game Elements Mapping)

The entire gamification system should be designed to adapt to the specific needs of each player [4]. It is challenging to develop a gamification application that suits the specific user. However, one of the approaches that can be explored is using the adaptive technique. A highly adaptive gamified application that can match the intended game mechanics and elements is required among learners-players' diversity [30]. The gamified application should be able to provide features that are suitable for a user adaptively. Adaptation of game elements can lead to an increase in participants for active users [30]. The authors

Table 8. Adaptive user type and game elements mapping

	User ID	2	6	56	755
User Type	Achiever	3.7	7	5.3	6.7
	Disruptor	2.5	4	4	3.5
	Free Spirit	5.3	7	5.3	6.7
	Philanthropist	4.8	6.3	5	7
	Player	6	6.8	5.5	2.5
	Socialiser	3.8	6.5	4.8	7
Competence	Challenges	4.6	6.5	5.1	5.5
	Quests	5	6.9	5.4	5.3
	Learning	4.7	7	5.3	6.7
	Knowledge Sharing	4.6	6.2	5	5.4
	Progression	4.8	6.8	5.3	5.4
Relatedness	Social comparison	5.1	6.7	5.2	4.2
	Social competition	4.2	6.1	4.9	5
	Social discovery	4.2	5.9	4.8	4.3
	Social network	3.9	5.6	4.7	4.3
	Teams	4.2	5.8	4.8	4.3
Autonomy	Creativity tools	3.8	5.4	4.6	5
	Exploratory task	5.4	6.8	5.3	5.8
	Nonlinear gameplay	5.1	6.7	5.2	6.8
Rewards	Badges	4.7	6.8	5.3	5
	Certificates	4.8	6.9	5.3	5.6
	Leaderboard	4.4	6	4.9	4.2
	Points	4.9	6.8	5.3	5.4

also suggested that adaptation should not be based on users' choice but rather on indirect measurements through a questionnaire or user interaction.

Table 8 is generated based on matrix multiplication or matrix product between HEXAD user types and user type and game element-matrix. Based on the result, we can see that different user preferences prioritise. Besides, gamification designer can construct a more effective technique by understanding the importance of the game elements for a specific player.

6 Conclusion

The user type profile may be derived from a combination of either all types. The user profile analysis will give some clear insight into the prominent and less prominent characteristics of an individual user or group of people. The gamified application should be design using game elements that suitable for a user because a particular game element may not be appropriate, and some might negatively affect some user types.

This adaptive user type and game element mapping can also help gamification designers choose which Gamification features to incorporate into the gamified application. It is recommended to suit a user type with the suitable game elements by using an adaptive approach. Using matrix multiplication or matrix product and correlation analysis, we can map user types with game elements. The mapping generated can be used by a gamification designer to develop a more engaging application.

Acknowledgement. This research was supported by Ministry of Higher Education and Media and Game Innovation Centre of Excellence, Institute of Human Centered Engineering, Universiti Teknologi Malaysia, Skudai, Johor, Malaysia through the Malaysia Research University Network research grant (R.J130000.7809.4L870) with the title, Gamification Platform and Virtual Environment for University 4.0.

References

1. Deterding, S., Sicart, M., Nacke, L., O'Hara, K., Dixon, D.: Gamification: using game-design elements in non-gaming contexts. In: CHI'11 Extended Abstracts on Human Factors in Computing Systems; Vancouver, BC, Canada, pp. 2425–2428. ACM (2011). 1979575
2. Lavoué, É., Monterrat, B., Desmarais, M., George, S.: Adaptive gamification for learning environments. IEEE Trans. Learn. Technol. **12**(1), 16–28 (2018)
3. Knutas, A., Ikonen, J., Maggiorini, D., Ripamonti, L., Porras, J.: Creating student interaction profiles for adaptive collaboration gamification design. Int. J. Hum. Cap. Inf. Technol. Prof. **7**(3), 47–62 (2016)
4. Nicholson, S.: A RECIPE for meaningful gamification. In: Reiners, T., Wood, L.C. (eds.) Gamification in Education and Business, pp. 1–20. Springer, Cham (2015). https://doi.org/10.1007/978-3-319-10208-5_1
5. Böckle, M., Novak, J., Bick, M.: Towards adaptive gamification: a synthesis of current developments. In: Proceedings of the 25th European Conference on Information Systems, ECIS 2017 (2017)

6. Gallego-Durán, F.J., Molina-Carmona, R., Llorens-Largo, F.: Measuring the difficulty of activities for adaptive learning. Univ. Access Inf. Soc. **17**(2), 335–348 (2017). https://doi.org/10.1007/s10209-017-0552-x
7. Jianu, E.M., Vasilateanu, A.: Designing of an e-learning system using adaptivity and gamification. In: 2017 IEEE International Systems Engineering Symposium (ISSE), pp. 1–4 (2017)
8. Monterrat, B., Lavoué, É., George, S.: A framework to adapt gamification in learning environments. In: Rensing, C., de Freitas, S., Ley, T., Muñoz-Merino, P.J. (eds.) EC-TEL 2014. LNCS, vol. 8719, pp. 578–579. Springer, Cham (2014). https://doi.org/10.1007/978-3-319-11200-8_78
9. Bartle, R.: Hearts, clubs, diamonds, spades: players who suit MUDs. J. MUD Res. **1**, 19 (1996)
10. Yee, N.: The demographics, motivations, and derived experiences of users of massively multi-user online graphical environments. Presence Teleoper. Virtual Environ. **15**(3), 309–329 (2006)
11. Lazzaro, N.: Why We Play Games: Four Keys to More Emotion Without Story. CRC Press, Boca Raton (2004)
12. Berens, L.V.: Understanding Yourself and Others: An Introduction to Temperament. Telos Publications, Candor (2000)
13. Nacke, L.E., Bateman, C., Mandryk, R.L.: BrainHex: preliminary results from a neurobiological gamer typology survey. In: Anacleto, J.C., Fels, S., Graham, N., Kapralos, B., Saif El-Nasr, M., Stanley, K. (eds.) ICEC 2011. LNCS, vol. 6972, pp. 288–293. Springer, Heidelberg (2011). https://doi.org/10.1007/978-3-642-24500-8_31
14. Tondello, G.F., Wehbe, R.R., Diamond, L., Busch, M., Marczewski, A., Nacke, L.E.: The gamification user types hexad scale. In: Proceedings of the 2016 Annual Symposium on Computer-Human Interaction in Play, Austin, Texas, USA, pp. 229–243. ACM (2016). 2968082
15. Ferro, L.S.: An analysis of players' personality type and preferences for game elements and mechanics. Entertain. Comput. **27**, 73–81 (2018)
16. Ferro, L.S., Walz, S.P., Greuter, S.: Towards personalised, gamified systems: an investigation into game design, personality and player typologies. In: Proceedings of the 9th Australasian Conference on Interactive Entertainment: Matters of Life and Death, Melbourne, Australia, pp. 1–6. ACM (2013). 2513024
17. Kocadere, S.A., Caglar, S.: Gamification from player type perspective: a case study. Educ. Technol. Soc. **21**(3), 12–22 (2018)
18. Monterrat, B., Lavoué, É., George, S.: Toward an adaptive gamification system for learning environments. In: Zvacek, S., Restivo, M.T., Uhomoibhi, J., Helfert, M. (eds.) CSEDU 2014. CCIS, vol. 510, pp. 115–129. Springer, Cham (2015). https://doi.org/10.1007/978-3-319-25768-6_8
19. Gonzalez, C.S., Toledo, P., Munoz, V.: Enhancing the engagement of intelligent tutorial systems through personalization of gamification. Int. J. Eng. Educ. **32**(1), 532–541 (2016)
20. Aldemir, T., Celik, B., Kaplan, G.: A qualitative investigation of student perceptions of game elements in a gamified course. Comput. Hum. Behav. **78**, 235–254 (2018)
21. Kotsopoulos, D., Bardaki, C., Lounis, S., Pramatari, K.: Employee profiles and preferences towards IoT-enabled gamification for energy conservation. Int. J. Serious Games **5**(2), 65–85 (2018)
22. Zichermann, G., Cunningham, C.: Gamification by Design: Implementing Game Mechanics in Web and Mobile Apps, p. 208. O'Reilly Media, Inc., Sebastopol (2011)
23. Kim, B.: Designing Gamification in the Right Way, pp. 29–35. American Library Association (2015)

24. Bozkurt, A., Durak, G.: A systematic review of gamification research: in pursuit of Homo Ludens. Int. J. Game Based Learn. **8**(3), 15–33 (2018)
25. Tobon, S., Ruiz-Alba, J.L., García-Madariaga, J.: Gamification and online consumer decisions: is the game over? Decis. Support Syst. **128**, 113167 (2020)
26. Ryan, R.M., Deci, E.L.: Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. Am. Psychol. **55**(1), 68 (2000)
27. Riley, G.: The role of self-determination theory and cognitive evaluation theory in home education. Cogent Educ. **3**(1), 1163651 (2016)