Redesigning Malaysian University Students' Player Traits from the Perspective of Game Theory: A Qualitative Study

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***Abstract*—Gamified learning has been gaining popularity in recent years due to its potential to change learners' behaviour and increase their motivation and engagement in an educational setting. However, the implementation of gamification in tertiary education may be challenging because of the distinct students' attributes, preferences and needs. Although previous studies suggest that the personalization of gamification can be achieved by adhering to learners' player typology based on personality, performance, learning styles and more. The authors of this study proposed a peculiar player trait based on game theory as it closely resembles rational decision-making by students in the learning process. The study was carried out for 8 weeks by separating 60 undergraduate students from the School of Educational Studies into a control group and an experiment group; the participants were then exposed to a gamified platform (*Classcraft*) and non-gamified learning environment (*Google Classroom*). The interviews were conducted pre, during and post-intervention. The qualitative data were then recorded, transcribed and analyzed. At the end of the study, the findings showed the segmentation of player traits based on the minimax principle (stagnation, omission, evasion, seclusion, corporation, collaboration, neglection, commonization, uniformation and tranquilization) and maximin principle (ambition, indagation, emulation, interaction, connection, exclusion, exploration, characterization, fashion and contemplation), a thematic framework was also constructed.**

***Keywords*—game theory, player traits, gamification, education**

I. Introduction

Gamification is the use of game design elements—whether social and/or self-game elements (e.g. points, leaderboards, levels, progression, competition, cooperation etc.) to be implemented in a setting that is traditionally non-resemblance with games [1, 2]. It has typically favourable benefits on interactivity and prosocial behaviour, as well as motivation, focus, and other cognitive abilities [3]. Gamification is a technical, methodological and strategic approach by allowing users to experience a unique participation which ultimately aims to advocate their specific behaviour or to transfer information through the generation of compelling motivation [4]. Owing to the gamification term's ubiquity and successful outcomes such as increased participation [5, 6], enhanced performance [7, 8], and elevated motivation [9, 10], via the use and manipulation of game elements, it is commonly implemented especially in the field of education [11].

The notion that people have various personalities, behaviours, and requirements induces the idea of customization in gamification [12]. Tailored gamification refers to adaptation that occurs at the design stage, typically based on one or a small number of chosen attributes, while personalised gamification, on the other hand, refers to dynamic adaptation to the individual user during the time of operation [13].

Initially, the categorization of players is done based on the fundamentals of the selection of games, in-game behaviour, players' intrinsic motivation and players' personalities [14]. However, previous studies [15–17] suggest that users' behaviour and performances are affected by their distinct individual attributes. And because there are so many various student profiles, needs, and learning styles in higher education, each game element and even every combination of game elements has a varied impact on each student [18]. Due to the complications mentioned, the need for game theory or, as pedagogues defined it, the theory of teaching and learning, which involves the pedagogic approach of decision-making for sustainable development, arises [19]. Both game theory and learning theory claim to offer explanations for rational behaviour in achieving a specific goal or payoff. A motivating premise that learning entails the development of a behavioural pattern appropriate to goal achievement, need reduction, or something similar is implicit in every theory of learning [20].

Thus, in this study, the authors aim to identify how the inclination of players from a game theoretic perspective and wishes to redesign the player traits based on the strategic approach players prefer. The authors hope to answer the following research question and research objective posed below:

RQ1: How do player traits associate with the principles of maximin and minimax?

RO1: To investigate how player traits are associated with the principles of maximin and minimax.

II. Literature Review

A. Gamified Learning

Gamification in education is the practice of incorporating game mechanics and game-like experiences into the creation of instructional materials, which is based on three crucial fundamental principles i): high choice; ii): low risk; and iii): a structured setting [21, 22]. The gamification of the educational process has the potential to improve students' motivation, engagement, and performance due to its easiness, effectiveness and merriment to use, which could lead to more and longer educational involvement, followed by increased knowledge and enhanced abilities [23, 24]. It took careful consideration and understanding of students' feelings to

design a gamification method that would function appropriately. The system that awards points and permissions to students for accomplishments must be fair and strike a balance between the amount of effort and fun [25]. Huang and Soman [2] suggested a five-step process consisting of i): comprehension of target audience and context, ii): definition of learning objectives, iii): structure of experience, iv): identification of materials, and v): application of game elements. According to [26], although points, levels, goals, and status are the most frequently used and favoured aspects in game design, previous research showed that the predominant utilised game elements consist of table, points, leaderboards, and badges.

B. Player Types and Player Traits

As games are being introduced to the market as a product of entertainment, business corporations tend to segment customers and consumers, which aims to improve their services by identifying and providing clients with items that better match their needs and wants [27].

The typology of players is commonly done by using the types or traits system. In contrast to the static picture of personality that attributes frequently imply, type is a systems theory that assumes individual purpose or intentionality, and a dynamical approach to personality, focusing on behaviour in action [28]. The types/traits of players in a game-based environment are usually categorized based on personality [29, 30], playing styles [31], playing patterns [32, 33], motivation [34-35], emotional reaction [14], equipment used [36], and intensity of playing [37]. Sezgin [38] synthesized the player typologies into 10 categories, namely completionists, socializers, suicide-squad fiends, pathfinders, collectors, belligerents, explorers, deep gamers, casual gamers and underrecognized. However, player types/ traits are deemed to be unstable and change over the course of time [39].

C. Game Theory

Originally, the introduction of game theory was mainly used for the purpose of aiding in the creation of military strategies, and it was later used to shed light on a range of biological, political, and economic phenomena [40, 41]. It is a branch of decision theory that is concerned with the analysis of choices made by two or more rational adversaries when there is rivalry and conflicting interest in which the course of action is chosen after taking into account all of the potential options that the other players in the same game may have [42].

A game is defined as the mathematical formation of a situation that several individuals or groups of people compete with one another while adhering to a set of rules [41, 43]. Depending on the disclosure of the structure of games, and the rationale of players and their opponents' decisions, the games could be generally categorized into games with complete information, incomplete information, perfect information and imperfect information. Based on the number of players participating in a game, the game's symmetry, and player collaboration, the types of games can be further categorized into cooperative and non-cooperative games, normal form and extensive form games, simultaneous move games or sequential move games, constant sum, zero-sum and non-zero-sum games and lastly symmetric and asymmetric games [44].

D. Minimax and Maximin

Depending on the objective of players, different strategies will be selected to achieve a particular goal and obtain a designated outcome (payoff). The only factor that determines the minimum gain an opponent can make is this player's own strategic approach [43]. A player's maximin strategy maximises its objective function while minimising the objective function of the opposing player's plan. The maximin rule recommends selecting the course of action that prevents the worst-case situation from occurring [45]. On the contrary, a player's minimax strategy is a play by the opposing player that minimises the objective function that is maximised by that action [46]. In general, the minimax approaches a game in a pessimistic or a risk-aversion manner, which means it braces for the worst situation to happen while the maximin approaches tends to formulate the best out of the worst cases, thus a more conservative or optimistic approach [47].

According to [48], payoffs in a game is also known as outcomes that is determined by the participants' chosen strategy. It could take the form of number, utility or monetary [49]. To put it in the context of the current study, the gains could be understood as the perceived benefits students/ learners receive, while losses as resistance or obstacles that occur to them during the learning process. Based on distinct students' player traits, the perceived benefits may differ. For example, achievers may find grades, badges or marks to be the perceived benefits in class; socializers on the other hand might find the opportunity to connect and forming relationships with others to be a gain; while immersionalist would perceive gains as the opportunity to be relaxed and being able to role-play in a gamified classroom.

III. Materials and Methods

A. Sample

Purposive sampling, also known as judgement sampling, was conducted in the current study by the authors. It is a non-random sampling method that does not require a predetermined number of informants or underlying theories [50]. Anyhow, the inclusion and exclusion criteria for the participants selected are listed in the Table 1.

Table 1. Inclusion and exclusion criteria for the selection of participants

Inclusion Criteria	Exclusion Criteria
-Students who are willing to participate throughout the entire study	-Students who are unwilling to participate in the study
-Students who are in full-time undergraduate-studies	-Students who are part-time/ not undergoing undergraduate studies
-Students who can communicate well in English language	-Students who cannot communicate in English language
-Students who have basic knowledge on the use of technology	-Students who do not have any knowledge on the use of technology

The study population consist of a total number of 8624 undergraduate students [51]. It was mentioned by [52] that most research studies deemed 5–50 participants as adequate for sample size in qualitative research. However, [53] pointed out that saturation of data can be achieved with an approximated of 9–17 interviews. Thus, based on the criteria mentioned above, 60 tertiary education students from the

School of Educational Studies were involved in the study. All of the participants aged between 20 to 24 and were partaking in an instructional technology-related course over the period of 8 weeks. The study is approved by the Human Research Ethics Committee of Universiti Sains Malaysia (JEPeM) with the given code: USM/JEPeM/20110560. A consent form was distributed to all students who voluntarily participated in this study. Due to the consideration of the participants' confidentiality, they will be represented in numbers from Student 1 to Student 60.

B. Research Design

This current study takes place in a higher education setting. Participants are separated into two groups—the control group (n = 30) and the experimental group (n = 30). The two groups took turns being exposed to a gamified learning environment using *Classcraft* and a non-gamified learning environment (*Google Classroom*). A total of three in-depth interviews were then conducted before and after the intervention of distinct classroom settings via ZOOM, an online meeting platform. The interviews were carried out on a one-to-one basis to avoid the opinion of participants being affected by one another.

C. Instrumentation

The educational setting and the limited time allocated for teaching and learning in every classroom session is needed to be taken into consideration. Initially, Nick Yee's player typology test derived from Massive Multiplayer Online Role Playing Games (MMORPGs), it is mainly categorized into achiever, socializer and immersionalist as shown in Table 2 [54]. Due to Yee's player typology's close resemblance to the use of *Classcraft*, which is a Role-Player Game (RPG) like gamified platform and the ability to capture the essence of player traits within a learning classroom. It is selected and adopted into the current study.

Table 2. Yee's player traits [54]

Category	Achievement (Achiever)	Social (Socializer)	Immersion (Immersionalist)
Sub-component	Advancement Mechanic Competition	Socializing Relationship Teamwork	Discovery Role-play Customization Escapism

According to [55], a 5-step Interview Protocol Refinement (IPR) should consist of i) ensuring the alignment between interview questions and research questions, ii) constructing an inquiry-based conversation, iii) receiving feedback on interview protocols, and iv) pilot testing of the interview questions to ensure the reliability of the qualitative data. Therefore, the interview questions were later formulated under strict protocol as shown in Fig. 1.

In total, 19 questions were developed for the pre-intervention phase, 22 questions for the in-between-intervention phase, and lastly 19 questions at the post-intervention phase. The authors extended Yee's player traits and ensured that the questions developed were associated with the principles of minimax and maximin. The interview questions were then validated by experts in the respective field, and a pilot test was conducted on 39 students before the initiation of the current study.

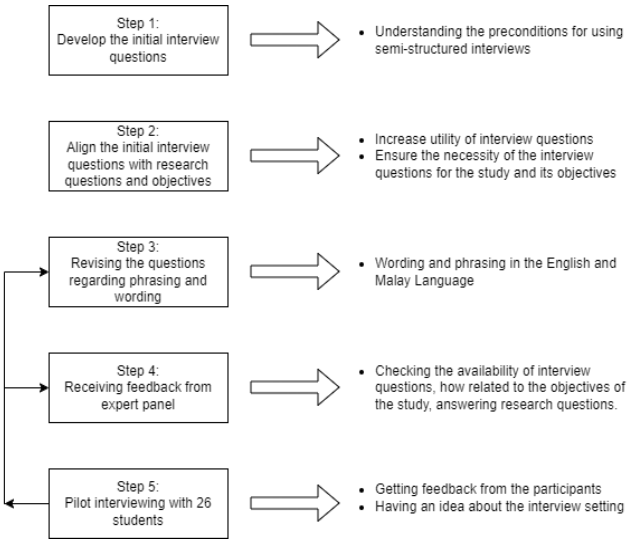

Fig. 1. Interview protocol development.

IV. Result and Discussion

A. Data Collection and Analysis

All audio content was recorded during the commencement of the interviews. The recordings were later transcribed into written text form. The content analysis method was conducted after the collection of data. The coding of the existing data was done by using Nvivo. The frequency and the percentage of occurrences were recorded. After that, thematic analysis was done with a deductive approach. The findings are presented in Table 3.

Table 3. Codes and themes

Code	Frequency	Themes	Extracts
Improve Challenge Reattempt	N=20 (33%)	Ambition	*"So yeah, I would prefer to, you know, continue with harder questions to challenge myself." (S11, Session 6)* *"I would try to look for journals that relate to the topic and try to learn from it so I can improve myself." (S29, Session 13)* *"I will try. I will try again, again and again until I get it."(S32, Session 2)* *"when it comes to gold point and experience points. Uh, I try to uh finish my task um more than the others. I mean, I tried to finish it up faster and I tried to answer all the questions correctly so that I'll get more marks than my other friends." (S28, Session 1)*
Risk Aversion	N=14 (23%)	Stagnation	*"So I don't feel like I want to challenge more and I want harder questions itself now." (S18, Session 6)* *"I don't think I want to challenge myself." (S26, Session 7)* *"…there is no attempt of me like trying to get more than that." (S34, Session 9)*
Probe	N=37 (62%)	Indagation	*"The games is designed from a level to another level. So I have to pass this level or I have to go through this uh particular task and only that I can upgrade to the next level." (S53, Session 12)* *"but anyway you can obtain points, as long as you listen closely in the lesson, you can receive more*

Code	Frequency	Themes	Extracts
			experience points, and you level up even quicker" (S15, Session 7) *"I can level up when I have finished my work.- So that I can gain- uh yes XP experience uh as I have finished doing my task." (S25, Session 6)*
Unsure Unknown	N=14 (23%)	Omission	*"I don't really know actually on how to add my score in Classcraft." (S33, Session 13)* *"I was like kind of wondering why weren't we all in the same level because everybody was doing the same thing like someone…And then like what if I could level up to? Uh, um, to a higher level?" (S42, Session 2)* *"I'm not really sure how the gold, how the gold and coins, uh, system works…" (S58,Session 3)*
Compete Competitive Compare	N=41 (68%)	Emulation	*"I'll compete with like- like one of my friends." (S3, Session 12)* *"I compare the ranking with my friends." (S13, Session 10)* *"all of us have the desire to win, hoping that we can receive something from this." (S15, Session 7)* *"my inner self we want to compete. I mean, um, a good competition actually between amongst our, amongst my friends. I mean, to compete, to get uh, to get the highest points as I can, um is a good thing." (S2, Session 15)*
Uncompetitive	N=19 (32%)	Evasion	*"I don't really compete with my friends." (S11, Session 6)* *"like make you feel belittled like compared to others." (S4, Session 6)* *"I find that if you compete with others and you fall behind and you don't win against others, it just makes you feel down and then you don't really have fun and you might even ruin your relationship between you and your friends because just keep comparing." (S10, Session 15)*
Communicate Text	N=26 (43%)	Interaction	*"I can easily connect with my friends, with the close one I can ask them like I feel comfortable." (S18, Session 6)* *"I feel like it's, uh, easier to learn when you have a group discussion, uh, and you discuss with your friends about certain things." (S3, Session 12)* *"at least I asked her through WhatsApp, but I seems can get the instruction so I have to ask it directly. So yeah, I have I asked my friends for instruction." (S32, Session 2)*
Alone Quiet	N=17 (28%)	Seclusion	*"I won't be like, you know, too close, uh, especially to strangers that I don't even know." (S11, Session 6)* *"I want to work alone because my opinion is uh, difference between uh from them, so I think. I don't want to meet them often so I think I prefer to learn alone." (S37, Session 15)* *"We might hold different opinions, it needs to be unified. In terms of coming to an agreement might be difficult." (S9, Session 7)* *"…they didn't say anything. So I guess I didn't say anything." (S42, Session 2)*
Bond Cohesion Closeness Long-term Meaningful	N=50 (83%)	Connection	*"it can foster a stronger bond and teamwork within the groups. It could also enhance team cohesion among us." (S14, Session 10)* *"when I get close with someone I try to not lose- lost them, you know, like- I know it's quite…Uh, because I want to be- you know- around someone. Uh, I'm afraid to be alone. So I will try to maintain the friendship." (S11. Session 5)* *"I would prefer to have a long-term relationship with others because uh, how they say I'm actually. Very big on relationships…If I wanna form a bond with someone, I would want that bond to last forever." (S28, Session 8)* *"I think long term relationship is more meaningful… short term relationship is like it ends faster than the longer and it's not-.It's not that that meaningful or impactful in my life." (S35, Session 12)*
Work Short-term	N=26 (43%)	Corporation	*"I prefer to relationship for work purpose only." (S18, Session 6)* *"I would prefer forming short term relationship for the time being." (S3, Session 11)* *"I like to socialize with other people, but I don't like to...Uh, carried that relationship or that friendship throughout my life." (S47, Session 8)* *"Because it's a it's a meets to an end. You know, like both of us understand that. Well, I'm assuming them both- both of us will understand that. We are doing this because it was necessary." (S54, Session 11)*
Delegate Together Discuss Team	N=26 (43%)	Collaboration	*"I don't really believe myself at times. So it is best to ask my friends and all." (S4, Session 6)* *"So I feel like everyone has their own specialty, right? So sometimes we'll just do like, I'll search for the answers, then other people they will like answer, like they'll type in the answer. Sometimes we'll just do like, OK, if we have like different parts some, some people they will do like part A and then I'll do Part B like that." (S47, Session 1)* *"Since like it. It will be easier for us to work together, so we do delegate the task to each other. "(S48, Session 14)|* *"I feel like it's more towards, uh, teamwork and getting the work done together as a team." (S50, Session 11)*
Individuality	N=19 (32%)	Exclusion	*"…the types of friend that I have is irresponsible and wouldn't do their part and I have to carry the entire group. I might as well just do individually." (S10, Session 16)* *"I don't really discuss among my friends because, uh, it was a limited time. So I just and I tried to answer myself…" (S18, Session 6)* *"I tend not to ask for questions to my friends because I would try to do it on my own to see how far that I've gotten." (S28, Session 1)* *"I do not seek help from people, I try my best to answer with my own capabilities. If I'm having trouble trying to answer it, then that's my own mistake." (S29, Session 13)*
Explore Discover	N=26 (43%)	Exploration	*"By discovering new things myself…So let's say I'm not going to give class craft as an example…So by that sense of exploring, give me. Yeah, that's like my kind of way of having fun." (S10, Session 15)* *"Like what will we will be like exploring through, you know, the class craft, maybe if we were exposed to that" (S11, Session 5)* *"I've tried exploring the class and I I've tried exploring a few elements. Maybe uh, if I use if there is going to be next week, if uh, they need to use the element, then I guess they will be an advantage because I've already explored the few things in the Classcraft." (S28. Session 1)* *"The fact that you can kudos someone else. Yeah, I think that's the only thing because.Every other feature. It's really easy to discover." (S29, Session 13)*
Hermit	N=16	Neglection	*"so far I'm not discovering yet." (S30, Session 16)*

Code	Frequency	Themes	Extracts
	(27%)		*"I'm not quite, uh, discovered anything new at the moment. Maybe if I had the time to, like, look into it even more, maybe I would find out something." (S4, Session 5)* *"I don't feel like anything is like discovering or exploring new things" (S18, Session 6)* *"not yet, because I haven't discovered the app fully. "(S44, Session 14)*

B. Definition of Themes

The themes found in the current study based on player traits of students using thematic analysis are shown in Table 4. Each theme was defined by the authors for a better understanding. Furthermore, the thematic framework developed is also portrayed.

Table 4. Definition of themes

Themes	Definition
Ambition	Ambition is the maximin approach of the advancement subconstruct. Learners who possess this trait tend to advance quickly in the obtainment of currency, status and in the learning environment, mastery. One who possess such approach tend to challenge themselves even though failing may occur.
Stagnation	Stagnation on the opposite of ambition, it represents the minimax approach, as learners do not wish to advance or challenge themselves, thus avoiding any hard challenges.
Indagation	Learners with the indagation trait delve into the function of the underlying system (e.g. scoring, rewards etc.), which prompts them to use that particular system to their advantage to lessen their effort, thus the minimax approach.
Omission	Leaners with the omission trait tend to dismiss the fundamental principle of the system. In which they tend to play or go along with ways that allow them to enjoy themselves.
Emulation	The maximin approach of the competition subconstruct is known as emulation, as individuals favoured a competitive environment that allows them to suffice their desire to win.
Evasion	The minimax approach for competition, on the contrary, evades competition at all costs. This is labelled as the minimax approach as learners could learn or play in a less resistant way.
Interaction	The subconstruct of socialising suggests that individuals received contentment (benefits) upon conversing and interacting with others. By embedding the maximin principle, learners with this trait intend to socialize to maximize the sense of fulfilment.
Seclusion	The embodiment of minimax principle in the seclusion trait allows learners to learn in their own susceptible way to avoid others from affecting their progress/ performance.
Connection	Individuals with this maximin relationship trait are more likely to find meaning in forming connections and long-term relationships.
Corporation	The minimax relationship trait, on the other hand, focuses on short-term relationships and forming bonds with others out of necessity or work purposes only.
Collaboration	Individuals find fulfilment in a team effort as it eases the process of work, which correlates with the minimax principle as they work while helping out each other upon facing any difficulties or challenges.
Exclusion	Individuals who fixate on completing the goal in the shortest time possible or for their own understanding, disregarding any help from others.
Exploration	Learners that tend to discover hidden features that aid them in learning or give them an advantage.
Neglection	Individuals do not make the effort to explore and are negligent about the hidden features or unknown functions.
Characterization	Individuals who find amusement in impersonating someone else in a virtual setting.
Commonization	Individuals who do not dwell deep into the game world and implies to separate the real and virtual world.
Fashion	Individuals who enjoy in altering the appearances of the character they created to differ from others.
Uniformation	An individual who abstains from personalizing their characters' appearances.
Tranquilization	The minimax principle is embedded in the tranquilization trait as individuals avert the issues (risks) they are facing at the moment by switching towards other activities or things that tranquilize them.
Contemplation	An individual with the contemplation trait confronts the challenging situation they face, believing that only through solving the root of the problem will they truly escape from the issue itself.

Based on the themes found, the strategy of learning by students can be mainly separated into a minimax or maximin approach in which they either maximizes the benefits they received from the learning process, or they minimize the obstacles they face while studying. Table 4 shows the association between the principles of minimax and maximin and the extended player traits which are identified based on the participants' strategical approach towards risks and benefits in a gamified learning environment.

The gamified environment evokes a competitive nature among learners, with the indagation trait at 62% and emulation at 68%. In the achievers' category, the authors found that the motivation that prompted the learners to take a maximin approach (ambition, indagation, emulation) or the minimax approach (stagnation, omission, evasion) largely depends on their interest in the subject, how they value the task given, and also family honour- in which they wish to make their family members proud by having a better achievement."And since most of the time, the *Classcraft* application requires students to compete and work in groups, and this precipitates learners to take a maximin approach (interaction 43%, connection 83%, collaboration 43%) as it gives them a better advantage to win against other players. Lastly, the ability to customize characters' cosmetics and power plays a huge part in the gamified platform *Classcraft.* Hence in the immersionalist category, major of the students took a maximin approach (exploration 43%, characterization 77%, fashion 55%, tranquilization 50%).

V. Conclusion

In conclusion, this study answers the research question posed by examining the minimax and maximin strategies chosen by learners (or players) in a gamified learning environment. The qualitative data collection has proven that the redesigning of player traits from a game theory perspective is possible. The maximin player traits include ambition, indagation, emulation, interaction, connection, exclusion, exploration, characterization, fashion and contemplation, while on the opposite, the minimax player traits consist of stagnation, omission, evasion, seclusion, corporation, collaboration, neglection, commonization, uniformation and tranquilization.

However, several limitations do occur in this study. Firstly, collected data could be interpreted differently or overinterpretation. Secondly, since only university students from the school of educational studies are involved, the generalization of the results to other fields and learners of all ages should be cautious. Thirdly, due to the study's qualitative research approach, the results may be tainted by the values of the researchers. The causality of the students' action was not identified in the study as well, which may lead to the impreciseness in group comparisons. Lastly, there is a possibility that the novelty effect might affect the data collected. It is recommended that a larger sample consisting of students from various disciplines and a larger age range could be included in future studies. The use of other subject matter, the time frame of the study conducted as well as the use of distinct player typology tests could be considered.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Mageswaran Sanmugam conducted the research; Musabah Said Al Breiki and Darren Lim analyzed the data and wrote the paper; Wan Ahmad Jaafar Wan Yahaya reviewed, proofread and make corrections to the paper; all authors had approved the final version.

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REFERENCES

[1] S. Deterding, D. Dixon, R. Khaled, and L. Nacke, "From game design elements to gamefulness: Defining 'gamification,'" in *Proc. 15th Int. Acad. MindTrek Conf. Envisioning Futur. Media Environ. MindTrek 2011*, no. March 2014, pp. 9–15, 2011. doi: 10.1145/2181037.2181040

[2] W. H.-Y. Huang and D. Soman, "A Practitioner`s Guide To Gamification Of Education," *Early Child Dev. Care*, vol. 189, no. 3, pp. 392–404, 2013. doi: 10.1080/03004430.2017.1324434

[3] S. Siripipatthanakul *et al.*, *Gamification and Edutainment in 21 st Century Learning*, vol. 2, no. 25, 2023.

[4] M. C. Serrano, "Gamification and the history of art in secondary education: A didactic intervention," *Educ. Sci.*, vol. 13, no. 4, 2023. doi: 10.3390/educsci13040389

[5] A. Omotosho, T. Tyoden, P. Ayegba, and J. Ayoola, "A gamified approach to improving student's participation in farm practice—A case study of landmark university," *Int. J. Interact. Mob. Technol.*, vol. 13, no. 5, pp. 94–109, 2019. doi: 10.3991/ijim.v13i05.9404

[6] A. Suh, C. Wagner, and L. Liu, "Enhancing user engagement through gamification," *J. Comput. Inf. Syst.*, vol. 58, no. 3, pp. 204–213, 2018. doi: 10.1080/08874417.2016.1229143

[7] R. Pelegro, "Gamification in online education," *SSRN Electron. J.*, no. January, 2022. doi: 10.2139/ssrn.4054977

[8] İ. Yıldırım and S. Şen, "The effects of gamification on students' academic achievement: a meta-analysis study," *Interact. Learn. Environ.*, vol. 29, no. 8, pp. 1301–1318, 2021. doi: 10.1080/10494820.2019.1636089

[9] I. A. D. Astuti, Y. B. Bhakti, R. A. Sumarni, D. Sulisworo, and M. Toifur, "Flipped classroom and Kahoot in physics learning: Improving Students' motivation learning," *Int. J. Educ. Manag. Innov.*, vol. 2, no. 2, p. 175, 2021. doi: 10.12928/ijemi.v2i2.3491

[10] V. J. Sotos-Mart ńez, J. Tortosa-Mart ńez, S. Baena-Morales, and A. Ferriz-Valero, "Boosting student's motivation through gamification in physical education," *Behav. Sci. (Basel).*, vol. 13, no. 2, 2023. doi: 10.3390/bs13020165

[11] A. M. Toda, R. M. C. do Carmo, A. P. da Silva, I. I. Bittencourt, and S. Isotani, "An approach for planning and deploying gamification concepts with social networks within educational contexts," *Int. J. Inf. Manage.*, vol. 46, no. May, pp. 294–303, 2019. doi: 10.1016/j.ijinfomgt.2018.10.001

[12] W. Oliveira *et al.*, *Tailored Gamification in Education: A Literature Review and Future Agenda*, vol. 28, no. 1, Springer US, 2023.

[13] W. Oliveira *et al.*, "The effects of personalized gamification on students' flow experience, motivation, and enjoyment," *Smart Learning Environments*, vol. 9, no. 1. 2022. doi: 10.1186/s40561-022-00194-x

[14] S. K. Holm, "Player types of gamers: Critical evaluation," in *Proc. Conf. Hum. Factors Comput. Syst.*, pp. 1–6, 2019. doi: 10.1145/3290607.3299084

[15] C. E. Lopez and C. S. Tucker, *The Effects of Player Type on Performance: A Gamification Case Study*, vol. 91, no. 814, 2019.

[16] Y. Shen, H. C. Choi, M. Joppe, and S. Yi, "What motivates visitors to participate in a gamified trip? A player typology using Q methodology," *Tour. Manag.*, vol. 78, no. October 2019, 104074, 2020. doi: 10.1016/j.tourman.2019.104074

[17] R. Smiderle, S. J. Rigo, L. B. Marques, J. A. P. de M. Coelho, and P. A. Jaques, "The impact of gamification on students' learning, engagement and behavior based on their personality traits," *Smart Learn. Environ.*, vol. 7, no. 1, 2020. doi: 10.1186/s40561-019-0098-x

[18] A. Khaldi, R. Bouzidi, and F. Nader, "Gamification of e-learning in higher education: a systematic literature review," *Smart Learn. Environ.*, vol. 10, no. 1, 2023. doi: 10.1186/s40561-023-00227-z

[19] A. & J. Ahrens and Zaščerinska, *Perspective of Game Theory in Education for Sustainable Development*, pp. 1–9, 2012.

[20] H. A. Simon, "A comparison of game theory and learning theory," *Technology*, vol. 21, no. 3, pp. 267–272, 1956.

[21] D. Dicheva and C. Dichev, "Gamification in education: Where are we in 2015?" *E-Learn 2015 - Kona, Hawaii, United States*, no. July 2014, pp. 1445–1454, 2015.

[22] D. E. Osheim, "'This could be a game!': Defining gamification for the classroom," *J. Chem. Inf. Model.*, vol. 53, no. 9, pp. 1689–1699, 2013.

[23] P. Dana and V. Martin, "Implementation of Gamification Principles into Higher Education," *Eur. J. Educ. Res.*, vol. 11, no. 1, pp. 1–16, 2022.

[24] N. Sunarti, N. Fatma, A. N. Yahya, B. Lew, C. Liang, and M. Mahdzir, "Students' perception on the application of gamification in education during COVID-19 pandemic," *J. Innov. Technol.*, vol. 2022, no. 10, pp. 2805–5179, 2022.

[25] G. M. Chans and M. Portuguez Castro, "Gamification as a strategy to increase motivation and engagement in higher education chemistry students," *Computers*, vol. 10, no. 10, pp. 1–24, 2021. doi: 10.3390/computers10100132

[26] K. Ofosu-Ampong, "The Shift to Gamification in Education: A Review on Dominant Issues," *J. Educ. Technol. Syst.*, vol. 49, no. 1, pp. 113–137, 2020. doi: 10.1177/0047239520917629

[27] J. Hamari and J. Tuunanen, "Player types: A meta-synthesis," *Trans. Digit. Games Res. Assoc.*, vol. 1, no. 2, pp. 29–53, 2014. doi: 10.26503/todigra.v1i2.13

[28] P. Geyer, *Psychological Types and Traits : Some Fundamentals*, no. August, 2014.

[29] E. S. de Lima, B. Feijó, and A. L. Furtado, "Player behavior and personality modeling for interactive storytelling in games," *Entertain. Comput.*, vol. 28, no. August, pp. 32–48, 2018. doi: 10.1016/j.entcom.2018.08.003

[30] C. Potard, A. Henry, A. H. Boudoukha, R. Courtois, A. Laurent, and B. Lignier, "Video game players' personality traits: An exploratory cluster approach to identifying gaming preferences," *Psychol. Pop. Media*, vol. 9, no. 4, pp. 499–512, 2020. doi: 10.1037/ppm0000245

[31] B. Bontchev, D. Vassileva, A. Aleksieva-Petrova, and M. Petrov, "Playing styles based on experiential learning theory," *Comput. Human Behav.*, vol. 85, pp. 319–328, 2018. doi: 10.1016/j.chb.2018.04.009

[32] A. Drachen, A. Canossa, and G. N. Yannakakis, "Player modeling using self-organization in Tomb Raider: Underworld," *CIG2009 - 2009 IEEE Symp. Comput. Intell. Games*, pp. 1–8, 2009. doi: 10.1109/CIG.2009.5286500

[33] F. Schimanke, R. Mertens, and B. S. Huck, "Player types in mobile learning games – Playing patterns and motivation," in *Proc. 2018 IEEE Int. Symp. Multimedia, ISM 2018*, no. June 2019, pp. 247–252, 2019. doi: 10.1109/ISM.2018.00035

[34] Y. Lee, B. Magerko, C. St, C. Heeter, and B. Medler, "Player types : Gaming achievement goal," *Distribution*, pp. 43–48, 2005.
[35] F. C. Tseng, "Segmenting online gamers by motivation," *Expert Syst. Appl.*, vol. 38, no. 6, pp. 7693–7697, 2011. doi: 10.1016/j.eswa.2010.12.142
[36] N. Partners, MOBILE ESPORTS Special Report : Evolution of Mobile Esports for the Mass Market Overview, 2019.
[37] K. P. Kallio, F. Mäyrä, and K. Kaipainen, "At least nine ways to play: Approaching gamer mentalities," *Games Cult.*, vol. 6, no. 4, pp. 327–353, 2011. doi: 10.1177/1555412010391089
[38] S. Sezgin, "Digital player typologies in gamification and game-based learning approaches: A meta-synthesis," *Bartın Univ. J. Fac. Educ.*, vol. 9, no. 1, pp. 49–68, 2020. doi: 10.14686/buefad.610524
[39] A. C. G. Santos, W. Oliveira, J. Hamari, and S. Isotani, "Do people's user types change over time? An exploratory study," *CEUR Workshop Proc.*, vol. 2883, pp. 90–99, 2021.
[40] R. W. Dimand *et al*., *A History of Game Theory. Volume 1, From the Beginnings to 1945 Routledge Studies in the History of Economics*, Taylor & Francis Routledge, 1996.
[41] M. J. Osborne, *An Introduction to Game Theory*, 2000.
[42] A. Paturel, "Game theory," *Nav. War Coll. Rev.*, vol. 14, no. 5, pp. 16–42, 2014.
[43] H. V. Georgiou, "Elements of game theory—Part I: Foundations, acts and mechanisms," no. June 2015, pp. 0–37, 2015.
[44] Nitisha, "5 Types of games in game theory," *Economic Discussion*, 2015.
[45] C. R. Sunstein, *Maximin*, vol. 841, no. 2006, pp. 940–979, 2020.
[46] Y. Tanaka and A. Satoh, "Maximin and minimax strategies in two-players game with two strategic variables," no. 76352, 2017.
[47] StudySmarter, "Maximin Strategy," 2023.
[48] G. Goertz, *Chapter 6: Multimethod Game Theory*, pp. 169–177, 2017.
[49] J. Rosenmüller and W. Trockel, *Game Theory*, vol. 14, no. 5. 2001.
[50] M. Dolores and C. Tongco, "Definition of purposive sampling," *A J. Plants, People Appl. Res.*, vol. 5, pp. 1–12, 2007.
[51] USM, Common Data Set 2022–2023, 2023.
[52] S. L. Dworkin, *Sample Size Policy for Qualitative Studies Using In-Depth Interviews*, 2012. doi: 10.1007/s10508-012-0016-6
[53] M. Hennink and B. N. Kaiser, "Sample sizes for saturation in qualitative research: A systematic review of empirical tests," *Soc. Sci. Med.*, vol. 292, p. 114523, 2022. doi: 10.1016/j.socscimed.2021.114523
[54] N. Yee, "Motivations of play in online games," *Cyberpsychology Behav.*, vol. 9, pp. 1–10, 2006.
[55] M. L. Yeong, R. Ismail, N. H. Ismail, and M. I. Hamzah, "Interview protocol refinement: Fine-tuning qualitative research interview questions for multi-racial populations in Malaysia," *Qual. Rep.*, vol. 23, no. 11, pp. 2700–2713, 2018. doi: 10.46743/2160-3715/2018.3412

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