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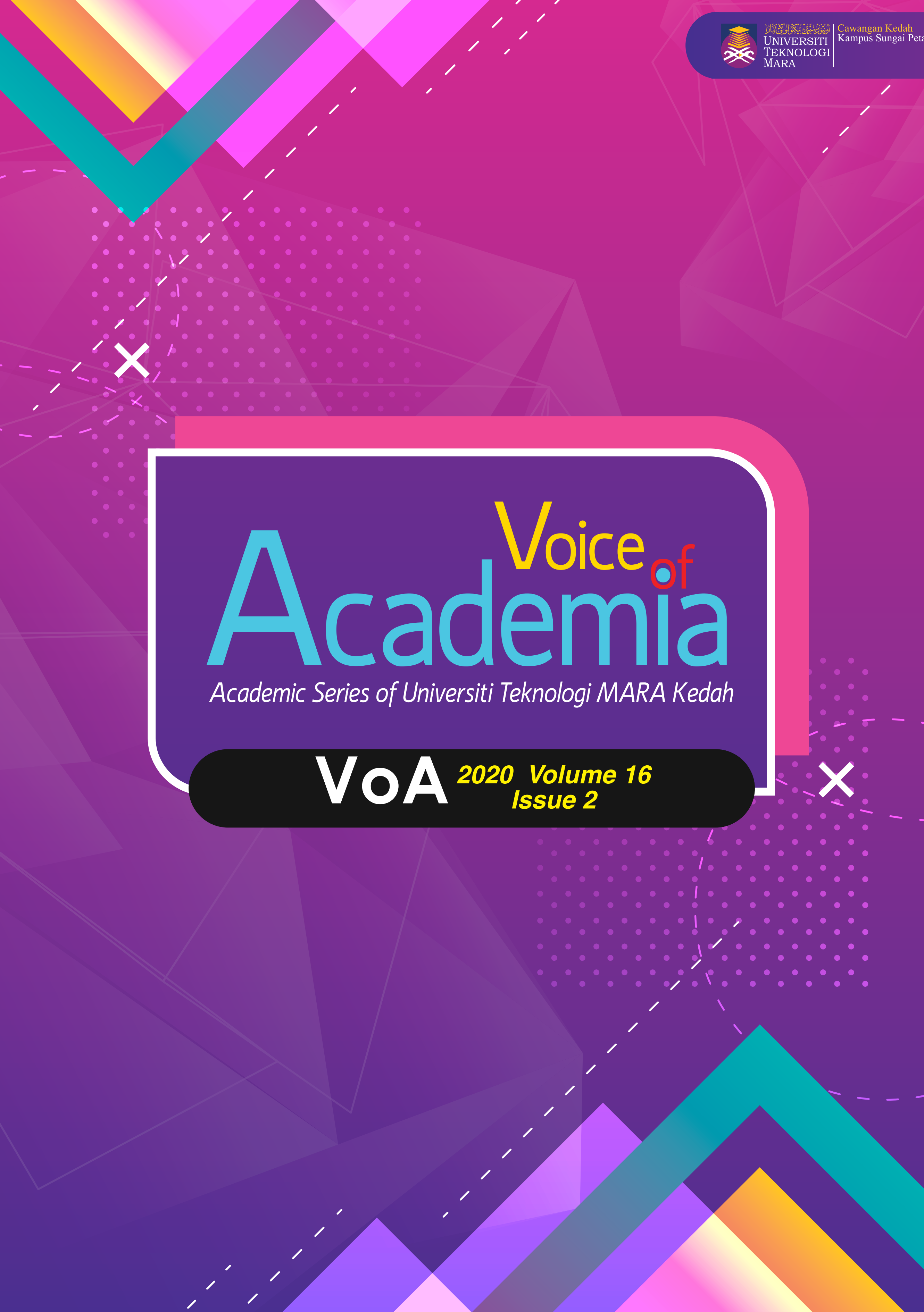

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LUDOLOGICAL APPLICATION IN THE GAMIFICATION OF TERTIARY LEVEL EDUCATION

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ABSTRACT

The education system is meant to prepare young minds for the workforce. Yet, despite the rapidly evolving industry, this system is still reminiscent of industrial-age values whereby students are trained to sit in line and follow instructions. On the contrary, the current industry requires candidates who are capable of critical thinking, creativity or flexibility, maintaining motivation, and being engaged with their work. The current conventional education approach lacks the necessary mechanics that drives the development of engagement in students. Through ludology, or game studies and gamification, it becomes possible to modify the current education approach and instill these values in students. Here, we aimed to develop a framework for applying ludological mechanics in the form of gamification to improve student participation and engagement in an education course. The core of the gamification system was developed using Microsoft Excel. The key student participation elements were first identified and segregated into three general categories; in-class participation, lab participation, and participation outside of the classroom. These were then broken down further for a more accurate record of each participation. A points-based reward system was then developed, dubbed "Extra Points" or "ExP" to act as a gamification currency. A shop mechanic was then designed to attribute value to the points. To avoid inflation, a balanced point-based economy was then developed, taking into account student behavior, perceived preferences, as well as feedback. The ExP system effectively assimilates the core values of well-balanced RPGs, encouraging students to willingly and actively participate and engage with the system. In this regard, the ludological approach successfully improves self-motivation in students while enumerating their participation, providing a clear indicator of each students perceived level of engagement during class.

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1. Introduction

1.1 The current education system

The Malaysian education system for the most part has remained the same since the introduction of formal education during the British rule (Mohd Zain, et al., 2017). While the syllabus, general contents and assessments have been updated here and there, the approach and teaching mechanism are still relatively unchanged. Commonly referred to as the "Factory Model of Education", this approach has been proven effective for the first few industrial revolutions. However, with the advent of the IR 4.0, it becomes evident that there is a dire need for the education system to shift further into the coveted "modernization" of education. While the first three industrial revolutions thrive by training labourers to work in either a literal or metaphorical assembly line and follow instructions, the latter requires the workforce to be able to think critically, solve problems and be innovative. Clearly, in order to train students to fit this new-age workforce demographic, the education system must therefore be updated to compensate. (Saud, et al., 2018).

1.2 Ludology

Ludology is defined as the study of the many aspects of game design, beyond simply "making a game". It looks into the intricacies of game narratives, player emotion and growth, interface and UX design, psychology, and history, among others (Crogan, 2004; Järvinen, 2007; Apperley, et al., 2012). Interestingly, games have the power to hold a player's interest and keep them engaged on a task. However, in order to achieve this, the use of appropriate elements must be employed in the features provided by a particular set of gameplay elements (Cowley, et al., 2008), (Schoenau-Fog, 2011). Otherwise, the players would quickly be ejected from the intended psychological flow state, and lose interest (Nah, et al., 2014). The use of certain ludological concepts has also been theorized to be capable of improving pedagogy (Sanchez, et al., 2017; Royce, 2010; Ang, et al., 2008).

1.3 Gamification

Gamification can be described as the application of game elements within a non-game environment, and should not be confused with game-based learning (GBL), which is the application of a game structure in teaching a specific topic. It essentially utilizes gameplay components in order to modulate its target demographic towards in the intended behaviour (Deterding, et al., 2011; Lee, et al., 2011; Dicheva, et al., 2015). Minor applications of gamification can be observed in various marketing strategies such as the Starbucks Rewards, AisAsia Big Points, Watsons Member Points, and the Petronas Mesra Loyalty Programme. Use of progress bars to encourage the feeling of advancement in various mobile shopping apps is also an example of a minor gamification application. In this vein, marketing companies have begun to capitalize the benefits afforded by gamification in order to increase customer engagement and retention (McCarthy, et al., 2014; Harwood, et al., 2015; Hofacker, et al., 2016).

Notably, there have been several attempts at the application of this concept within the classroom context as well. Classcraft for example, is a commercial platform that provides a tool for the construction of an extensive gamified narrative for a classroom (Sanchez, et al., 2017). Other smaller scale projects have also proven the effectiveness of gamification in improving engagement and performance in the classroom (Nicholson, 2013; Mohamad, et al., 2018).

The use of this concept has been explored in various degrees at different education levels. However, there remains to be a clearly defined model (or set of) and framework for the development and flexible use of gamification within the context of a tertiary level education. Here, we have designed and tested a framework towards addressing this gap.

2. Method

2.1 Establishment of classroom gamification context

Taking into consideration the predefined core value of gamification, i.e. the incorporation of game elements into non-game settings, we first established a clear context of how to employ said elements. Observations of a few candidate groups (classrooms) were carried out to affirm common student behaviours that are ideal for modulation. During this period, all of the student wants, needs and responses whether direct or indirect were noted throughout interactions during and outside of the scheduled classroom sessions. These components were then narrowed down into clearly defined categories that can then be itemized and gamified. After a brief trial period, the students were then given a questionnaire to determine their preferences of the determined items.

2.2 Development of a points-reward mechanic

The ludological components discussed earlier were first converted to suitable gamification elements; Points-reward, tailored assignments, leader board, and persuasive design. The suitability of these elements in their implementation were then determined and subcategorized into three sections; acquisition of points, expenditure of points, and conversion of excess points. The first section was then further divided into two; within and outside the classroom. Whereby, the former involves lecture sessions and lab sessions, while the latter revolves around optional assignments and online quizzes. The second section was divided into two subsections; facilitation of assessments and facilitation of coursework, whereby the former targets the modulation of scores acquired by students, while the latter modulates the process of coursework being carried out (e.g. submissions, extensions, etc.). The third section was also further divided into two subsections; Facilitation of passing marks and the raising of letter grades.

2.3 Development of a shop mechanic

The ludological components discussed earlier were re-categorized into suitable gamification elements. The gamified classroom items were reorganized into a list of perks, similar to item shops in most Role Playing Games (RPGs) as shown in Table 1. A few extra options were added to the list to observe the students' response towards them. Careful deliberation of the intended effects of some of these perks lead to the creation of different tiers, similar to the tiered potency of curative items in games such as Final Fantasy and Moonlighter. Following the narrative design of the former, each perk was given an easily identifiable moniker through the addition of letters (S, M, L) or by including its tier indicator in parentheses (e.g. Tier 1, Tier 2, etc.) to clarify the magnitude of their effects. Although, other naming conventions (Minor token, Greater token, etc.) to further facilitate the narrative of the shop is possible, the nomenclature were kept within the language limitations of the sample group. As use of letters S, M and L are common in denoting sizes, and use of numbers is rather self-explanatory, the naming conventions were retained as such.

2.4 Development of a behaviour modulation model

Target behaviour was established through heuristics, surveys and brief (and/or continuous) discussions with the students. The general wants of educators were also deliberated through discussion with a small group of lecturers to establish a starting point for the development of the model. The gamification framework was tested iteratively throughout a single semester, whereby any problems with student behaviour is first taken note of. Then, a component of the gamification system is added, removed or modified, and the feedback from the students is observed and recorded.

2.5 Development of a balanced gamified economy

As with any good game design involving the management of a fictional currency, it crucial that a balance is maintained between the cost of a perk and its perceived value. Depending on the intended use of the perk, its cost must therefore be adjusted accordingly. Four factors; purpose, frequency, impact and complexity were emphasized as key for influencing perk

3. Results and Discussion

3.1 Establishment of classroom gamification context

As shown in Figure 1, a set of gamifiable items were first listed down based on the observations of student behaviour and interactions throughout the semester. In the context of point redemption (the exchange of acquired gamified points with classroom-related perks), the results of which reveals students to be more inclined to opt for hints before test (87%), assignment deadline extensions (60.9%), assignment resubmissions (63%), and lab report resubmissions (73.9%). On the other hand, in relevance to classroom dynamics, results indicated that students prefer to choose their own assignments (84.8%), and work in groups (78.3%). Interestingly, it is an even split of preference between being a team member and group leader.

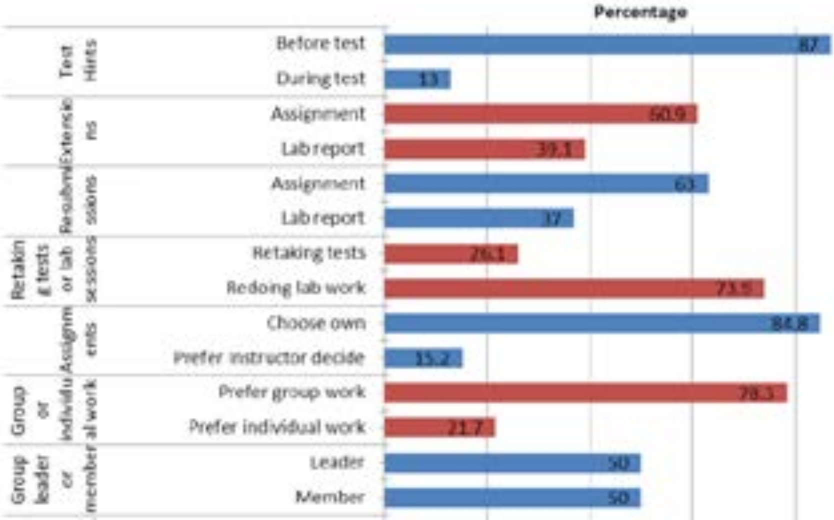

Figure 1. Survey of student preferences of predetermined gamifiable items.

The results suggests students prefer to be given agency over their coursework, as evidenced by the option to choose their own assignments. From this data, the assignment-distribution mechanic was altered to cater to a more open approach. Students were given the freedom to choose any assignments from any chapters, at any time within the predetermined duration; in this case from the second week to the end of the study leave. Furthermore, two assignment modes were created; individual and group, to cater to the fifty-fifty split in preference. This requires the use of game theory and risk-reward in the design of the assignments, which will not be discussed in this study. The remaining items listed in the survey were then incorporated into the "ExP shop" mechanic accordingly.

3.2 Development of a classroom points-reward mechanic

A points-reward mechanic was developed surrounding the condensed ludological components discussed earlier, which were then converted to suitable gamification approaches (Table 1).

Table 1. Re-categorization of ludological targets into gamification elements

Ludological component	Approach in gamification
Opportunities for Building Self-Esteem	- Points-reward - Agency (tailored assignments)
Skill Development	- Points-reward - Agency (Tailored assignments)
Relative Position	- Points-reward - Leader board
Levelling Up rather than Levelling Down	- Points-reward - Persuasive design
An Experience that Encourages Risk-Taking	- Points-reward - Agency (Tailored assignments) - Persuasive design

The mechanic involves a participation metric, where the students' participation would be directly measured through the acquisition and loss of points. In this case, students who participate in class, and by extension the system (according to the predetermined rules) will be rewarded. Like any game design, these points function to propel player motivation. However, to avoid the system from devolving into a race for arbitrary rewards, goals and achievement indicators of no practical value, the points also function as a currency unit which players can exchange for perks as shown in Figure 2.

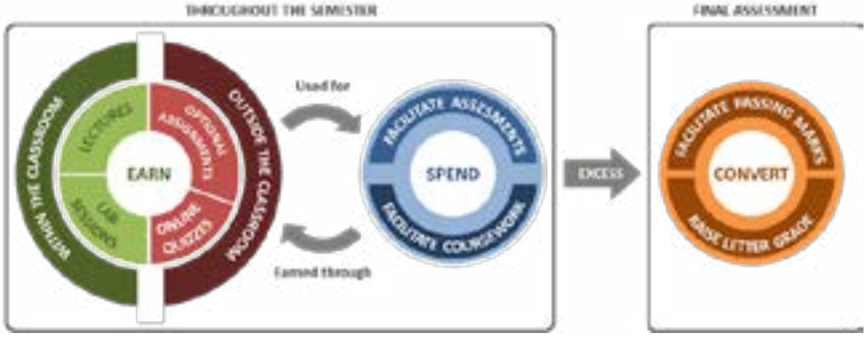
THROUGHOUT THE SEMESTER
FINAL ASSESSMENT
WITHIN THE CLASSROOM
LECTURES
LAB SESSIONS
EARN
OPTIONAL ASSIGNMENTS
ONLINE QUIZZES
OUTSIDE THE CLASSROOM
Used for
Earned through
FACILITATE ASSESSMENTS
SPEND
FACILITATE COURSEWORK
EXCESS
FACILITATE PASSING MARKS
CONVERT
RAISE LETTER GRADE

Figure 2. Detailed dynamics of the ExP system

At its surface, the structure of the system is simple enough; students earn points by participating in class, then they spend their points to get ahead in class. However, it is the responsibility of the designer to ensure that the players, i.e. students are motivated to participate and spend. Therefore, from the designer's perspective, it becomes imperative that the process or earning and spending points act as motivators as well as currency.

To achieve this, we have broken down the dynamics in Figure 2 and defined "participation" into participation during lectures, and participation outside of the classroom. To ensure a clear rule for point acquisition, the former was further subdivided into "asking questions" and "answering questions". As this framework was developed for a STEM course, it is necessary to include "lab sessions" as part of the participation within the face-to-face learning context, but in a practical session setting rather than the conventional classroom setting. Upon deliberation, it was decided that the metric for lab participation to be focused on addressing student weaknesses observed; lack of preparation prior to lab sessions, over-reliance on the instructor, lack of familiarity with the topic being covered despite having a theory session prior to each lab. To cater to this, the metric for the "lab session" category was set to revolve around allowing students to present the lab briefing at the beginning of each session. The briefing was divided into; i) the introduction, where the theory behind the lab work would be discussed, ii) the methodology, where students would present the workflow of the lab session, preferably in a mind map or jotter book fashion, iii) the results, where students would present their raw observations, iv) the discussion, where students would link the results with the theory, and v) the question and answer, where any relevant questions and answers would be awarded points accordingly. A rubrics was prepared beforehand to be able to accurately assess student presentations and provide feedback immediately after.

Participation outside of the classroom was aligned according to the predetermined course assessment breakdown set by the university.

Taking student behaviour into account, sinks were introduced to the system to reduce the likelihood of inflation in the established gamification economy, which will not be discussed in this study.

3.3 Shop mechanic

True to the standard shop mechanic, a currency is needed in order to assign numerical value (i.e. cost) to the items listed. For the purpose of the study, this currency was named "Extra Points" or "ExP". The use of the term "points" is crucial here as it dissociates from the usual "score" that students have associated with traditional education contexts.

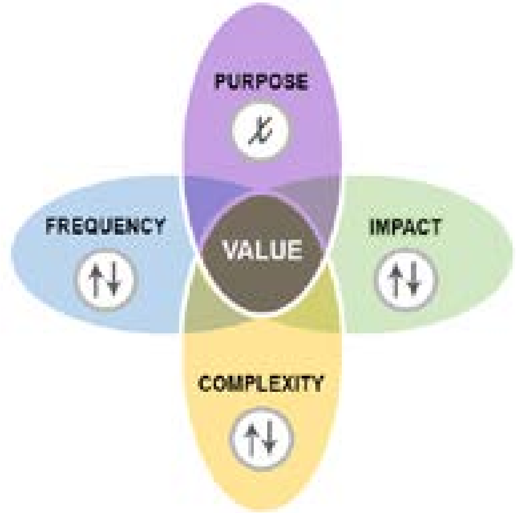

Figure 3. Model for determining the value of perks offered.

As shown in Figure 3, each perk was then carefully assigned a value based on i) the intended frequency of use, ii) its purpose, iii) the impact or significance of its use, and iv) its complexity of use. Firstly, perks designed to be used at high frequencies are assigned lower cost, while it is the opposite for perks intended to be used less often. Secondly, the purpose of a perk, whether to encourage persistence against unsuccessful attempts, or to encourage teamwork for example would increase its value. Thirdly, perks of greater significance, i.e. is more impactful to the students, must be assigned a much greater value. The "Phoenix Down" and "Boost M" perks as an example are relatively costly, as they grant the opportunity to completely reset an unsatisfactory test result for the former, while the latter allows a pre-calculated boost in test scores without having to go through the arduous task again. The impact here also relies mostly on the weightage of the coursework in question; the higher the weightage, the higher the impact of the resubmission allowance. The student would therefore have to weigh their options when deciding on a perk to redeem. Lastly, perks of greater complexity in its use carry the risk of decreasing its appeal and subsequently, worth. These are especially true for perks that have prerequisites for redemption. Complexity can be used to either complement or add on to the purpose of the perk by layering on requirements that further shifts student behaviour. However, unless it is compensated by a greater impact, students would likely see it as a chore and forgo it altogether. Arguably, the students' cognitive capacity must also be taken into account when equipping a perk with a caveat. The final output of the current perk development is as shown in Table 2.

Table 2. List of classroom-related perks

	ITEM	COST (ExP)	COST TARGET	EFFECT TARGET	DETAILS
1	Reset Token	5	Individual	Individual	Redo an assignment/lab report/presentation
2	Overdue Token S	5	Individual	Individual	Submit an assignment/report overdue by up to 1 week
3	Overdue Token M	10	Individual	Individual	Submit an assignment/report overdue by up to 2 weeks
4	Overdue Token L	15	Individual	Individual	Submit an assignment/report overdue by up to 3 weeks onwards
5	Delay Token S	2	Individual	Individual	Extend an assignment/lab report by 1 day
6	Delay Token M	5	Individual	Individual	Extend an assignment/lab report by 3 days
7	Delay Token L	10	Individual	Individual	Extend an assignment/lab report by 1 week
8	Hint (Tier 1)	10	Individual	Class	Reveal test question nature
9	Hint (Tier 2)	15	Individual	Class	Reveal test question topic x 1 (Tier 1 must be purchased)
10	Hint (Tier 3)	20	Individual	Class	Reveal test question topic x 2 (Tier 2 must be purchased)
11	Nullify (Tier 1)	30	Individual	Individual	Any 1-2 mark question becomes nullified (free marks)
12	Nullify (Tier 2)	50	Individual	Individual	Any 3-5 mark question becomes nullified (free marks)
13	Boost S	25	Individual	Individual	Increase assignment/test score by a small %
14	Boost M	50	Individual	Individual	Increase assignment/test score by a medium %
15	Phoenix Down	60	Individual	Individual	Retake a test.

**The list of items is extracted from the system at the time of writing*

3.4 Points-reward based behaviour modulation model

As previously mentioned, the overall framework proposed here revolves primarily around a points-reward system tied heavily to the observed wants and needs of the students (within the context of the classroom) such as resubmissions, extensions and extra marks. At the same time, the instructor's wants at a given time (i.e. what behaviour they wish to observe in the students) are also a significant factor in maintaining the system. From there, a model for the interaction between these two wants was proposed while incorporating a points-reward mechanic as its modulator (Figure 4).

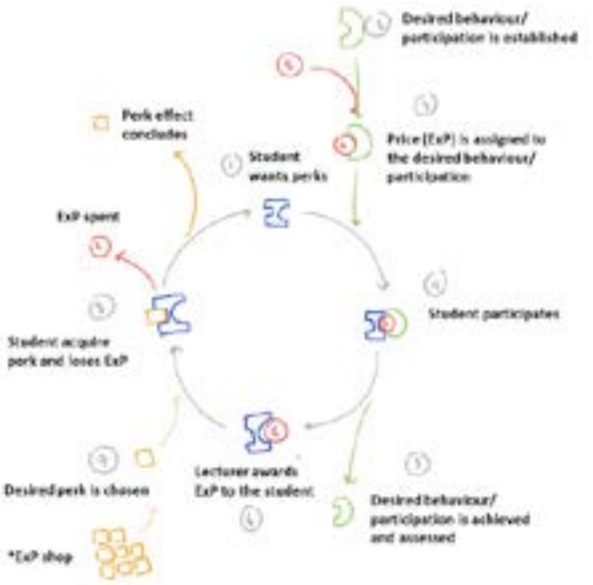
Desired behaviour/
participation is established
Perk effect
concludes
Student
wants perks
Price (ExP) is assigned to
the desired behaviour/
participation
ExP spent
Student participates
Student acquire
perk and loses ExP
Desired perk is chosen
Lecturer awards
ExP to the student
Desired behaviour/
participation is achieved
and assessed
*ExP shop

Figure 4. Student behaviour modulation model using ExP as a motivational currency, where target behaviour and perks are the main manipulated variables in sustaining its motion.

As mentioned previously, the wants of the students must first be clearly defined and established (Figure 4(1)), which will act as the carrot at the end of the stick. Then, to achieve a balanced behaviour modulation dynamic, a well-defined target behaviour, represented by the green icon in Figure 4(2) (such as asking questions in class or taking extra assignments) needs to be established. It should be noted that a clearly defined target is necessary in to facilitate student compliance, as a vague target would lead to unclear instructions and ultimately discourages students from participating. These targets will then be assigned a numerable value, represented by the red icon Figure 4(3). Should the target behaviour and its value be appealing to the student, they will therefore participate (Figure 4(4)). Upon achievement of the target behaviour (Figure 4(5)), the student will then be awarded the associated value (Figure 4(6)) to be used to exchange for the desired perk (Figure 4(8)). After which, the given value is then removed or deducted from the student (Figure 4(9)). Once the effects of the acquired perk concludes (Figure 4(10)) or the student develops a desire for another perk, the cycle is then repeated.

3.5 Balancing the gamification economy for inflation

Much like most virtual economics, especially those in Massively Multiplayer Online RPGs (MMORPGs), the gamified currency presented here carries a risk of hyperinflation. Especially, since the utility of the acquired points are limited to a relatively small selection, as opposed to the expansive roster offered by online games. Furthermore, sufficiently active players tend to accrue more of the virtual currency than their peers, creating a huge imbalance in the flow of virtual currency. Within the context of the classroom, this is observed when there is an apparent discrepancy in student ability, whereby students who are notably more competent would accrue points faster than their less able classmates (Figure 5).

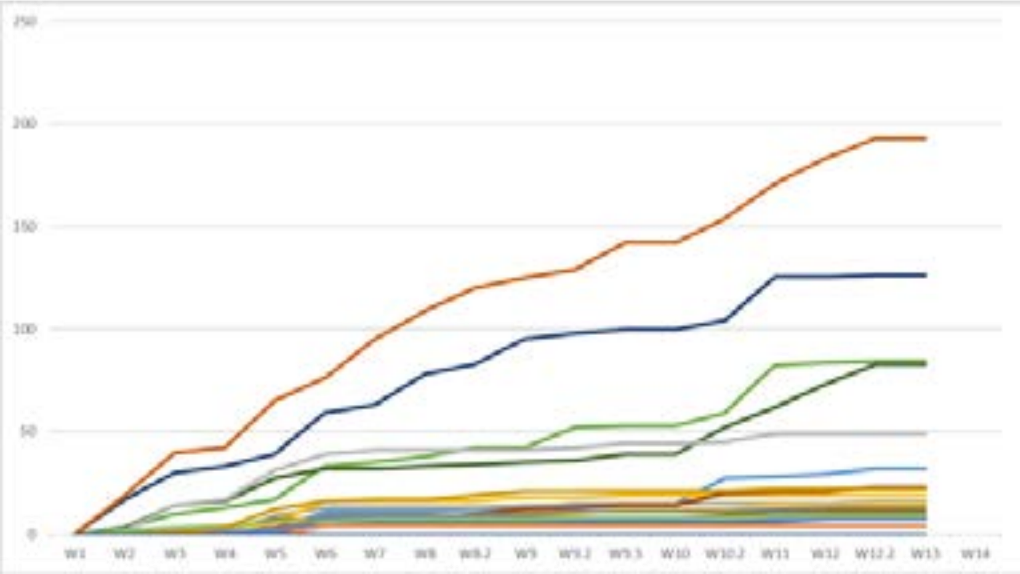

Figure 5. Cumulative ExP acquired by students throughout the 14 week semester.

To adjust for inflation, perks that are intended to be used frequently were assigned a lower cost, while being careful to not negatively affect its value. The purpose of this was to increase the appeal and frequency of its use, which would aid in the removal of the gamification currency accumulated. While game mechanics tend to rely on sinks in order to encourage a steady out flow of the game currency outside of the virtual economy, this is not so easily translated into the gamified classroom setting, mostly due to the ethical concerns in its implementation. Games such as Ragnarok Online for example, incur a fee for the inevitable (and relatively frequent) equipment maintenance of a player's avatar. If the player refuse to comply, the equipment simply "breaks", permanently removing it from their inventory. This in turn compels the player to reengage with the game's other mechanics in order to recover the lost asset.

In the classroom setting however, such a mechanic, while not entirely impossible, would be relatively complicated to carry out. For one, a suitable risk mechanic must be introduced that requires the student to pour in their earned points to avoid or alleviate. The most common theme to achieve this would be by incurring either a scheduled fee, or an expiration date for a previously redeemed perk, which would require a timely removal of the virtual currency accordingly. This however, requires the design of a "persistent" perk of acceptable value as discussed in Figure 3. Maintenance of the perk must therefore incur a cost in order for the student to continually benefit from it. However, this significantly increase the complexity of the mechanic, which may in turn negatively affect its appeal. In addition, keeping track of "persistent" perks would require the aid of an automated system, which may require some degree of technical know-how on the educator's part.

A thesis by Lahti in 2015 suggests that in order to discourage inflation, the system should include a number of ways to encourage the outflow of the virtual currency in a "healthy" manner (Niko, 2015). Debatably, within a video game proper, it would be possible to introduce a plethora of consumable items to control the economy of the game. While it isn't impossible, doing the same in a gamified classroom economy bears the risk of increasing complexity and reducing appeal.

Admittedly, this is a problem that is as of yet unsolvable using the current developed gamification mechanic. The vast asymmetry in student competency is similar to putting players of disparate skills in the same ring; completely unfair, and may require interventions beyond the classroom gamification.

3.6 Reception of the gamified system

Observation of responses revealed that the student demographic is highly varied in their acceptance of the gamification system. While the majority does respond positively and as expected, their varied literacy towards the general concept of games has proven to be a major hurdle in the execution of the system. Students with prior experience with video games, especially RPGs for example, were very quick to grasp the gamification concept and have little problems understanding its rules and benefits. Students with little to no experience with games were notably much more difficult to acclimatize to the new system. Though, this may be more due to the deeply rooted conventional teaching and learning methods that they have grown accustomed to.

Furthermore, interactions with the students revealed that a number of them had limited IT literacy. The compounding unfamiliarity towards both technology in general and the concept of gamification may have contributed to their reception of the system as a whole. Although some of these students showed improvements throughout the semester, further study may be needed to clarify the contributing factors.

4. Conclusion

In conclusion, the current study has successfully established and tested the gamified classroom mechanic revolving around a developed behaviour modulation model. However, a few concerns were highlighted as well, whereby reception of the students towards the gamified system may vary depending on pre-existing game and IT literacy. Careful deliberation of this matter suggests that the issue may be addressed through one of three approaches; i) Improvement on the introduction of the system at the beginning of the semester, ii) modification of the user experience (UX) design to cater to the observed demographic, or iii) further simplification of the gamification protocols involving student-lecturer interactions.

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