

An Empirical Study of the Effects of Virtual Currency on Learners in Out of Class Practicing^{*}

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Abstract. As a gamification element, virtual currency (VC) stands for rewards that can be exchanged for virtual or real goods. While some forms of reward-based gamification have been studied extensively, the exploration of the impact of VC on learners is relatively scarce. In particular, there is a lack of studies investigating its effects in different learning contexts. Since VC can evoke perception of benefits with positive impact on course outcomes, it may be experienced as an extrinsic incentive. On the other hand, VC can promote internalized motivation when awarded for accomplishment of certain challenges. To bridge this gap we are conducting a longitudinal study on the impact of VC on student motivation and engagement in different contexts and with different types of learners. The goal of this paper is to empirically investigate whether and how VC can improve the engagement in out-of-class practicing of a certain population of learners in a gamified Discrete Structures course. The study demonstrated a strong positive impact of VC on learners' engagement however VC exhibited no significant impact on students' academic performance and intrinsic motivation.

Keywords: engagement · motivation · gamification · virtual currency · case study

1 Introduction

Gamification, the use of game design elements in non-game contexts [5], has become a promising strategy for enhancing learners motivation, engagement, and performance. The driving insight of educational gamification lies in the promise to transfer the motivational potential of games to non-game learning environments. While games use a variety of elements, the range of game elements used for gamifying learning is rather limited and is typically confined to reward structures based on points, forming the so-called reward-based gamification [17, 22]. The usual types of rewards commonly include points, badges, and leaderboards

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and rarely some less common rewards such as virtual currency. Previous studies have shown that reward strategies can encourage learners to keep track of their learning and performance since rewards can serve as indicators of progression and goal accomplishment [25]. In discordance to its popularity, empirical research on reward-based gamification paints a conflicting picture [6, 27]: some find positive results [4], others find no or even negative effects, like a decrease in student performance [20]. The emergence of such conflicting results is attributed to poor gamification design [21] by some researchers, or to novelty effects by others [11]. In this context, extending the range of game elements used for studying reward-based gamification can shed new light on the understanding of its mechanisms and potentials for learning. Many games incorporate game design elements that can be redeemed for unlocking or buying objects (e.g., new characters, tools, weapons, stages). Utilizing rewards in such a way can enhance players' motivation and engagement due to the possibility of achieving useful objects and tools, and using them to progress and perform better in the game [25]. While this idea has been transferred to gamification in educational contexts, typically in the form of virtual currency [8], the exploration of its motivational and psychological impact on learners is relatively scarce. This inadequate interest is intriguing as Chang and Wei [1] identified badges and virtual currency as two of the most engaging game elements used in MOOC environments. In their meta-study, Huang et al [12] provide evidence that not all game elements have the same effect on student learning outcomes. This indicates that it is important to further our understanding about which game design elements work under what circumstances. In order to foster the design of applications that effectively motivate and appeal to individual learners, we need to improve our understanding of the relationship between game elements, such as virtual currency, and the motivation that can emerge in learning activities gamified with them.

As a gamification element, virtual currency (VC) typically stands for all kinds of rewards which can be exchanged with virtual or real goods [12]. It can be viewed also as a reward that has some exchange value within the system. Since virtual currency evokes perception of benefits with positive impact on course outcomes, it may be experienced by learners as an extrinsic incentive. On the other hand, based on Ryan and Deci [28] we can assume that VC can enhance intrinsic motivation when it is awarded for the accomplishment of specific challenges. Unraveling these motivational possibilities suggests studying the psychological effects of VC in different contexts. Furthermore, as of now there is a lack of empirical studies investigating the effects of virtual currency on different learner populations. Recognizing the above gaps, we are conducting a longitudinal study on the impact of the game element virtual currency on student motivation and engagement in different contexts and with different types of learners. The learning activity in focus is student practicing. Practicing is known to be an effective strategy for self-training, yet some students lack motivation to engage or persist in practicing activities [7]. By gamifying this type of learning activities we aim at increasing learners' engagement and, by extension, their academic performance. Thus the goal of the study presented here was to empirically investigate whether and how gamifying learning activities with virtual currency

can engender motivation for out-of-class practicing in a “Discrete Structures” course. To improve our understanding of the motivational drivers that influence learners’ engagement in the activity, in addition to the motivational scale based on the Self-Determination theory [2], in this study we also used the Expectancy-Value-Cost (EVC) [16] scale as an instrument for estimating the motivational quality (intrinsic vs. extrinsic). In particular, we were interested in finding out why learners value gamified practicing - because it is fun/interesting or because it is useful for completing the course. Specifically, we addressed the following research questions:

RQ1: Does virtual currency encourage more active engagement in out-of-class practicing?

RQ2: Does virtual currency improve students’ academic performance?

RQ3: Do gamified activities using virtual currency improve intrinsic motivation?

In the next section we review the related work. The design of the study and the data collection process are described in Section 3, and the results of the experiment are reported in Section 4. In Section 5, we discuss the results and conclude the paper.

2 Related Work

Reward-based gamification is a design method to condition a behavior by affording rewards (e.g., points, badges). While some authors have shown positive outcomes of using reward strategies in improving learners’ motivation [19], engagement [23], learning outcomes [19], and enjoyment [21], other studies have found that gamification decreases class participation, exam performance [10,20], motivation [12] and leads to lower knowledge acquisition [20]. Although virtual currency falls in the reward category, it offers more complex motivational mechanism driven by the possibility to earn certain values that enable obtaining of some other desirable objects. In this aspect, the present study aims at bringing extra light to our understanding of the potentials of rewards-based gamification.

Yet, a limited number of papers have studied the effects of VC in different learning contexts and categories of learners. In one of the first experiments with VC, O’Donovan et al. [23] describe their implementation of a gamified game development course with points that could be redeemed for course benefits along with badges, progress bars, and a leaderboard. Although the study concludes that the in-game currency was very well received, its isolated effect was not statistically confirmed. Another early attempt of using VC studied the effects of adding VC along with some social motivators to a peer help system to incentivize learners to help their peers [29]. Essentially, when gamification is driven by several game elements, the isolation of the effect of each one is problematic.

Gamifying a Computer Science course with virtual currency (BitPoints) used together with levels and stars was proposed by Lopes [18]. BitPoints were earned for overcoming obstacles associated with challenges (in practical exercises). The earned BitPoints could be used for purchasing tools/hints for solving other tasks.

Explicit evaluation of the VC impact on student learning has not been performed. An alternative kind of VC, in a form of coins, used for gamifying a Software Testing course [20] has been studied recently, but with inconclusive results. Outside of computing subjects, in Duolingo (<https://www.duolingo.com/>) a type of VC (Lingots) is awarded upon successful completion of some lessons or tasks. This VC can be used to buy prizes (i.e. extra lessons, bonus skills, outfits for the Duolingo mascot). Similarly, in Super Chinese (<https://www.superchinese.com/>) learners earn coins when they complete a session with no mistakes and make streaks of correct answers. The coins can be used to unlock a full version of the system for a certain time. Regarding math disciplines, virtual currency in a form of eCoins, was used in a Statistics course [4] but in combination with levels, progress feedback, time pressure, and pathways. The earned eCoins could be used to remove parts of a question or an entire question from a test set. Virtual currency, as a feature for enhancing engagement, has also been studied in a MOOC environment, where redeemable points were reported as the second most engaging gamification mechanism [28]. A similar version of VC, called in-course redeemable rewards, was reported in [26]. It was issued to students for completing predefined tasks and could be exchanged for various privileges (e.g., unlock exclusive learning contents, extra attempts and/or more time to perform quizzes, extended due date of assignments). Nonetheless, the subsequent studies [24] did not demonstrate a significant increase in student engagement.

A more systematic exploration of the effect of VC on learners' behavioral and psychological outcomes began with the work of Dicheva et al. [9]. In a Data Structures course gamified with badges, leaderboard, and VC students could earn and spend VC based on rules specified by the instructor. The earning rules were based on the amount, the level of difficulty, and the correctness of the solutions of completed problem-solving exercises. Students could spend their VC on purchases of deadline extensions, re-submission of homework, etc. The idea behind this form of gamification economy was to stimulate students to practice more in order to attain the intended learning outcomes by incentivizing them with purchasable course-related 'benefits'. The reported results of the study confirmed that the targeted motivational effect was achieved but again without isolating the motivational impact of VC from the other elements used to gamify the course. This early work was followed by two consecutive studies with a focus on examining the effect of VC on learners enrolled in a Discrete Math course and in a Computer Networking course. Unlike the previous studies, they studied empirically the individual effect of VC (which was the single gamification element used) in two different contexts (subject and student population) as an initial step towards gaining more generalizable results. These two studies showed that using VC to gamify practicing increased students' engagement, leading to improved academic performance. The present study narrows the focus by preserving the subject (Discrete Structures) but shifting it to a different population of students (with potentially different learning objectives and attitudes). As the motivational drivers of these two populations may be different, we were interested to examine how they interact with the motivational affordances provided by VC and whether this interaction yields different psychological and behavioral

outcomes. Furthermore, we were interested to explore empirically if VC is perceived as an intrinsic or extrinsic motivator by the type of learners participating in this experiment.

3 Case Study

3.1 Course Description

The experiment reported here was conducted in a Discrete Structures course offered at Villanova University. This is a required course for majors and minors in Computer science and computer engineering. It also can fulfill a mathematics requirement which attracts some non-technical students. Students from freshmen through seniors take this class. Because the course is open to all students with no prerequisites, no programming is included. The course is a one-semester treatment of discrete structures covering sets, trees, graphs, logic and proof, mathematical induction, relations, functions, sequences, summations, and elementary combinatorics. In this offering of the course, the textbook was *Discrete Mathematics: An Open Introduction* by Oscar Levin, 3rd edition. (<http://discrete.openmathbooks.org/dmoi3.html>)

The course structure was fairly traditional, with three midterm exams and a final exam, weekly quizzes, a homework set on each section, and a class participation component. All instructors used the same exams, quizzes, and homework sets. All instructors used the same set of PowerPoint slides, modified from slides used in a previous semester by a different instructor.

3.2 The OneUp Course Gamification Platform

In this study we used the OneUp course gamification platform [9] to gamify the Discrete Structure course. OneUp supports a large set of gamification elements, including experience points (XP), leaderboards, progress bar, avatars, badges, virtual currency, content unlocking, goal setting, challenge duels and callouts, and learning dashboard. It is configurable and the instructor sets which game elements they want to use in their course. Since this study utilized only the game element virtual currency (VC), below is a description of the support for it provided by OneUp.

The use of virtual currency in the gamified environment is governed by rules of two types: VC earning rules and VC spending rules. The earning rules specify in what circumstances the system shall award virtual currency to the students. Each rule specifies a learning activity and a condition related to the student performance in it, as well as how much VC should be awarded to the student if the condition is satisfied. The activities can be either automatically graded by the system practicing quizzes (warm-up challenges) and graded course quizzes (serious challenges), or not automatically graded, for which the instructor has to enter students' scores, such as assignments, labs, projects, attendance, etc. OneUp has an event-based game engine which checks if the defined rules are

satisfied for a given student and if so, adds to their account the corresponding VC. Students can check their VC transactions at any moment.

The spending rules specify what the students can buy with the accumulated virtual currency. The spending rules involve typical course-related benefits, such as extending a homework deadline, re-submitting of an assignment, excusing skipping of a class, awarding extra-credit points to a lab or homework, etc. These are offered in the Course Shop, where the students can buy them as in a traditional online shop. The system sends a notification to the instructor for each purchase and also to the student, when the instructor changes the status of the transaction from ‘requested’ to ‘in progress’ to ‘completed’. It should be noted that both the earning and spending rules are created by the instructor; there are no hard-built rules in the system. The instructor decides what they are comfortable with to offer and creates both kinds of rules in the system interface during the system configuration.

3.3 The Experimental Setting

The experiment occurred in the Spring 2021 semester. Sections were taught by three instructors with a total final enrollment of 82 students. The three instructors carefully coordinated the classes. All used exactly the same slides, the same quizzes, homework, and examinations. One instructor taught in the afternoon in person with a final enrollment of 38 students. One instructor taught the course in the evening in person with a final enrollment of 33 students. The third instructor taught in the day online with a final enrollment of 11 students.

The experimental group consisted of the day sections, for a total of 49 students. The evening students served as the control group. The evening students were the same demographic: full-time undergraduates.

All students in all sections were introduced to the OneUp gamification platform and had access to the practice problems (warm-up challenges) there. The content of the OneUp challenges followed the text’s examples and homework questions. The quizzes and exams were written in and administered through Blackboard (using Random Blocks so each student had similar but distinct questions). We closely matched the formats of the quiz, exam, and OneUp warm-up challenge questions. All the students could see that doing warm-up challenges in OneUp provided good preparation for quizzes and exams.

The students in the experimental group had access to virtual currency rewards for doing the warm-ups; the control group did not. Amazingly, we managed to get nearly all the way through the course (week 12 of 14) before the control group students discovered that the other students were earning virtual currency. For evaluation purposes, the final grades used in this study are those obtained before any adjustments due to the virtual currency purchases.

The OneUp platform offers many flexible options for earning and spending virtual currency. The instructors jointly chose the OneUp earning and spending rules and values listed in Table 1.

Table 1: Earning and Spending Rules.

Earning Rule	VC earned
At least 60% on first warm-up on topic	50
At least 5 warm-ups on topic	50
At least 85% on 5 warm-ups on topic	100
At least 90% on a homework	20
Perfect homework score	10
Notable class contribution	20
Spending Rule	VC Cost
Add 10% to quiz	200
Add 2.5% to final	400
Add 1% to midterm	160
Add 10% to a homework	200
Drop lowest quiz	800
Retake quiz	200
One day late homework submission	80
Resubmit a homework	200
Add 2% to participation score	160

3.4 Study Design and Research Methods

We used three complementary methods to answer the research questions. We extracted data from the OneUp logs about student interaction and engagement with the gamified environment to answer the first research question (RQ1). These included students’ visits to the gamification-related webpages, how many practice quizzes (warm-up challenges) students have completed, etc. To answer the second research question (RQ2) about the impact of gamifying the course on students’ academic performance, we compared the final course grades of the control group and the experimental group. To answer the third research question (RQ3), we conducted a motivational survey with the experimental group. The survey was a modified version of the Basic Psychological Needs Satisfaction Scale – Work Domain [2]. This 21-item scale was chosen because Self-Determination Theory is linked to basic psychological needs, i.e., Autonomy, Competence, and Relatedness ([2, 13, 15]). We hypothesized that these basic psychological needs apply to course work as well, and slightly modified the scale items to reflect this, e.g., “I feel like I can make a lot of inputs regarding how my classwork gets done” vs. “I feel like I can make a lot of inputs regarding how my job gets done”.

4 Results

4.1 Student Engagement with the Gamification Platform

This section presents an overview of how the students interacted with the OneUp platform during the study.

The use of virtual currency To answer the question of how the students from the experimental group used virtual currency in the gamified course, we extracted data from the OneUp transaction log. The data show that the students have earned a total of 64,760 course bucks during the semester, recorded in 774 earning transactions. Each VC earning transaction is a result of satisfying a particular VC earning rule defined by the instructor. The distribution of the transactions by students is given in Figure 1. It can be seen that 16% of the students have 1 or no earning transactions at all. Those are the students who did not practice in OneUp; some were awarded points by the instructor for participating in class activities. From the students who used OneUp, the majority had between 11 and 20 (30%) or between 21 and 30 (30%) earning transactions, and 11% had more than 30 transactions. Figure 2 shows the actual amount of VC (course bucks) earned by students. As a context, the amount of course bucks specified in the earning rules related to taking warm-up challenges was either 50 or 100. As can be seen, the largest percentage of the students (41%) have earned between 1,001 and 2,000 bucks and 9% more than 3,000. This does show considerable engagement. As to how the students have earned their VC, 51% of the transactions were related to completing 5 warm-up challenges in one topic with results at least 70% correct. This is followed by 37% of the transactions for completing at least 5 challenges in one topic with results at least 85% correct. The latter shows the persistence of the students to keep re-taking some warm-up challenges until they get them correct.

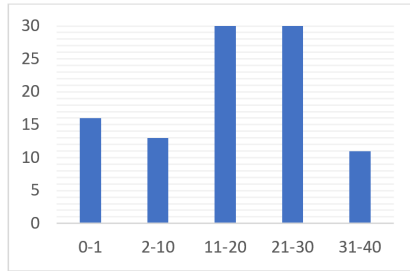


Fig. 1: VC Earn. Trans. by Students.

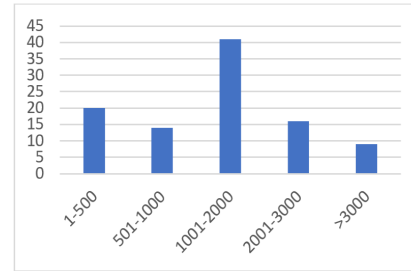


Fig. 2: Earned VC by Students.

Regarding the spending of the earned virtual currency, students made 243 purchases in the Course Shop spending 59,620 course bucks. The distribution of the spending transactions by students is shown in Figure 3, and the distribution of the actual spent bucks in Figure 4. Note that the highest price in the shop was 800 bucks, the lowest 200, and the average price around 300 bucks.

Most of the students (48%) made up to 5 spending transactions. The 16% that haven't bought anything have never logged in OneUp and have been awarded VC by the instructor for class activities not related to practicing in the platform. Interestingly, most of them have final course grades between 85 and 89 and might have benefited of using the awarded VC, but they never logged in OneUp even

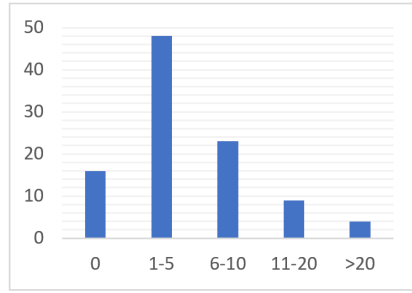


Fig. 3: Spend. Trans. by Students.

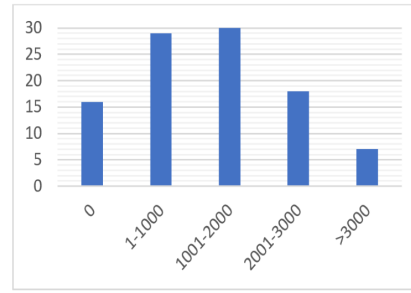


Fig. 4: Spent VC by Students.

for that reason. A possible explanation is that these students were confident in their knowledge and did not feel they needed additional practicing, so having never been to OneUp, they have not even seen that they have VC to spend. Fig. 5 depicts the distribution of the students' spending transactions by category. It shows that students' favorite was buying an extra point on an exam (41%), followed by buying 5 points on the final exam (22%) and adding 10% to a homework grade (11%). It is noticeable that there were not many requests for retaking a quiz and re-submitting or extending the deadline for a homework.

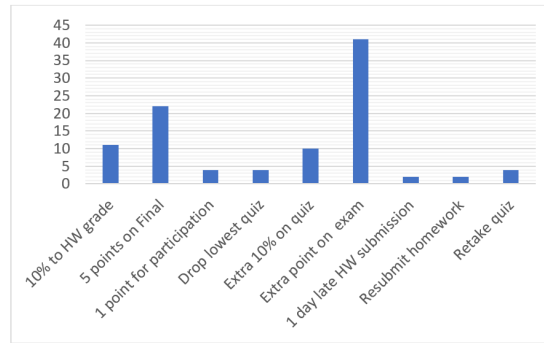


Fig. 5: Spent Transactions by Category.

We added to the OneUp interface a pop-up question displayed at the time of each spending transaction asking the student for the reason for that particular purchase. 7% of the students did not answer and 13% selected "Prefer not to say". Of those who answered, 50% said that they did it because they worried about their performance in this course, 46% because they had much earned VC and wanted to spend some, and only 4% because they were busy and could benefit from some extra time. Overall, the students made good use of the offered virtual currency in the course. 16% of the students spent all their VC and finished

the course with a balance of 0. The majority of the students who were using OneUp (55%) spent most of their earned VC and had a remaining balance less than 100 course bucks. A likely reason for not spending all earned VC is that the students did not have enough course bucks to purchase a desired item, or that they collected bucks with the intention of making purchases at the end of the course, but then realized that they did not need any of the offered course benefits.

Taking warm-up challenges To assess whether the use of virtual currency improved the engagement of students in out-of-class practicing, we compared the number of taken warm-up challenges in OneUp by the students in both the control and the experimental groups. The students from the control group took 985 unique warm-up challenges with a total of 1,384 attempts, while the experimental group took 3,674 unique warm-up challenges with a total of 6,485 attempts. The increase of the student engagement with OneUp is striking: the number of warm-up challenges taken from the experimental group is close to 4 times (373%) and the number of challenge attempts is close to 5 times (470%) bigger than those of the control group. Figure 6 shows the percent of students who have taken between 1–50, 51–100, 101–150 and more than 150 unique challenges in both groups. It also shows that 44% of the control group and 30% of the experimental group did not try any challenges. For the experimental group, this is consistent with our previous observation that for each gamified environment, which use is not required, there is a group of students who never participate no matter what kind of gamification is used. Figure 6 shows that the largest percentage of the students in the control group (44%) have taken between 1 and 50 unique challenges, while 23% in the experimental group have taken between 51–100 unique warm-ups and 23% have taken between 101–150 unique warm-ups, with 9% taking more than 150 challenges.

Similarly, Figure 7 shows that the students in the experimental group have taken many more warm-up challenges. While the largest percentage (35%) of students in the control group who practiced in OneUp fall in the interval of 1–50 challenges taken, the largest percentage from the experimental group (26%) are in the interval 151–250. In addition, 9% have taken more than 250 warm-ups. The average number of warm-up challenge attempts for the control group was 65.90, while for the experimental group it was 162.12.

As can be seen, these results provide a strongly positive answer to our first research question “Does virtual currency encourage more active engagement in out-of-class practicing?” (RQ1).

4.2 Student Academic Performance

With regard to RQ2, we hypothesized that the virtual currency would motivate students to spend more time studying and thus improve their performance [14]. The format of the quizzes closely followed the OneUp warm-up challenges, so we expected a close correlation of challenge attempts to performance on the

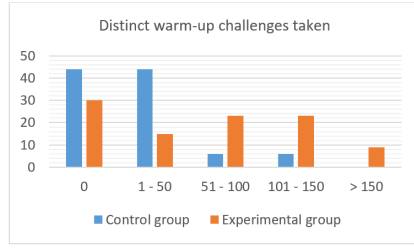


Fig. 6: Distinct warm-ups taken.

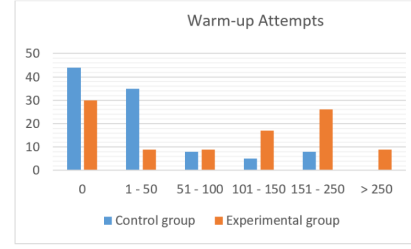


Fig. 7: Warm-up challenge attempts.

quizzes. In the following analysis, we compare the day in-person experimental group ($n=37$) with the evening in-person control group ($n=29$). (By removing the online section’s data from this analysis, we avoid possible bias due to the format of the class; also the online class was much smaller so including its data does not significantly affect the analysis. Here we also remove students without final grade data who withdrew before the end of the course.)

The analysis does not support the hypothesis. For the experimental group the average grade is 87.73, compared to 85.85 for the control group, essentially no difference (t-test p-value of 48%). When looking just at the quizzes, the experimental group averaged 84.32 versus 79.40 for the control group, again not significant (t-test p-value of 13%). These results suggest that offering the class virtual currency did not significantly improve student performance (RQ2).

We next analyze the relationship between the number of OneUp warm-up challenges taken by a student (referred to as OneUp score) to their final course grade and also to their quiz grade total. For the experimental group’s relation of OneUp score and final grade, $R^2 = 0.045$, while $R^2 = 0.011$ for the experimental group’s relation of OneUp score and quiz total. Interestingly, the control group had higher correlations and R^2 values. For the control group’s OneUp score and final grade, $R^2 = 0.214$ while $R^2 = 0.129$ for the control group’s OneUp score and quiz total. Perhaps future research could explore the conjecture that virtual currency causes students to focus on earning more than on learning, while students who do not earn currency attempt fewer OneUp challenges but focus more intently on learning if they do choose to work on them.

4.3 Motivational Survey

We performed a paired-samples t-test and a stepwise regression to address RQ3 (i.e., Do gamified activities using virtual currency improve intrinsic motivation?). To determine the impact of virtual currency on intrinsic motivation, two measures of intrinsic motivation were employed. The first set of analyses centered on exploring pre- to post-test differences in autonomy, competence, and relatedness as measured by the Basic Psychological Needs scale (e.g., [2, 13, 15]). The second set of analyses were designed to elucidate a relationship between academic performance as measured by participants’ final course grades and participants’

task-specific activity perceptions as measured by the Intrinsic Motivation Inventory (IMI; [3]). Factors of the IMI were drawn for the current study because they directly reflect intrinsic motivation (i.e., Interest/Enjoyment), because they are related to behavioral representations of intrinsic motivation (i.e., Perceived Choice), or because they are implicated in internalization of intrinsic motivation (i.e., Value/Usefulness). To perform the analysis, thirty-three matched pairs (i.e., students who took both the pre- and post-test surveys) were extracted from the full dataset. These students were all between the ages of 18 and 25-years-old, with half being drawn from the freshman class, 36.4% from the sophomore class, 11.4% from the junior class, and 2.35% from the senior class. Well over half of the participants (61.4%) were male, whereas 36.4% of participants were female and 2.3% of participants identified as having a non-binary gender. The racial composition of participants was majority White (75%), whereas 15.9% were Mexican/Hispanic/Latin, 4.5% African American, and 4.5% Asian. Further, 34.1% of participants were computer science majors, whereas 15.9% were mathematics majors and the remaining 50% of participants came from various majors. The data were cleaned and negatively worded items recorded in accordance with the previous literature.

The t-test results indicated a significant difference from pre- to post-test on the Relatedness factor of the Basic Need Satisfaction at Work scale. In other words, participants who took both the pre-test and post-test felt more positively about how they related to other students in class after our intervention than before, $t(32) = -2.29$, $p = 0.02$. The stepwise regression analysis was conducted to determine which IMI factors predicted participants' final course grades. Thus, the independent variables (e.g., predictor variables) for this regression model were Interest/Enjoyment, Perceived Choice, and Value/Usefulness and the dependent variable (e.g., outcome variable) was participant's final course grades. For the current study, neither Interest/Enjoyment ($B = -0.07$, $SE = 0.11$, $p = .53$), Perceived Choice ($B = -0.00$, $SE = 0.10$, $p = .94$), nor Value/Usefulness ($B = -0.05$, $SE = 0.15$, $p = 0.72$) emerged as a significant predictor of participants' final course grades, so all three factors were excluded from the final model. For our participants, the final model of the stepwise regression was non-significant indicating that none of the three factors significantly predicted participants' grades.

5 Conclusion

Reward-based gamification is seen as an aid to learner motivation, given that motivation is one of the leading factors of academic success [27]. Although the effect of reward-based gamification in educational context has been addressed in many papers, the number of works that empirically examine the effects of using virtual currency is still limited. Specifically, there is a lack of studies that explore the potential motivational and behavioral effects of VC on learners. On the one hand, VC might function as an extrinsic reward, leading learners to engage in the learning activities in order to earn the desired amount of VC. On the other

hand, learners might be motivated to collect VC as a sign of achievements. Yet, it can be perceived as an indicator of their level of learning. Accordingly, one of the goals of this study was to add to the understanding of the effect of VC on learners' behavior and motivation.

While the study results demonstrated a strong positive impact of VC on learners engagement in out-of-class practicing there was no statistically significant difference in the final course grades between the experimental and control group. Thus, inconclusive results were obtained regarding the impact of VC on learners' academic performance. Similarly, no significant relationship was found between learners' intrinsic motivation and their academic performance in the present study. An interesting observed relationship between the individual student OneUp scores to their academic performance suggests further study of a potential influence of VC on the activity outcomes pursued by learners, specifically, shifting their focus on earning virtual bucks rather than learning. While the use of VC as a gamification element is not new, its motivational effect on learners is not sufficiently understood. The present paper aims to expand the current understanding of the motivational mechanisms afforded by the game element virtual currency.

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