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INFORMATION SYSTEMS EDUCATION JOURNAL

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Coin Counter: Gamification for Classroom Management

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Abstract

In recent years, gamification has been utilized in a number of different contexts, including educational applications. This paper describes a unique application of coin-based gamification classroom management system in undergraduate programming classes. The coin-based gamification allowed students to earn and spend coins as a form of classroom currency. Students earned coins for certain desired behaviors, which were above and beyond normal behaviors, and were able to spend the coins for things like an assignment or take-home exam due date extension. Survey based results were collected from 104 students and the results indicated that the gamification classroom management system was positively associated with classroom enjoyment, student participation, class strategy, perceived control, and classroom performance. Although the gamification classroom management system was related to desired outcomes, there were some negative outcomes, most notably the additional burden on the instructor that we highlight. A discussion, future pedagogical research thoughts, and recommendations for system improvements are provided.

Keywords: Gamification, classroom management, coin counter, assignment management, teaching technique, teaching learning

1. INTRODUCTION

Over the past few years, the concepts of gamification have been implemented in various industries as well as widely discussed in academic literatures. The context of gamification ranges from marketing (Hofacker et al., 2016; Moise and Cruceru, 2014), organization (Kim, 2013; Singh, 2012), healthcare (King et al., 2013; McCallum, 2012), information systems (Thiebes, Lins, and Basten, 2014), and education (Kapp, 2012; Dicheva et al., 2015).

Gamification is defined as "the use of game design elements in non-game contexts" (Deterding et al., 2011, p. 9). Examples of game

mechanics include, but are not limited to points, levels, leaderboards, badges, onboarding, challenges, and quests (Zichermann and Cunningham, 2011). By integrating the 'fun' element into tasks, these game mechanics may help motivate users and promote engagement (Thiebes, Lins, and Basten, 2014). A recent literature review of empirical studies articulated that gamification promotes motivational affordances leading to psychological outcomes which, in turn, result in behavioral outcomes (Hamari, Koivisto, and Sarsa, 2014). In general, gamification provides positive effects, both behaviorally and psychologically to its users (Hamari, Koivisto, and Sarsa, 2014).

2. GAMIFICATION FOR CLASSROOM MANAGEMENT

Gamification has been used in the context of education. When properly implemented, "gamification can help enrich educational experiences in a way that students will recognize and respond to" (Deterding, 2012, p. 17). An empirical study found that achievement badges can be used to affect the behavior of students even when the badges have no impact on the grading (Hakulinen, Auvinen, and Korhonen, 2013). When applying gamification to software tutorials, students significantly completed tasks faster than those without gamification components and students reported the game conditions were more fun, enjoyable, engaging, and effective (Li, Grossman, and Fitzmaurice, 2012).

Although there have been positive outcomes, not all gamification efforts in the classroom have yielded desired consequences. One study found that students' engagement plateaued after a few weeks into the class. Once the novelty of the gamification had worn off, the high performers continued to engage in the gamified activities and the leaderboards became demotivating factors for many because they did not have a chance to catch up (Nicholson, 2013). Another study found that gamification did not improve educational outcomes and, in fact, decreased leaners' motivation, satisfaction, and empowerment (Hanus and Fox, 2015).

This paper presents a unique application of gamification in a higher-education context. In particular, in this classroom setting the mechanics involved students earning coins to help with student engagement, enjoyment, and managing classroom expectations. In the sections that follow, the specifics of the coin based gamification will be described.

3. COIN COUNTER

This particular application of gamification utilized a fictional "currency" based on earning and spending virtual coins. The coins are named either "Galleons" or "Doubloons" based on the class's theme (i.e., either "Wizard School" or "Pirates"). The class topic was undergraduate programming, which will be described in more detail, but is noted here since some of the examples covered relate to this material. As described in the next section, students earned coins in various ways and they had the opportunity to spend coins (for their benefit) in various ways.

Earning Coins

Students earned coins during the semester in many ways, however, not all activities were valued the same. Some activities were relatively easy to achieve, such as attending class or completing in-class challenges. Typically, these were worth 1 coin. Some activities were more effortful, such as providing written or verbal feedback concerning a team presentation or actively participating in class discussions. This kind of participation was typically awarded at least 2 coins (based on the quality and thoughtfulness of the feedback). Other activities involved spending time outside of class, such as attending department or school activities (e.g., a career development dinner). On top of that, students could frequently earn an extra coin by attending such events in their groups, by sending the instructor a picture of them at the activity holding their team banner.

Coins may also be awarded to students whose performance in regular activities was clearly outstanding. This encouraged students and teams to go above and beyond the stated requirements on some activities (such as doing extra homework problems). Typically, these bonuses were worth 1 coin.

Finally, coins were also awarded for semester-long accomplishments, such as maintaining perfect attendance, close to perfect attendance, and team accomplishments (such as high scores across team lab day coding challenges). These accomplishments typically earned 3-5 coins, with (fewer) coins also awarded to runners-up.

An example of an in-class activity from early in the semester would be for the student to make

their name appear at a random location on the screen. Once completed, the student would raise his/her hand to show the instructor his/her app and earn their coin(s). More complex or time-intensive activities may be awarded 2 or 3 coins.

Bonus coins were also offered to students who identified errors in any of the course content, including grammar, typos, and code syntax mistakes. One particularly conscientious and gifted student spotted so many of these that she ended the course having earned 79 coins.

The instructor was able to be as creative as he/she wished when deciding how to offer and award coins. Coins could be offered to encourage students spending time and effort on any desired activity. If the instructor felt a particular activity was difficult or especially worthwhile, more coins could be offered to encourage its completion. Activities that mainly involved "just showing up" were typically rewarded with a single coin. Although each semester was similar, they were not identical as the total number of coins earned typically varied between 50 and 60 coins, with some students earning less and some on the high end earning more.

Keeping Track of Coins

For the coin reward system to work, students needed to be able to see when coins were awarded (or spent) and to check their current balance. To allow students to do so, the instructor developed a course access app (see Figure 1, located in the Appendix). Any time students logged in to check the course app and they had received (or spent) coins, it would count them up (or down) and play a little coin-pickup (or coin-spent) sound. The coin balance is saved so that, when the student logs back in, only the change in balance (either positive or negative) is visually counted while playing the appropriate sound effect.

The course access app is a Java desktop app that loads encrypted data from a secure server. The instructor used a database to manage student data during the semester and to provide the data to the course access app. Students were required to enter a semester access code to download and install the course app and to provide an individual password to use to access the grades portion of the app (Figure 1). The app loaded the most current data each time it was launched and, optionally, checked for updated content every 15 minutes.

Spending Coins

Students were allowed to spend their coins during the semester on a few "items" and at the conclusion of the semester on several more. For example, during the semester, students were able to purchase due date extensions for homework and take-home exams. These offers were typically distributed via email and/or with a notification in the course access app. The offers included details about the price (in coins) and the deadline to purchase the item. For example, roughly 24 hours before the due date for a take-home exam, students received an email with a specific offer (see Figure 2, located in the Appendix section). In this case, the price was 8 coins to purchase an extra 48 hours to complete the exam.

Items are priced consistently from semester-to-semester based on the number of coins offered to date for the class. The pricing is influenced by the perceived value of the item to the students and typically high enough to represent a significant expenditure. For example, in the email offer described in Figure 2, the price of 8 coins may represent close to half of the number of coins offered (i.e., that could have been earned) at that point in the semester and around 15% of the final total number of coins possible to earn.

This pricing was intentional, with the goal of making students value the coins they had earned while also encouraging them to work to avoid finding themselves in a position where they needed to spend coins. Through this, students may become more highly motivated to keep up with the reading, keep current on the homework, attend office hours right-away when they need help, and to start on activities and exams immediately (leaving time for unanticipated difficulties and time constraints).

Students may also spend their coins at the end of the semester at a themed "store" (either the "Wizard's Gift Shop" or the "Pirate Pizzeria Company Store," See Figure 3, located in the Appendix). For simplicity, the store is a paper-based system because the final coins and prices are not calculated until just before the final date. However, these prices and offers in Figure 3 are not a surprise to the student. They have been discussed in class during the semester and summarized in an email previewing the store's items at least a week in advance.

As shown in Figure 3, there are five main purchase opportunities: "erasing" an absence (which affects the student's course participation

score), dropping a team lab day score (just for the purchasing student), boosting a homework check score (in case there were problems they couldn't solve), exchanging coins for use in the other class, or buying credit on the final exam (up to, potentially, 100%). Although each is priced differently, they are scaled to have nearly the same impact in terms of affecting the student's final point total (so that the coins have approximately the same value no matter how they are spent).

4. RESULTS

The system was implemented in two different undergraduate programming classes at a private university in the United States. Overall, 104 students, 72 Male, 32 Female, utilized the coin counters and completed the survey. Throughout the semester, the number of coins the students earned ranged from 24-79 coins, with the average of 43.57 coins. Students spent between 11-65 coins during the semester, with the average of 34.47 coins. By the end of the semester, most students spent as many coins as they could. Only 9.10 coins on average were left unused.

In addition, a short questionnaire about the coin counter was offered at the end of the semester, with 104 out of 122 students providing responses (85%). The survey questions and item loadings are presented in Table 1 and detailed survey results are presented in Table 2, both located in the Appendix section. As can be seen in Table 2, the results of the coin-based gamification system were positively related to the classroom outcomes. In particular, the average for each construct (for example the average of items 1 and 2 for the fun scale) on a rating scale of 1-7 was 6.25 for fun, 4.63 participation, 5.65 for strategy, 5.83 for performance, 5.79 for control, 6.09 for motivation (item 16), and 6.50 for overall (item 19). Of note, the highest rating for item was for item 19, which was an indicator of if the students thought overall the coin system was a positive addition to the class. Additionally, students perceived the system as fun, providing motivation, helping with performance and control, and although it was related to increased participation, not at the same levels of the other constructs.

An open-ended question was also used to gather general feedback about the coin reward system. The majority of students responded positively to the usage of coin counters for the classroom and assignment management and wished other classes utilized the system. Examples of student comments included "the doubloon system was very rewarding and motivated me to do better and try harder to earn additional doubloons. I think every class should have a point system of some sort like this one. It gives the students an incentive to do better and try harder in every assignment that they do," "I like the system, it also takes away the discussion of extra credit work. Smart!," "I think it creates a fun environment in the class. Increases the competition!," and "I do think the doubloon system should be implemented in other classes. It was an incentive to attend class, especially with the ability to purchase absences at the end of the semester. Many students feel it is unnecessary to weigh so much of one's grade on absences, since the harm is being done to the student for not attending rather than the professor (missing classwork, class participation, notes, etc.); hence, reflective in their grade. Therefore, as professors have controlled how effective absences are in one's grade, the doubloon system offers students to regain control of the impact."

Many students mentioned that the coin counter may help them focus more on learning and less on just finishing the work to meet the deadline. For example, "I liked having the flexibility of erasing absences and getting extra time where needed. I'm not sure how much it motivated, but it does allow me to focus on material and not worry so much about other things going on (deadlines and such)," "[The coin counter] helped students with completing assignments without penalization by purchasing extensions. Life happens and sometimes things aren't done within the timeline one sets for themselves to complete tasks," and "It definitely reduced my stress a bit knowing that I could trade in some doubloons for final grade points. Overall, a very wise, thoughtful and fun approach to a programming class."

As mentioned in some of the previous comments, the coin counters also added a fun factor to the classroom management. Additional feedback included "I loved the doubloons! It definitely made the class more enjoyable," "The [coin counter] gives students [sic] the incentives to do more but in a fun way than just saying extra credit," and "I really enjoyed the system and loved checking to see my total."

A number of students reported increased participation and class involvement because of the coin counters. For example, "I liked the galleon system. It motivated me to participate more on optional in class activities and got me

engaged," "I think the galleon system is a great system to motivate students to come to class and to do their class work. I think most students would be more interested in the class if the galleon system was provided," "I think the doubloon system was excellent. The members of my group had regular discussions on how would we spend them and we looked forward to the trophies to get extra doubloons," and "I would like to see a reward based point system more often in other classes. It gives some more incentive to come to class and to participate in activities."

When asked about what could be improved, a few students would like to know the prize options and costs of what they can purchase with their coins in order to plan their semester accordingly. Example of comments include "I liked the concept of having a sense of control in my grade. It would have been nice to have known the values and the things you could buy at the beginning of the semester," "I wish the things you could buy would be announced before than it was. It did not have to include the prices, but I would have like to know exactly what I could earn during the semester and at the end so I would know if I should save up for something better later on or spend it now," and "I would have liked to know at the beginning of the semester how much things would cost at the end, and what opportunities we would have to spend doubloons. This would have allowed me to calculate/plan for how I would like to spend them. I would have liked to be able to see how spending doubloons on various things would impact my grade. It was not easy to figure out where the best use of doubloons was to most effectively help my grade."

5. DISCUSSION

The results provided evidence that students responded well to the currency-based classroom management system. As can be seen in the quantitative survey results in Table 2, overall the students responded that positively for all items. With that being said, student perceptions of the coin-based gamification system as being fun and helping performance were the highest rated constructs, whereas participation was the lowest. The open-ended survey question also provided qualitative data on student reactions, which was again positive.

Overall, the quantitative and qualitative results provide evidence of the positive outcomes associated with the coin-based gamification classroom management system. Although we feel confident that the coin-based gamification system described in this paper was related to desired outcomes, we did not have a control group to compare against. If future classes and pedagogical research efforts would like to employ a control group, this would provide additional strength in our findings.

Although it is not something that can be seen in the results, there were a few different primary strategies that students employed with their collecting and spending their coins. In terms of collecting coins, some students (e.g., those who were higher in achievement-orientation) wanted to collect every point possible as it served as motivation for them. Other students were motivated to collect some coins, but did not capitalize on every coin collecting opportunity as they were content to have a decent number of coins. As for spending coins, some students get behind on their homework and have to use most (if not all of their coins) for due date extensions. Other students stay current on all of their work and save all of their coins (hoarding them). These students then end up using most of their coins on the final exam for extra points, or even buying it off completely if they have enough coins. As noted above, it would likely help all students, especially the hoarders, if they knew early in the semester what they could spend their coins on at the end of the semester. This is an enhancement that we recommend for future instructors using this type of classroom management system.

Students also saw the system as a fair way to receive (purchase) help where they specifically needed it. The coin system created an in-class economy of sorts, in which coins were a fungible resource to be spent as each student wished. For example, in some classes the professor will offer to drop the lowest quiz score. This is a generous policy, however, it doesn't benefit students who do great on all of the quizzes. Some of these students may benefit instead from extra time on a project, having an absence erased, or dropping the low score on a team activity. The system of virtual coinage allows students to make these decisions as individual, rational actors.

Another set of findings relates to the impact of this coin-based gamification system on the instructor. In terms of positives, the instructor believed that students enjoyed the gamification system and performed better in the class. Additionally, there was less complaining and haggling when compared to a traditional classroom management system. With the coin-based gamification classroom management system, students knew how to earn the currency

and how it could be spent (e.g., on due date extensions). As a result, there were fewer specious requests and arguments about due date extensions, extra credit, 'excused' absences, and such, which are otherwise so common.

Although there were advantages for the instructor, we must also acknowledge some of the downsides of this system. First, in terms of developing and setting up the system, there was a considerable investment of time. There was significant amount of programming involved, which we acknowledge that many instructors would be unable to perform themselves. For those that can do the programming, time is required to set up the system, forms, write up documents, and more. After the system is set up, there is a time commitment exerted with managing the system. Emails, such as the one shown in this paper, are sent to students and then students respond with personalized emails. Based on these personalized emails, there are likely to be different due dates for different students. Again, while this appears to clearly benefit students, it requires the instructor to manage more complex information, which would be more difficult as class-sizes increase.

For instructors looking at using such a system, it is important to realize that there are definite pros and cons. Students responded positively to the system, but there were enhancements that could be made on the instructor's end. One enhancement that was also mentioned in the open-ended comments relates to better information about what coins can be spent on at the beginning of the semester. This will better enable students to develop a strategy about how to optimally spend their coins throughout the semester. Hopefully future research will examine the impact of a similar type gamification system with more full information available for students at the beginning of the semester. Another suggestion for instructors is to take a long-term perspective with using this gamification classroom management system. There is a high initial time investment to setting up this system, but there is less time involved in future semesters using the same system. Also, if an instructor was able to automate the process of using the coins (i.e., clicking an online button as opposed to emailing the instructor) that would save the instructor considerable time. Finally, there could be sharing of resources between instructors to get the system up and running. As there is not always the need to "reinvent the wheel", there could be a considerable benefit to utilizing and even enhancing another instructor's existing system.

6. CONCLUSION

With student expectations changing and the increased popularity of gamification in a number of different aspects of life, this paper described a coin-based gamification classroom management system. The high level goals for this system were improved student engagement, enjoyment, and better management classroom expectations. The results showed that there were a number of benefits for students and they responded positively about the system. In particular, students thought the gamification classroom management system was fun, helped their classroom performance, increased perceptions of control, and helped with class strategy. There were also good points of the system for instructors, but there were some negatives that must be acknowledged, primarily related to the amount of time spent on the system. This paper provides suggestions for future pedagogical research on this topic, ideas for enhancing the system described in this paper, and recommendations for future researchers who might be considering using a coin-based gamification classroom management system.

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APPENDIX

Figure 1 Student individual interface showing overall performance and Galleon balance (Highlighted in red)

To: Student
From: Instructor
Date: Today, 8:30 PM
Subject: A Special Offer

Even though it is a virtual currency, the urge to spend your galleons can be ferocious. What should you buy with it? They say the only valuable commodity in life is time. When at work we trade our time for money, an exchange that often only makes the IRS happy. In any case, if you are struggling on your Exam 1 (due by class time tomorrow), I have an offer for you: For a measly 8 Galleons you may stretch the due date an entire 48 hours (to Thursday before class) without any late penalty.

This offer expires at 8AM tomorrow. Email me before 8AM if you want buy time by purchasing the Exam 1 deadline extender.

Figure 2 Example of offer notification

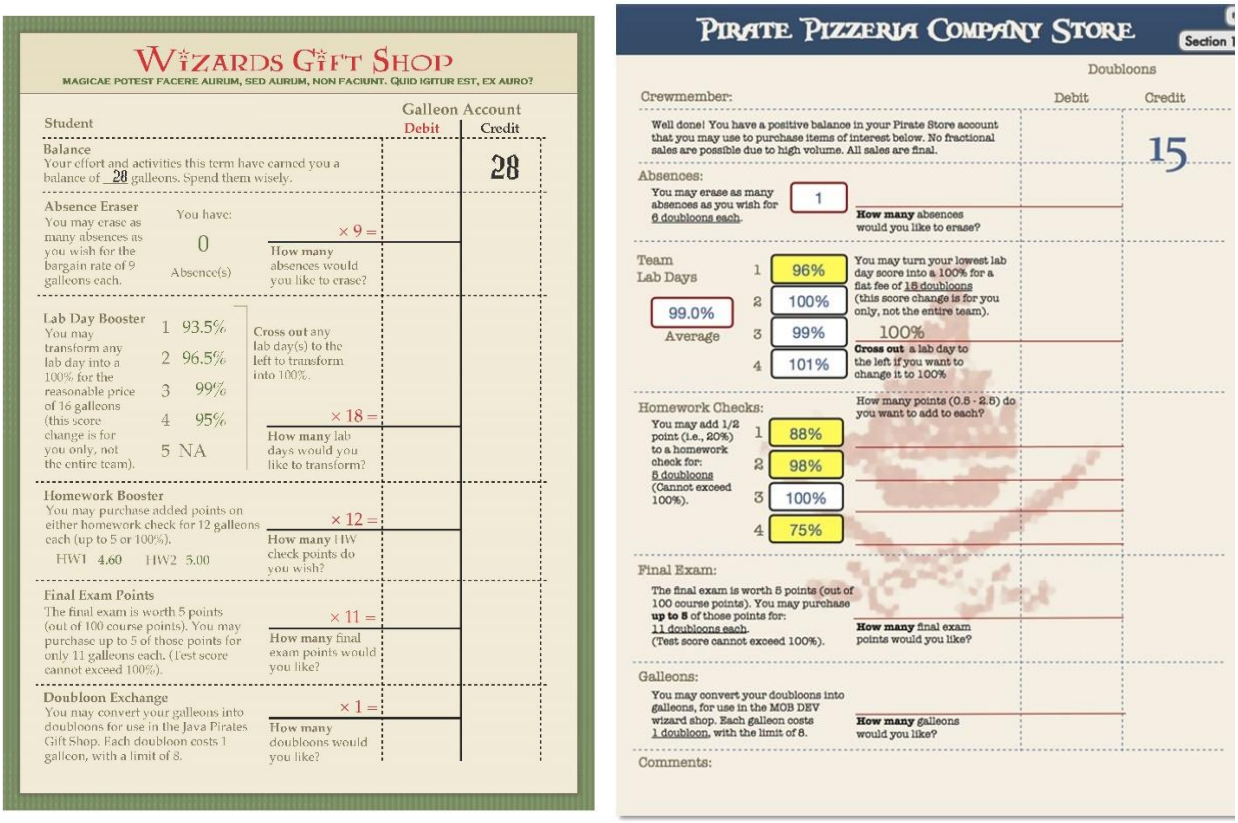

Figure 3 Themed Stores

Factor/Items	Cronbach's/ Item Loading
COMPUTER PROGRAMMING POSITIVITY	**α = 0.792**
I find the idea of developing apps: Boring (1) – Exciting (7)	0.079
Working with computers is: Frustrating (1) – Enjoyable (7)	0.043
FUN	**α = 0.660**
1. I enjoyed earning coins	0.554
2. It was fun to check the course app and see how many coins I had earned	0.792
PARTICIPATION	**α = 0.718**
3. I attended more classes than I otherwise would have in order to earn more coins	0.718
4. I would have skipped a relevant extra-curricular activity if coins had not been offered as a reward	0.537
5. The galleon system encouraged me to participate more fully in this class than I otherwise would have	0.631
STRATEGY	**α = 0.711**
6. I thought it was important to earn all of the coins I could	0.684
7. I had a clear strategy in terms of how I planned to use my coins this semester	0.595
8. I managed my coins well this semester	0.652
9. I gave this class 100% of the time and effort I needed to be successful	0.644
PERFORMANCE	**α = 0.762**
10. I expect to earn a higher grade in this class due to my use of coins	0.000
11. Being able to use my coins to purchase items I needed boosted my performance in this class	0.459
CONTROL	**α = 0.459**
12. The coin system gave me a sense of control over my course grade	0.280
13. The coin system was a fair way to receive credit where I most needed it	0.525
14. Coins were distributed in an equitable manner to all students in this class	0.319
15. The coin system allowed me to be more flexible with my time and effort in this class	0.419
Others	
16. I was motivated to do well in this class 17. I planned to use my coins as needed during the semester 18. I planned to save my coins until the end of the semester 19. Overall, the coin system is a positive addition to this class	N/A

Table 1 Survey questions and item loadings

Item	Mean	SD	Survey responses (1=Strongly Disagree; 7=Strongly Agree)												
			1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7
1 Fun	6.36	0.82	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.8%	0.0%	9.6%	1.0%	31.7%	0.0%	53.8%
2 Fun	6.14	1.06	0.0%	0.0%	1.9%	0.0%	0.0%	0.0%	6.7%	0.0%	10.6%	0.0%	34.6%	1.0%	45.2%
3 Participation	4.44	1.98	4.8%	0.0%	20.2%	0.0%	10.6%	1.0%	14.4%	0.0%	8.7%	1.9%	16.3%	1.0%	21.2%
4 Participation	4.32	1.76	5.8%	0.0%	15.4%	0.0%	7.7%	0.0%	24.0%	1.9%	17.3%	0.0%	14.4%	0.0%	13.5%
5 Participation	5.13	1.57	3.8%	0.0%	5.8%	0.0%	4.8%	0.0%	11.5%	1.0%	22.1%	1.9%	30.8%	1.0%	17.3%
6 Strategy	6.02	1.08	0.0%	0.0%	1.0%	0.0%	2.9%	0.0%	3.8%	0.0%	18.3%	0.0%	33.7%	0.0%	40.4%
7 Strategy	5.18	1.74	1.9%	1.0%	9.6%	0.0%	7.7%	0.0%	6.7%	1.0%	20.2%	0.0%	23.1%	1.0%	27.9%
8 Strategy	5.71	1.33	1.0%	0.0%	2.9%	0.0%	3.8%	0.0%	6.7%	0.0%	18.3%	1.9%	33.7%	0.0%	31.7%
9 Strategy	5.68	1.37	1.0%	0.0%	4.8%	0.0%	4.8%	0.0%	1.9%	0.0%	17.3%	0.0%	42.3%	1.0%	26.9%
10 Performance	5.96	1.17	1.0%	0.0%	1.0%	0.0%	1.9%	0.0%	4.8%	0.0%	19.2%	0.0%	32.7%	0.0%	39.4%
11 Performance	5.69	1.24	1.0%	0.0%	1.9%	0.0%	2.9%	0.0%	7.7%	1.0%	20.2%	1.0%	36.5%	0.0%	27.9%
12 Control	5.69	1.10	0.0%	0.0%	1.0%	0.0%	3.8%	0.0%	7.7%	1.9%	20.2%	1.0%	40.4%	1.0%	23.1%
13 Control	6.30	1.09	2.0%	0.0%	0.0%	0.0%	2.0%	0.0%	1.0%	0.0%	4.9%	0.0%	36.3%	2.0%	52.0%
14 Control	5.79	1.21	1.0%	0.0%	0.0%	0.0%	5.8%	1.0%	4.8%	1.0%	15.4%	0.0%	41.3%	0.0%	29.8%
15 Control	5.36	1.32	1.9%	0.0%	2.9%	0.0%	2.9%	0.0%	14.4%	1.9%	17.3%	0.0%	43.3%	1.0%	14.4%
16 Other	6.09	0.96	0.0%	0.0%	0.0%	0.0%	2.9%	0.0%	3.8%	0.0%	12.5%	0.0%	42.3%	1.0%	37.5%
17 Other	4.85	1.84	3.8%	0.0%	15.4%	1.0%	2.9%	0.0%	14.4%	1.0%	10.6%	1.0%	30.8%	1.0%	18.3%
18 Other	5.94	1.27	1.0%	0.0%	1.9%	0.0%	2.9%	0.0%	3.8%	1.0%	19.2%	0.0%	26.0%	1.9%	42.3%
19 Other	6.50	0.71	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.9%	0.0%	6.7%	1.0%	28.8%	1.0%	60.6%

Table 2 Student responses to survey questions