Journal of the Scholarship of Teaching and Learning, Vol. 15, No. 6, December 2015, pp. 48-62.
doi: 10.14434/josotl.v15i6.18988

Uptake of Optional Activities Leads to Improved Performance in a Biomedical Sciences Class

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Abstract: Optional (non-assessed) learning activities are a learning tool that may help students achieve their desired grade, or help students with lower levels of previous experience in the topic. This study examines the implementation of, and outcomes from, two optional activities, one online and one paper-based. The activities complemented the lectures and practical (laboratory) classes and were designed to give students additional practice with the key concepts. It was predominantly the most ambitious students who engaged with the activities. Those students who engaged with the activities achieved a higher mark relative to their mark in a comparable prerequisite class. The students strongly preferred the paper activities, and although they would like both online and paper options to be available, they would not be willing to pay a small fee for the online activity.

Keywords: Online, learning resources, engagement, genetics

Introduction

In many courses/subjects, formative activities or other study resources are provided to supplement the lectures and the practical (laboratory) classes. The provision of an array of study resources is known to result in better learning outcomes as it allows students to have choice in their study strategy (De Vita, 2001; Inglis, Palipana, Trenholm, & Ward, 2011). This blended learning and teaching environment supports academic success and has been increasingly utilised as the student cohorts become more heterogeneous (McKenzie & Schweitzer, 2001). Optional (non-assessed) assessments have the added advantage of providing students with control and autonomy over their learning and this increases their intrinsic motivation to study (Cook, 2001). Formative assessments that provide timely feedback have positive effects on learning outcomes (Gibbs & Simpson, 2004; Shaya, Petty, & Petty, 1993).

Online activities as additional resources

One tried and tested option is the provision of online resources such as practice exercises, as these come with a plethora of advantages including ease of providing feedback (Collis, De Boer, & Slotman, 2001), a user-defined learning pace (Sherman, 1998) and an opportunity to repeat assessments. Online assessments are especially useful for larger classes, in particular if the online resource is capable of providing immediate formative feedback in the form of breaking down a problem or providing hints. Setting formative online assignments encourages students to take ownership of their own learning and to monitor and reinforce their individual level of understanding.

Despite the inherent advantages of formative assessments such as online activities (McKenzie & Schweitzer, 2001), student participation in optional exercises is usually much

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lower than for compulsory assessment tasks. Surprisingly, in a study of a large cohort 1st year economics subject, it was found that only the weaker students chose to attempt the practice online tests, and as a result they significantly outperformed those who opted not to take the optional tests, suggesting that some students can successfully self-select for their needs (Sly, 1999). Interestingly, if given a choice of resources, the students who most use them only show high use of one of the available learning resources (Inglis et al., 2011). Major reasons stated for not using the resources are lack of time, motivation, or awareness of the formative resources, and the most curious reason of all, that they are reserving the resources for revision (Peat & Franklin, 2003).

Optional activities were included in this subject to provide flexible learning

The authors teach a 2nd year Genetics subject in an undergraduate Bachelor of Biomedical Science degree at a large Australian University. Due to flexible university entry requirements, there is a huge apparent disparity when it comes to the students' prior knowledge of genetics when entering this degree. Ensuring that all students are sufficiently equipped to achieve all the learning outcomes of the degree is a widely acknowledged challenge for instructors, especially in foundation subjects (Yeoh & Md Yunus, 2013). Additional activities are one solution to assist the students who are less well prepared and therefore serve to narrow the gap. Furthermore, a range of carefully designed optional modules not only helps students understand the study material better but also caters for the oft-neglected group of high achieving students, as it provides the opportunity for these higher-end students to be stretched. The 2nd year Human Genetics class BMS2042, comprising 229 students, was used to assess the impact of implementing two forms of optional study resources. The pre-requisite class for this subject is Molecular Biology, BMS1062.

The first optional resource was the online Pearson Education product MasteringGenetics™ (MG), which was packaged with the prescribed textbook and made available to all students free of charge via the Learning Management System (LMS), Moodle. The software asks questions, supplemented with animations, images, tutorials and videos and provides hints if needed; it even directs the students back to relevant figures or text in the textbook for reinforcement of concepts (Rayner, 2008). The multimedia aspect of MG was designed to provide enjoyable learning. MG questions were grouped into modules. The questions were selected to support the topics and concepts in lectures, and some of the modules provided sections of different difficulty levels so that students could attempt them based on their own identified level of understanding. This was designed to motivate the more experienced students to try the modules. The online modules were open to the students once the associated lectures had been delivered and students could re-attempt the questions as many times as they wished throughout semester. The software is programmed to provide immediate feedback and online coaching to help the students in their learning.

The second optional resource was optional problem sets (OPS) that were incorporated in hard copy into the practical (laboratory) manual for every practical except for the first one. There were six OPS, closely following the concepts covered in each practical, which were also aligned with the lectures. There were no sections of differing difficulty. Students were advised to answer all the questions. Students could answer these question sets in their own time, and as long as they showed evidence of having attempted them would receive hard copy model answers and face to face assistance if required. Just prior to their mid semester test, all model answers were made available in softcopy on the LMS. For students who made the effort, the model answers would give them meaningful and timely feedback on their understanding of the material covered in lectures and practicals. Both the MG and OPS were additional activities and were not assessed.

Research Aims:

The aim of this project was to establish whether 2nd year genetics students would engage in these optional activities and whether the activities provide measurable improvements to their grades in this subject. As the optional activities were presented in two separate modes (online and hardcopy) but on similar topics, it would be of interest to establish which was the preferred activity.

Methods

The six Optional Problem Sets (OPS) were available semester-long in the students' practical manual, but were placed with the practical class information for each week in weeks 2 – 7. The answers were provided week by week in hard copy in the laboratory classes, or by soft copy on the Learning Management System (LMS) a week before the mid-semester test (Figure 1). The seven MasteringGenetics™ (MG) modules were released sequentially as the lecture content was covered, but they remained open until the exam.

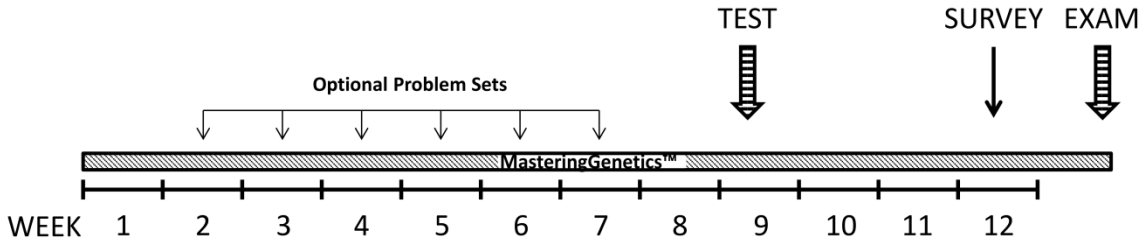

Figure 1. Timing of optional tasks during semester. There were six Optional Problem Sets. The Mastering Genetics modules were released throughout semester, and were available for revision. The major assessments were a mid-semester Test and a final Exam. The survey used in this study was administered in class in week 12 (see *Appendix*).

The survey was paper-based and administered in class in the final week (week 12). Of the 229 students enrolled, 63% completed the survey. 63% gave permission for us to examine their marks, 58% for examining their marks in the prerequisite class (BMS1062), and 62% for examining their engagement with the two activities. Survey questions used a five-point Likert scale (see *Appendix*).

The students' levels of engagement with the optional activities were coded. For MG, accessing 0-1 out of the seven modules was given 'none' for engagement, 2-4 modules was described as 'moderate' and 5-7 modules qualified as 'high'. For OPS, using 0-1 of the six was given 'none' for engagement, 2-4 was described as 'moderate' and 5-6 qualified as 'high'. Overall engagement was taken as a rough average of these two.

Mann-Whitney U tests were used to analyse differences in the means of distributions of student marks (*Md* = median). Wilcoxon-signed rank tests were used to compare the paired data sets of the marks each student achieved in two different classes, and to compare the answers that each student gave to different survey questions in order to identify patterns in their opinions. For the survey answers, means and standard deviation (SD) are presented because medians are not a meaningful representation of a five-point Likert scale. Chi-squared goodness of fit tests were used to compare the activities of groups of students. IBM SPSS Statistics 22 and Microsoft Excel 2010 were used for statistics. Graphpad prism was used to prepare graphs.

Results

Previous experience with genetics did not determine levels of engagement with activities

From comments and discussions with students in previous years, it was suspected that the students enter this class with different levels of experience in genetics. On the survey that was administered at the end of this class, 74.5% of the 145 students reported that they had done VCE units 3 and 4 Biology or equivalent (Biology classes from the final year of Victorian secondary schooling). These Biology subjects contain a large focus on genetics, so there are many students in this class who have significant experience in the topic. Notably, 18.6% reported that they had no previous knowledge of genetics from any source. It is vital to consider this important minority of students with no previous experience, when teaching the subject. These students would be expected to benefit most from additional practice in the fundamental concepts of genetics. However, of these 27 students, 8 showed no engagement with the activities, 12 showed moderate engagement and only 7 high engagement (Table 1). There was no significant difference between the engagement levels of the inexperienced students compared to the more experienced students, $\chi^2(2, n = 27) = 0.75$, $p < 0.69$. Interestingly, there was also no significant difference between the marks of those with prior experience in genetics ($Md = 75$, n = 111) and those who reported no prior experience ($Md = 75.2$, $n = 23$) by a Mann-Whitney U test ($U = 1259.5$, $z = -0.1$, $p = 0.92$). This analysis was performed on the 63% of students who completed these questions, as only these students could be defined by experience level.

The students were highly varied in the level they engaged with the optional activities

There was very mixed engagement of the students with the activities. Coding their levels of engagement revealed that 34% of the students did not engage at all with either activity (Table 1). Contrary to expectations, the level of engagement with the Optional Problem Sets (OPS) was much higher than with MasteringGenetics™ (MG), although there is no way of verifying that those students who accessed the OPS answers on the LMS were actually attempting the problems. A chi-squared goodness of fit test was used to examine whether it was the same keen students who were engaging at a high level with both the OPS and MG, but this test revealed a large and significant difference, $\chi^2(2, n = 144) = 31.08$, $p < 0.0001$***, indicating that individual students tended to engage with just one activity rather than both (Table 1). Interestingly, the pattern of engagement with the activities shows a clear bimodal distribution for OPS and a clear bimodal distribution for MG (Table 1).

Table 1. Percentage of students showing engagement levels with OPS and MG.

Engagement level *n* = 145	**Modules attempted of MasteringGenetics™**		**Answers accessed* for Optional Problem Sets**		**Overall engagement**
none	0-1	58.3 %	0-1	36.8 %	34.1 %
moderate	2-4	9.7 %	2-4	10.4 %	28.2 %
high	5-7	31.9 %	5-6	52.8 %	27.1 %

* Accessing the answers only in the four hours preceding the practical test was not counted.

There were some interesting patterns of activity. 20% of the students downloaded the OPS answers on the day of the mid-semester test between 12 noon and the test time at 4pm. 15 of these students downloaded three or more of the OPS answers in this time. As the OPS were

designed to help them specifically with the concepts covered in the mid-semester test, this suggests last minute or desperation studying, rather than a productive use of the optional activities. Learning analytics did not allow us to collect similar data for MG. In several of the MG modules, advanced questions and simpler questions were provided along with the standard questions. For these modules, there were 209 attempts of the standard level questions, 80 attempts of the advanced questions, and 94 of the simpler questions. This is interesting, as it suggests that the students are using the modules for different things, either catch up, revision or extension.

The students had unrealistic aims for their grades

On the survey at the end of the semester, before the final exams, the students were asked what final grade they were aiming for in this class. It is worth noting that this sort of direct question is fraught with bias, as the answer can be quite personal (van Dinther, Dochy, & Segers, 2011). As the students had already received 40% of their assessment marks at this stage, most students should have had a reasonable estimate of their attainable final grade. However, the distribution of grades that the students intended to achieve was far higher than what they did finally achieve (Table 2). 84 of the students aimed for a High Distinction (the highest grade) and only 50 of them achieved it. Of 134 students, 50% of the students achieved their intended grade, 47% scored lower, and 3% scored higher than the mark they were aiming for. Of the four students who scored higher, none showed low engagement with the optional activities.

Table 2. Percentage of students achieving specific grades.

n = 134	**High Distinction 80-100**	**Distinction 70-79**	**Credit 60-69**	**Pass 50-59**	**Fail <50**
Aiming for this grade*	62.2 %	29.6 %	6.7 %	1.5 %	0
Achieving this grade*	37.0 %	29.6 %	20.0 %	10.4 %	3.0 %
High engagement students with this grade (n = 39)	64.1 %	17.9 %	12.8 %	2.6 %	2.6 %
Moderate engagement students with this grade (n = 49)	32.7 %	34.7 %	20.4 %	12.2 %	0
Low engagement students with this grade (n = 46)	19.6 %	34.8 %	23.9 %	15.2 %	6.5 %

* Only students with both grade and intended grade were included.

Students who engaged highly with the activities were more likely to achieve their desired grade

As would be expected, the number of students achieving a high grade was greater for the students with moderate or high engagement with the optional activities (Table 2). A chi-squared goodness of fit test indicates that there is a large and significant difference between the distributions of grades achieved by students of low or moderate levels of engagement when compared to the distribution of grades achieved by the students with high engagement, $\chi^2(7, n = 92) = 89.8$, $p < 0.0001$***. This analysis shows that engagement with the activities correlates with higher grades. It either indicates that a higher level of engagement resulted in higher

marks, or that the students who achieve high marks also tend to be the ones who are engaging with the activities.

As these activities are within the students own control, it was of interest to examine their intended grade along with their engagement. It might be expected that each students' level of engagement would correlate with whether they achieved their intended grade. Indeed, of the 39 students who had high engagement, 66.7% scored their intended grade or higher, while only 43.5% of the 46 low engagement students scored their intended grade or higher (Table 3). A chi-squared goodness of fit test indicates that the students scoring lower than they intended had a significantly different pattern of engagement with the optional activities compared to the students achieving intended or higher scores, $\chi^2(3, n = 87) = 10.0$, $p = 0.0016$**. Indeed, 42% of the 62 students who scored lower than their desired mark had low engagement with the optional activities and only 21% had high engagement; in comparison, 28% of the 71 students achieving their desired or higher mark had low engagement, 37% of them high engagement and 35% had moderate engagement. These data show that students who did not achieve as planned tended to be less engaged with the optional activities than those who did achieve.

Table 3. Percentage of students of different engagement levels scoring their intended grades.

Level of engagement with optional activities *n* = 134	**Scored higher grade**	**Scored intended grade**	**Scored lower grade**
% of high engagement students (n = 39)	2.6%	64.1%	33.3%
% of moderate engagement students (n = 49)	6.3%	45.8%	47.9%
% of low engagement students (n = 46)	0	43.5%	56.5%

Only students with both grades and intended grade included.

The students who engaged highly with the activities showed a significant increase in their numerical marks

One of the key questions when introducing learning activities, assessed or optional, is whether the use of the activities improves the students' outcomes. In this study, rather than use a concept inventory, the total marks from the class were chosen as a readout of student success. This is, after all, the result that the students are focused on improving, and the aim of the intervention was to provide students with the opportunity to improve their final mark. The optional activities are also closely aligned with the summative assessments in the class, and so an increase in marks should represent an increase in the abilities on which the optional activities focused.

To ask whether the optional activities improved the students' final mark, the students' marks in this class (in 2013) were compared to their marks in the prerequisite class (BMS1062) in 2012. Students who failed this class in 2013 were excluded from this comparison. This provided us with comparisons for 113 students out of 144 in total (78%). To verify that this is a representative subset, a Mann-Whitney U test was used to demonstrate that there is no difference in the range of marks between these 113 students and the total class for either the prerequisite class ($Md = 76$, $n = 113$ compared to $Md = 75.5$, $n = 118$, $U = 6533$, $z = -0.264$, $p = 0.792$) or this class ($Md = 77.5$, $n = 113$ compared to $Md = 75.2$, $n = 135$, $U = 7098$, $z = -1.055$, $p = 0.291$).

A Mann-Whitney U test determined that the students with high engagement ($n = 33$, $Md = 82.6$) had significantly higher scores in this class compared to those with low engagement ($n = 37$, $Md = 74.1$, $U = 268.5$, $z = -4.0$, $p < 0.0001$**). This data cannot be taken in isolation, however, as the students who showed a high level of engagement within this class also showed

significantly higher marks in their prerequisite class (n = 33, Md = 80), when compared to those who showed no engagement (n = 37, Md = 72, U = 379, z = -2.7, p = 0.006**). To remove this confounding factor, the marks achieved by the low engagement students in the prerequisite class were compared to their marks in this class using a Wilcoxon signed-rank test, and the same comparison was carried out for the high engagement students. The marks of the low engagement students in the prerequisite class (n = 37, Md = 72) were compared to their marks in this class (Md = 74.1) and no significant difference was seen (z = 0.975, p = 0.33). However, when for the marks of the high engagement students in the prerequisite class (n = 33, Md = 80) were compared to their marks in this class (Md = 82.6), it was clear that their marks in this class were significantly higher than in the prerequisite class (Wilcoxon signed rank test, z = 2.084, p = 0.037*). This test identified a medium effect size (r = 0.256), and an increase of the mean by 2.3 marks. There was insufficient statistical power to examine whether it was engaging with the OPS or the MG that contributed most to this increase in marks.

The students who did not engage with the activities thought they were too much work

To understand how the students responded to MG a survey was administered to the students about their experiences (Figure 2). Of the 145 respondents, 44% replied that they did none of the MG modules, 23% did 1-2, and 33% did more than 2 (data not shown). The students who did no MG modules were asked to answer questions 6 and 7. Indicating a low level of care with reading instructions, 13 students who reported doing 1-4 of the modules also answered these questions. Including these students in the data, 47% of these 74 students agreed that they did not do the MG assignments because they were not assessed for marks, but the distribution of their answers on the 5-point Likert scale is quite broad, with a mean of 3.2 ± 1.2 (SD). When asked if they did not do MG because it looked like too much work, 35% were neutral, and 46% disagreed, giving a very central and broad distribution with 2.6 ± 1.0 (SD), suggesting this is not the only reason. The survey asked the students why they did not do the OPS (Figure 2, Questions 20 and 21), but again, 7 students answered these questions despite doing some of the OPS. The answers of students who did 5-7 of the OPS were excluded for analysis. Of the remaining 37 students, 65% agreed that they did not do the OPS because they were not assessed for marks. 64% also agreed that they did not do the OPS because they looked like too much work.

Responses to the online MasteringGenetics™ modules

81 of the 145 respondents reported doing at least some of the MG modules. The survey asked questions about the usability of the program as it was presented to students (Figure 2, Questions 8-18). The responses to MG were overall very positive. 90% of the 81 students found MG easy to use, 86% found MG easier to use because it was integrated with the LMS (Moodle), and reported that integrating MG with the LMS made them more likely to use it (means of 4.3 ± 0.6, and 4.3 ± 0.8, SD). 81% of the students agreed that MG helped them understand the concepts in the lectures, and 74% the concepts in the practicals (means of 4.1 ± 0.7 and 4.0 ± 0.8, SD). Interestingly, when asked if they would have done more MG if they were assessed, 70% agreed, and when asked if they would have done more if they had more time, 88% agreed. This cohort of students tends to be very motivated by marks, so questions were included that asked whether they thought that MG helped them gain a better mark in the mid-semester test, and whether they thought that MG would help them in the final exam. For the mid-semester test, referred to as the prac test in the questionnaire, 43% agreed, and 46% were neutral (mean of 3.5 ± 0.9). For the final exam, however, 63% agreed, and 36% were neutral (mean of 3.8 ± 0.8). This is not unexpected as MG is mainly designed to support the lectures (assessed in the

final exam) rather than the practicals. 88% agreed that MG is a useful revision tool (mean 4.3 ± 0.7). It was surprising however, that 68% of the students disagreed that they would have done the MG assignments if they had to pay a very moderate fee of $30. Indeed, when all students were asked, 60% of 140 agreed that they would only pay $30 for MG if it were assessed for marks. This distribution had a very wide spread, as 34% disagreed with this statement and the mean was 3.6 ±1.4. 60% recommended that MG should be used in this class, with 35% remaining neutral.

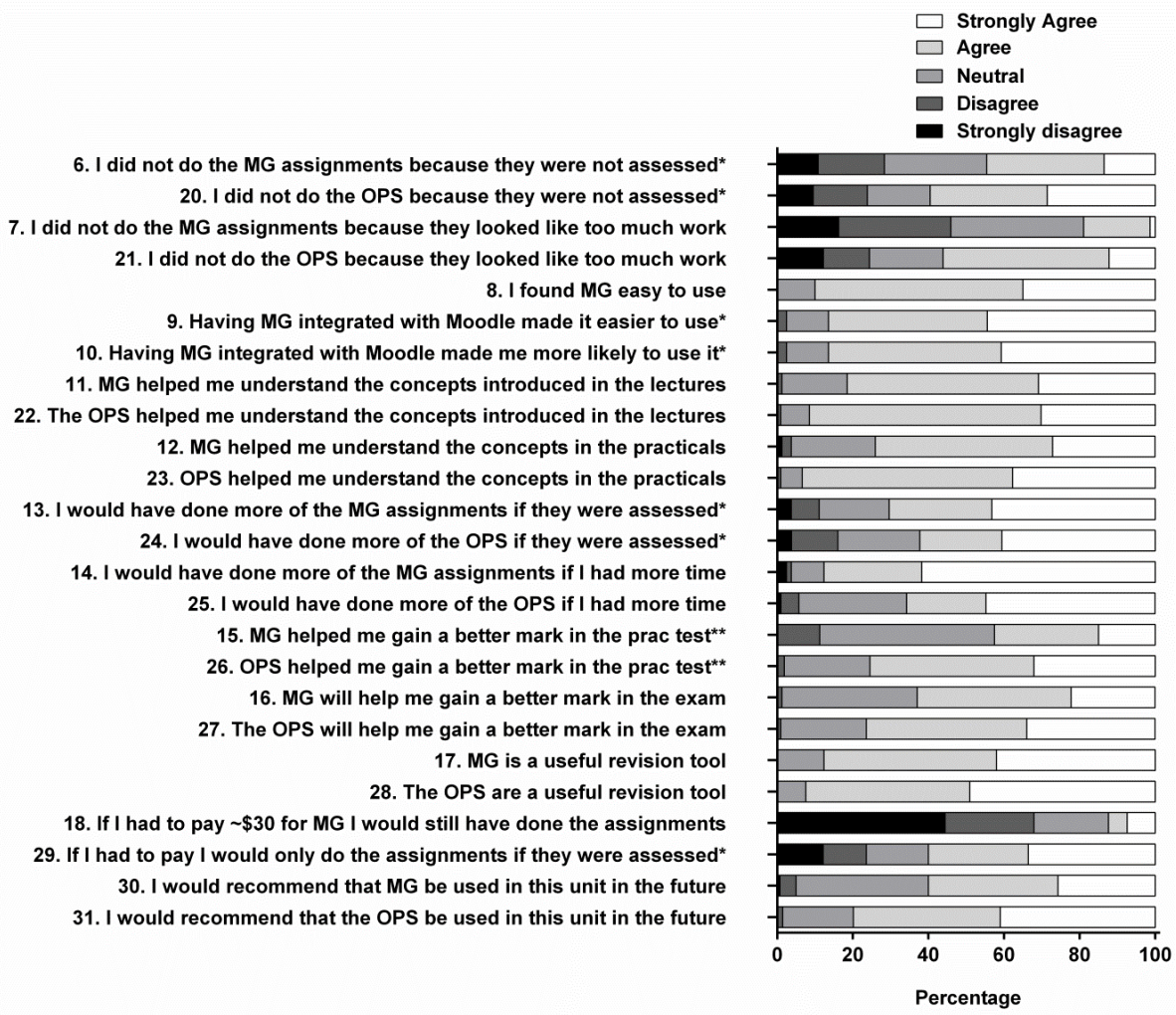

Figure 2. Responses to the survey on the 5 point Likert scale. Students who did not do the optional activities were asked to answer Questions 6,7,20,21. Students who did the optional activities were asked to answer Questions 8-18, 22-28. All students were invited to answer questions 29-31
* question shortened for figure. Full length question is available in the *Appendix*.
** The mid-semester test is referred to as the prac test

Responses to the paper-based Optional Problem Sets

Of the 141 respondents, 75% reported doing at least one of the OPS. 41% reported doing all 7 of them. The survey asked the students how useful they found the OPS (Figure 2, Questions 22-29), and a very large 91% of 106 respondents to this question reported that the OPS helped

them understand the concepts introduced in the lectures, and 93% the concepts in the practicals. There was no statistically significant difference between their answers for these questions for the MG and the OPS with a Wilcoxon signed rank test (z = -0.165, p = 0.869, z = -1.781, p = 0.075). Their responses to whether they would have done more OPS if they were assessed were very broad. 62% agreed, but 22% were neutral and 16% disagreed, with a mean of 3.8 ± 1.2, and their responses were not significantly different for the MG (z = 1.413, p = 0.158). Again, 65% students agreed that they would have done more if they had more time, but 28% were neutral and 6% disagreed, with a mean of 4.0 ± 1.0. 75% of the students were of the opinion that the OPS helped them get a better mark in the mid-semester (practical) test, and 72% in the exam (with a mean of 4.1 ± 0.8 for both). In fact a significantly higher number of students felt this for the OPS compared to the MG (z = -4.576, $p < 0.001$** for mid-semester test, z = -2.046, p = 0.041* for the exam). 92% agreed that the OPS are a useful revision tool (mean 4.4 ± 0.6), with no significant difference in their answers about MG (z = -0.19, p = 0.985). 80% of 139 respondents to this question recommended that OPS be used in this class in future, and this was significantly higher than the recommendation for MG (z = -4.484, $p < 0.001$**). When asked which of the activities should be used in the future (Figure 2, Questions 30 and 31), 76% recommended using both MG and OPS. 15% recommended only OPS, and only 6% recommended MG alone. 4 recommended neither be used. Even students who strongly favoured one optional activity over the other recommended that both should be provided.

Discussion

The optional activities provided in this unit are useful to students who take the effort to utilise them. This study has clearly shown that the students who engaged with the activities gained a boost to their final mark when compared to their mark in the pre-requisite course. This is consistent with another study, which found that optional activities can improve the marks of the students who engage with them (Buchanan, 2000). Inherently, it is the more driven students who engage highly with these activities, but even if not all students are engaged, it is gratifying to see the benefit. Nevertheless, these optional activities were not as widely used as the authors would have liked. It is interesting to see that, in contrast to the findings by Sly, (Sly, 1999), the students who made most use of the optional activities in this study were not necessarily the weakest students, but rather the students who were driven to achieve a higher grade. This pattern of activity has, however, been observed in another study (Hoskins & van Hooff, 2005). Overall, these results are a welcome encouragement that investing time and effort into providing optional activities generates a worthwhile outcome, although more needs to be done to encourage the at-risk students to engage (Hoskins & van Hooff, 2005; Peat & Franklin, 2002). The results presented here can also be shown to future classes to encourage students to participate, as these activities are likely to increase their marks. Although it is a small increase, it could make the difference between two different grades (eg. Distinction to High Distinction), and this has strong implications for students' chances to achieve a high Grade Point Average (GPA) for entry into other courses such as Medicine, which is of significant interest for Biomedical Science students.

As this student cohort is diverse with respect to their background in the field of genetics, two different modes of optional activities (online and paper-based) were offered, and each activity contained different levels of challenge. However, most of the activities were designed to help bridge the gap for students who have not had genetics experience before. Despite this, the students who used the activities were a mix of those with and without prior knowledge in the subject. It is interesting to note that there was no difference between the final marks of the students with or without prior experience. It is possible that the optional activities helped to

achieve this, but this cannot be determined from the data available. It is also possible, however, that the students without prior experience were perfectly able to keep up in this class despite the speed at which it is delivered. This would be interesting as students without prior experience have previously complained about their perceived disadvantage. The data from this study could be shown to future students to demonstrate that they have just as much chance of success regardless of their background experience.

As the concepts in the optional activities were aligned to the delivery of the relevant lectures and practical classes, it was expected that students would time their attempt of the optional activities in line with these classes. Surprisingly, the majority did not keep up with the optional resources, some stating that they preferred to save them for use as exam revision, '*I am saving mastering genetics for swot vac'* and '*I will use it for exam revision*'. These bizzarre reasons were also identified in the work of (Peat & Franklin, 2003). Strangely, it seems that students feel that activities can be used up, and so they want to save them for later. They do not consider the enormous value of reinforcing the lecture concepts during semester and then revisiting the activities again during exam revision. In the future, the authors will attempt to break this misconception at the beginning of the unit by assuring the students that keeping abreast of the work will provide the most benefit.

Many students did not engage with the optional activities because they were not compulsory and some thought that they were too much work. Strategic balancing of workload is a significant pressure faced by modern students, so this does need to be carefully managed. It is interesting that whilst students acknowledged that the optional activities helped them in their overall exam marks, a large majority reported that they would not have been willing to pay a fee of $30 for it. This may be because they also had access to the paper-based Optional Problem Sets. Contrary to expectations, the students preferred the paper-based OPS to the online MG activities. It is often considered that modern students are digital natives and the online generation, but despite all the bells and whistles of the multimedia support, paper-based was the preferred option. One possible reason is that face to face consultation was offered for the OPS if they were carried out early enough in semester, and this outweighed the automatic feedback built into the MG system. It is also possible that the students assumed that the OPS would be more representative of exam questions as they were produced by the teachers of the subject. It is also very interesting that students were polarised in whether they preferred the OPS or the MG. It seems that students do stick to specific types of activities, as has been described previously (Inglis et al., 2011).

This study has shown that optional activities are beneficial to students, in leading to better grades. It is possible that they also build confidence, and may operate as a useful self-check of student progress. Students who are highly engaged with these optional activities may be able to determine their strengths and weaknesses in the course and thereby focus better on parts that need more work. The optional activities used in this study were popular amongst the students who did engage with them, and these students did anticipate that using the optional activities would improve their marks. However, sufficient choice needs to be provided to students, as different individuals respond to different activities, possibly due to different metacognitive strategies and learning styles (Entwistle & McCune, 2004). It is also important to have a range of levels of challenge in the activities to cater for lack of prior knowledge and to challenge the best and brightest of the cohort.

Conclusion

The optional activities provided in this subject gave the students who engaged with them higher marks and a chance at a higher grade. The paper-based OPS activities were more popular than

the online MG activities, but the students recommended that both be provided, free of charge, in future.

Acknowledgements

We thank the other lecturers in this subject, Assoc. Prof. Coral Warr, Dr. Richard Burke, Dr. Michelle Dunstone and Dr. Caroline Speed, especially for their work on the MG modules. In addition, we thank Assoc. Prof. Coral Warr, Prof. David Smyth and Assoc. Prof. Steve McKechnie for designing many of the questions in the Optional Problem Sets. We thank the Better Learning and Teaching team, who with the permission of the Pro Vice Chancellor of Learning and Teaching, Prof. Darrell Evans, integrated MasteringGenetics™ with the LMS. This project was carried out with permission of the Monash University Human Ethics Committee, application no. 2013001379

Appendix

Appendix 1: Questionnaire administered to students in Week 1 of semester.

QUESTIONNAIRE BMS2042
For project 'The use and value of optional teaching resources in BMS2042

This questionnaire is optional and confidential, and will only be looked at after Dec 23rd, when we will use your student number to match up your opinions to your activities and results in this unit. Your student number will be removed for the final analysis.

Student number:.....

1. What mark are you aiming for in BMS2042? P (50 – 59) ☐ C (60 – 69) ☐ D (70 – 79) ☐ HD (80+) ☐
2. Do you expect this mark to be challenging to achieve? No ☐ Yes ☐
3. Have you done VCE units 3 and 4 Biology or equivalent? No ☐ Yes ☐
4. Before starting this unit did you have any familiarity with the study of genetics? No ☐ Yes ☐
5. How many of the MasteringGenetics assignments have you done? None ☐ 1-2 ☐ 3-4 ☐ 5-6 ☐ All 7 ☐

	If you did no MasteringGenetics assignments please answer the following two questions, then turn over	strongly agree	agree	neutral	disagree	strongly disagree
6.	I did not do the MasteringGenetics assignments because they were not assessed (for marks)	☐	☐	☐	☐	☐
7.	I did not do the MasteringGenetics assignments because they looked like too much work	☐	☐	☐	☐	☐
	If you did some or all of the MasteringGenetics assignments please answer the following questions	strongly agree	agree	neutral	disagree	strongly disagree
8.	I found MasteringGenetics easy to use	☐	☐	☐	☐	☐
9.	Having MasteringGenetics integrated with Moodle (rather than a separate website) made it easier to use	☐	☐	☐	☐	☐
10.	Having MasteringGenetics integrated with Moodle (rather than a separate website) made me more likely to use it	☐	☐	☐	☐	☐
11.	MasteringGenetics helped me understand the concepts introduced in the lectures	☐	☐	☐	☐	☐
12.	MasteringGenetics helped me understand the concepts in the practicals	☐	☐	☐	☐	☐
13.	I would have done more of the MasteringGenetics assignments if they were assessed (for marks)	☐	☐	☐	☐	☐
14.	I would have done more of the MasteringGenetics assignments if I had more time	☐	☐	☐	☐	☐
15.	MasteringGenetics helped me gain a better mark in the prac test	☐	☐	☐	☐	☐
16.	MasteringGenetics will help me gain a better mark in the exam	☐	☐	☐	☐	☐
17.	MasteringGenetics is a useful revision tool	☐	☐	☐	☐	☐
18.	If I had to pay ~$30 for MasteringGenetics I would still have done the assignments	☐	☐	☐	☐	☐

Please ALL STUDENTS answer the following question:

19.	How many of the Optional problem sets did you do?	None ☐	1-2 ☐	3-4 ☐	5-6 ☐	All 7 ☐

	If you did no Optional problem sets please answer the following two questions, then go to question 29	strongly agree	agree	neutral	disagree	strongly disagree
20.	I did not do the Optional problem sets because they were not assessed (for marks)	☐	☐	☐	☐	☐
21.	I did not do the Optional problem sets because they looked like too much work	☐	☐	☐	☐	☐
	If you did some or all of the Optional problem sets please answer the following questions	strongly agree	agree	neutral	disagree	strongly disagree
22.	The Optional problem sets helped me understand the concepts introduced in the lectures	☐	☐	☐	☐	☐
23.	The Optional problem sets helped me understand the concepts in the practicals	☐	☐	☐	☐	☐
24.	I would have done more of the Optional problem sets if they were assessed	☐	☐	☐	☐	☐
25.	I would have done more of the Optional problem sets if I had more time	☐	☐	☐	☐	☐
26.	The Optional problem sets helped me gain a better mark in the prac test	☐	☐	☐	☐	☐
27.	The Optional problem sets will help me gain a better mark in the exam	☐	☐	☐	☐	☐
28.	The Optional problem sets are a useful revision tool	☐	☐	☐	☐	☐
	Please ALL STUDENTS answer the following questions:	strongly agree	agree	neutral	disagree	strongly disagree
29.	If I had to pay ~$30 for MasteringGenetics, I would only do the assignments if they were assessed (for marks)	☐	☐	☐	☐	☐
30.	I would recommend that MasteringGenetics be used in this unit in the future	☐	☐	☐	☐	☐
31.	I would recommend that the Optional problem sets be used in this unit in the future	☐	☐	☐	☐	☐

32.	Which of the following combination of MasteringGenetics and Optional problem sets would you recommend for this unit in the future?	Both ☐	MasteringGen-etics only ☐	Optional problem sets only ☐	Neither ☐

33.	In which format did you buy the Klug and Cummings textbook ?	Both ☐	Hard copy only ☐	e-text only ☐	Neither ☐

34.	I bought the Klug and Cummings textbook because of its association with MasteringGenetics	strongly agree ☐	agree ☐	neutral ☐	disagree ☐	strongly disagree ☐

35. Do you have any other comments about MasteringGenetics, the Optional problem sets or the textbook?

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