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## Standing room only: faculty intervention increases voluntary lecture attendance and performance for disadvantaged year 1 Bioscience students

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### ABSTRACT


Literature shows that attendance is an important bidirectional link in engaging students in learning. However, metacognitive awareness eludes many first-year students – particularly the disadvantaged, including those with low admission scores, English as a second language or coming from low socio-economic status (SES), migrant, or first-in-family backgrounds. Our intention was to encourage punctual lecture attendance, but without making it compulsory, in a year 1 Anatomy unit. We compared lecture attendance without and with updates which informed students of their own accumulated attendance. Thus, the lecturer encouraged student time management. Compared with the other cohort, for students who were informed of their accumulated attendance, lecture attendance (56.5 vs. 77.5%) and performance (54.2 vs. 58.9%) were higher, the failure rate was about one-third lower (31.7 vs. 22.1%), the percentage of students scoring over 80% was 2.5 times higher, and the performance advantage of students' admission score was removed. Furthermore, updating on attendance resulted in low SES students attending to the level of high SES students. These findings suggest that simply updating students on their accumulated lecture attendance has a surprisingly strong effect on their performance, particularly if they are underachievers or from low SES backgrounds.

### KEYWORDS

Attendance; performance;  
time management; diversity

## Introduction

Anatomy, either as a stand-alone unit or as part of Bioscience, is integral to medical, biomedical, and health curricula – as it underpins the development of clinical knowledge and skills. The discipline areas of Health and Science have seen a dramatic increase in student enrollment, often accompanied by a lowering of the Higher Education (HE) admission score (Norton, 2013). Transforming the learning scape through online technology has numerous advantages in Medicine, including novel instructional methods (e.g. virtual, digital, social,

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and mobile media), flexible scheduling and economies of scale (Cook, 2007). Meta-analysis indicates that online learning is comparable, with blended learning slightly superior, to face-to-face modes (Means, Toyama, Murphy, & Bakia, 2013). However, without additional support, fully online learning may undercut progression among low-income and under-prepared students (Jaggars & Bailey, 2010). Lu and Lemonde (2013) showed that online teaching (*Lectopia* and real-time tutorials with postings and virtual whiteboards) was as effective as face-to-face (*Powerpoint*) for academically high-performing Health Science students. However, importantly, they found that lower performing students had a gradual worsening of performance with each more cognitively challenging question. These results suggest that, unless other resources are available, underachieving students may require attendance at face-to-face classes for deep learning to occur and that the learning scape (online, blended, face-to-face) may need to take into account the characteristics of the student cohort. At least in the short term, current infrastructure and faculty inertia are among the reasons that the learning scape will continue to include face-to-face teaching, either in the traditional or the blended mode. Our study addresses the question of how educators can encourage students to take responsibility for attending lectures, without making them compulsory.

Massification of HE is based on the premise that access and success should be equitable across class, ethnicity, geographical location, and other personal characteristics. HE institutions have adopted a range of initiatives to recruit (e.g. outreach) and support (e.g. transition) students from disadvantaged backgrounds. Such students suffer from a complex mix of social and cultural factors, including English as a second language or being from a migrant, first-in-family or low socio-economic status (SES) background. There is a strong association between HE admission score and SES (Norton, 2013), with low SES students tending to score poorly. Attrition risk factors for low SES students include financial limitations; family problems; doubt in the career-relevance of university; poor engagement; underachievement; low aspirations; and poor metacognitive skills (Abbott-Chapman, 2011; Karimshah, Wyder, Henmam, Tay, Capelin, & Short, 2013; Whiteford, Shah, & Nair, 2013). Discussions on maintaining academic standards, in an era of widening participation, have highlighted the need to resource targeted academic support. Such support should aim to improve students' metacognition, self-regulation skills, sense of belonging, and determination to reach their goals – resulting in resilient, independent learners (Abbott-Chapman, 2011; Karimshah et al., 2013; Whiteford et al., 2013).

Literature shows that attendance is an important bidirectional link in engaging students in learning. Although an 'academic' student may engage in deep learning in a passive lecture, a 'non-academic' student requires active enquiry-based teaching in order to become highly engaged and move beyond surface learning (Biggs & Tang, 2011). Engagement increases when students are motivated to attend lectures, view lectures online, attend tutorials, or learn with peers (McCredden & Baldock, 2011). Kahu (2013) explains that student engagement is influenced by university factors (e.g. policies, curriculum, and teaching quality) and by student factors (e.g. family support and self-efficacy). Studying first year, Bioscience students, Rytönen, Parpala, Lindblom-Ylänne, Virtanen and Postareff (2012) found that organized studying, in particular time management and self-regulation, and then peer support were the strongest predictors of academic achievement. On the basis of the literature, in theory, combining highly interactive classes with an incentive to attend may improve engagement, deep learning, and self-regulation (e.g. time management skills).

Lecture attendance and academic performance have been shown to be positively related, with the strength of this relationship shown to vary with quality of teaching, content and importance of the unit, availability of online learning support, homework completion, study skills, HE admission scores, sex, age, and employment commitments (Clark, Gill, Walker, & Whittle, 2011; Crede, Roch, & Kieszczynka, 2010; Gatherer & Manning, 1998; Ghenghesh & Nakhla, 2011; Hemers, 2010; Moore, 2008; Newman-Ford, Fitzgibbon, Lloyd, & Thomas, 2008; Romer, 1993; Salamonson, Andrew, & Everett, 2009; Thatcher, Fridjhon, & Cockcroft, 2007; Woodfield, Jessop, & McMillan, 2006). In 2010, Crede et al., using meta-analysis, showed that class attendance and performance were very strongly related, with attendance being a better predictor of grades than standardized admissions tests, high school GPA, study habits, or study skills.

In 2008, Newman-Ford et al., used an electronic attendance monitoring system (*Uni Nanny*) at an institution with a high proportion of disadvantaged students and found that lecture attendance was low, around 40–50%, and positively related to performance. However, compulsory lecture attendance is often seen as authoritarian, counter to educational philosophy, and antagonizing to students (Leufer & Cleary-Holdforth, 2010; St. Clair, 1999). Barlow and Fleischer (2011) raised the question of whose responsibility is lecture absenteeism – for example, institutions, faculty and/or students.

The major reasons for lecture absenteeism have been shown to be poor lecturing, availability of online resources (e.g. *Lectopia*), assessment pressures, low faculty expectations, timetable clashes (lecture or practical class), illness, employment commitments (e.g. financial difficulties lead to students attending paid work rather than class), transport difficulties, inconvenient timetabling (e.g. 8 am), inclement weather, and lack of motivation (Bati, Mandiracioglu, Orgun, & Govsa, 2013; Clark et al., 2011; Davis, Hodgson, & Macaulay, 2012; Hidayat, Vansal, Kim, Sullivan, & Salbu, 2012; Kelly, 2012; Lockwood, Guppy, & Smyth, 2006; Moore, 2008; Newman-Ford et al., 2008; Revell & Wainwright, 2009; Sawon, Pembroke, & Wille, 2012). For students studying Pharmacology, the major reasons for lecture absenteeism were not access to online material, rather they were shown to be timetable clashes, poor quality teaching, unforeseen circumstances (e.g. illness) and assessment pressures (Davis et al., 2012; Hidayat et al., 2012). The last two reasons were more commonly cited for absenteeism in under-performing students (Hidayat et al., 2012).

Several authors have reported that students' perceived attendance does not match their actual attendance (Kelly, 2012; Lockwood et al., 2006) and that, even when lectures are interactive and enjoyable, they were not 'unmissable' (Revell & Wainwright, 2009). Furthermore, when students were asked how they made up for missed lectures, Ghenghesh and Nakhla (2011) found that, although 30% of students used e-learning resources, 40% did nothing. These studies suggest that combining interactive lecturing and student-centered management practices with explicit attendance requirements may encourage students' self-regulation and engagement in learning (Barlow & Fleischer, 2011; Kelly, 2012).

We noted that many of our students did not fully appreciate the importance of consistently or punctually attending lectures and delayed, until too late, reviewing the lecture content online. Consequently, as Bioscience lecture content is sequential and cumulative, they 'missed the story' and were unprepared for practical classes. Our intention was to encourage punctual lecture attendance, but without making it compulsory, in a year 1 Anatomy unit. The study was conducted at a third-tier HE institution noted for its high proportion of low SES students. We compared two interventions. The first entailed measuring voluntary

lecture attendance in a selection of weeks of semester. The second measured voluntary lecture attendance, but with weekly updates providing students with information on their own accumulated attendance. In this way, we hoped to improve students' time management skills and sense of responsibility.

We related lecture attendance, with and without updated information on attendance, to student performance. Our analysis allowed us to account for other student characteristics, known to correlate with either attendance or performance, such as HE admission score and SES. We also surveyed the students' perceptions of the effect of the updates on their attendance and time management skills. Thus, the novel aspect of our study, whereby students track their own attendance via a weekly register, adds to the literature on delivering better outcomes for disadvantaged Bioscience students.

## Methods

We compared two interventions in different calendar years, in effect a baseline year and a trial year. The teaching environment was essentially the same for both cohorts. This experimental design has been used previously to test an incentive program aimed at increasing tutorial attendance (Rodgers, 2002).

### Teaching Environment for Both Cohorts

Our unit of study, Anatomy of the Trunk, was a core year 1, semester 1, unit for both Biomedical Sciences and Nutritional Therapy students. There were three 1-h lectures and one 2-h practical per week for 12 weeks. Lecture format consisted of *Powerpoint* slides and anatomical models, combined with interactive lecturing techniques using en masse synchronous demonstrations and kinesthetic mnemonics (Dickson & Stephens, 2014). The lecturer's scores for 'Overall satisfaction with the teacher' were high: 4.8 (5-point *Likert*). Lectures in week 8 were given by another experienced lecturer. Practicals, run by highly experienced tutors, had an 80% attendance requirement (standard practice at our institution). Assessment consisted of two short tests (run in practicals: weeks 3 and 8), a 2.5-h practical exam and a 3-h theory exam. No marks were allocated for attendance or participation. Students who failed a test were offered counseling, weekly appointments with the lecturer and structured homework.

Lecture attendance was voluntary. All three 1-h lectures were given on the same day (standard practice at our institution): at 9 am, 11 am, and 12 pm. The roll was distributed only at 9am and students signed during the first 5–10 min of the lecture. All students were clearly informed that lecture attendance was not compulsory. In an effort to encourage punctuality, latecomers were not permitted to sign. Head count indicated that students who signed the register remained in the lecture and attended the other lectures on that day. Lecture recordings (slides and audio) were available. Thus, students who preferred to view the lectures online were able to do so. Enrollments at the start of semester, at census date (week 4) and at the date of the exams; non-standardized (i.e. raw) final marks; and demographic factors were obtained from institutional records. Students who were low SES (based on home address and a national SES index), non-English speaking, and had an admission score <60 were considered disadvantaged. This study received approval from the institution's Human Research Ethics Committee.

### **Lecture attendance with no-updating**

For our first intervention (baseline:  $n = 139$  students), the roll was taken (without warning) in selected weeks (1, 4, 6, 7, and 11) of the semester and students were not updated on their accumulated attendance. These weeks were chosen to incorporate the census date and the start, middle and end of semester. At the start of semester, the lecturer explained that the roll taking was intended to encourage attendance, but that attendance was essentially determined by student motivation.

### **Lecture attendance with updating**

For our second intervention (trial:  $n = 113$  students), the roll was taken in each week of semester (excluding week 8) and students were updated on their own accumulated attendance. At the start of the semester, it was stressed that lectures were not compulsory, but students were encouraged to sign and monitor the roll in order to improve their time management skills. Non-signatories (latecomers and absentees) were recorded as '0'; signatories as '1'. Each week, when the roll was circulated, students could view their own and their peers' accumulated attendance. Perusal of the signatures and head count indicated that compliance was high, with minimal fabrication of attendance. A sample ( $n = 34$ ) of the 113 students who were given information on their attendance completed an anonymous questionnaire.

### **Statistical analysis**

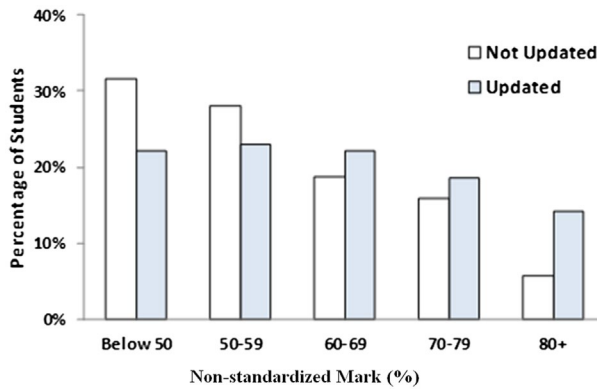
Using hierarchical multiple linear regression analysis, the dependent variable, student performance, was regressed on the independent variables: percentage of lectures attended, sex, age, HE admission score, course, whether the student was repeating the unit, SES, employment status, and language spoken at home. Furthermore, the dependent variable, percentage of lectures attended, was regressed on the student demographic variables listed above. The regression model for the not-updated cohort was compared with the model for the updated cohort. A combined model was also fitted, incorporating an indicator variable for the updating as well as the independent variables listed above. The models were checked to ensure that multicollinearity was not present. HE admission scores were unavailable for mature age, immigrant, refugee, and articulation pathway students. So, each missing value was imputed from the mean value for that student's course (because courses differ in their HE admission requirements). These student demographic variables were chosen because of their well-established relationship to either attendance or performance (Clark et al., 2011; Crede et al., 2010; Gatherer & Manning, 1998; Hemers, 2010; Moore, 2008; Romer, 1993; Salamonson et al., 2009; Woodfield et al., 2006). Thus, we were able to determine the most important predictors of performance and of lecture attendance for each of our cohorts – updated and not updated. We could also determine (via the interaction effect in the combined model) whether the effect of a particular variable (e.g. SES) was different for the two cohorts.

Weekly attendance was analyzed by ANOVA; student demographic variables and mark distributions by chi-square testing; group comparisons of attendance and mark by testing for differences between means ( $t$ -test, equal variances); and group comparisons of withdrawal and exam absentee rates by testing for differences between proportions ( $z$ -test).

**Table 1.** Lecture attendance and performance by student profile.

	Not updated				Updated				Overall			
	n	%	At%	Mk%	n	%	At%	Mk%	n	%	At%	Mk%
Sex												
Male	40	28.8	59.0	58.6	25	22.1	83.2	61.3	65	25.8	68.3	59.6
Female	99	71.2	55.6	52.4	88	77.9	75.9	58.2	187	74.2	65.1	55.2
Age												
17–19	84	60.4	60.5	53.1	74	65.5	78.9	57.5	158	62.7	69.1	55.1
20–24	41	29.5	43.9	55.5	23	20.4	72.6	62.3	64	25.4	54.2	57.9
≥25	14	10.1	70.0	57.3	16	14.2	78.1	60.6	30	11.9	74.3	59.0
HE Ad- mission Score												
≤49	9	8.3	48.9	52.4	11	14.5	69.1	59.8	20	10.8	60.0	56.5
50–59	40	36.7	54.5	49.1	12	15.8	64.2	49.3	52	28.1	56.7	49.1
60–69	43	39.4	54.0	54.3	28	36.8	79.3	57.9	71	38.4	63.9	55.7
≥70	17	15.6	68.2	65.7	25	32.9	86.8	65.2	42	22.7	79.3	65.4
Course												
Biomedical Sciences	108	77.7	55.4	53.6	89	78.8	75.4	58.9	197	78.2	64.4	56.0
Nutritional Therapy	31	22.3	60.5	56.2	24	21.2	85.4	59.1	55	21.8	71.5	57.5
Attempt												
First	108	77.7	67.6	56.7	104	92.0	79.7	58.5	212	84.1	73.5	57.6
Repeat	31	22.3	18.1	45.4	9	8.0	52.2	63.0	40	15.9	25.8	49.4
SES												
Low	37	26.6	55.7	50.1	28	24.8	78.6	61.6	65	25.8	65.5	55.0
Medium	67	48.2	51.9	52.9	55	48.7	76.5	58.7	122	48.4	63.0	55.5
High	35	25.2	66.3	61.1	30	26.5	78.3	56.8	65	25.8	71.8	59.1
Job												
Unemployed	24	17.3	53.3	54.7	24	21.2	78.8	55.7	48	19.0	66.0	55.2
Seeking em- ployment	47	33.8	62.6	50.6	25	22.1	76.8	61.5	72	28.6	67.5	54.4
Employed	68	48.9	53.5	56.5	64	56.6	77.3	59.1	132	52.4	65.1	57.8
Home Lan- guage												
English	65	46.8	57.5	59.1	73	64.6	78.1	61.9	138	54.8	68.4	60.6
Non-English	74	53.2	55.7	49.9	40	35.4	76.5	53.5	114	45.2	63.0	51.2
Overall	139	100	56.5	54.2	113	100	77.5	58.9	252	100	66.0	56.3

Note: Number of students (n), percentage of students (%), mean percentage of lectures attended (At%), and mean mark (Mk%) of students in both cohorts – roll with no updating (139 students) and roll with updating (113 students) on accumulated attendance.



**Figure 1.** Distribution of marks for the student cohorts who were not updated (139 students) and who were updated (113 students) on their accumulated attendance.

## Results

Table 1 shows the high proportion of disadvantaged students in our study. It also shows mean percentage of lectures attended and mean non-standardized mark, for both interventions: roll with no updating on accumulated attendance ( $n = 139$ ) and roll with updating on accumulated attendance ( $n = 113$ ). Although the cohorts differed ( $p < 0.05$ ) in the proportion of repeating students, non-English home language students, and HE admission score, these differences were accounted for in our regression analysis.

### Student performance

As shown in Table 1, overall mean mark was higher ( $p < 0.029$ ) in the cohort updated on accumulated attendance (58.9%) than in the other cohort (54.2%). The mark distribution for each cohort is shown in Figure 1. In the cohort updated on their accumulated attendance, more students scored 80%+ ( $p < 0.012$ ) and fewer scored <50% ( $p < 0.046$ ) compared with the other cohort. The practical exam showed a similar level of improvement in performance to the theory exam.

Table 2 shows the results of the regression analysis for both cohorts and for the interaction effects between the cohorts. The independent variables (e.g. attendance, home language) are listed in order of the strength of their predictive value ( $t$  statistic). The most significant predictor of mark, in both cohorts, was lecture attendance ( $p < 0.0005$ ). The improvement in mark with increased attendance was significantly greater ( $p < 0.021$ ) for the updated cohort, as also visually illustrated by the different slopes of the lines in Figure 2.

For both cohorts, performance was lower ( $p < 0.002$  and  $p < 0.008$ ) for students whose home language was not English. When students were updated on their accumulated attendance, the performance of repeating students was higher than first attempters ( $p < 0.003$ ). When students were not updated, there was no significant difference between repeating and first attempters, reflected by the significant ( $p < 0.002$ ) interaction between the two cohorts. When no updating was given on accumulated attendance, a higher HE admission score was associated with a higher student performance ( $p < 0.017$ ) and performance was



**Table 2.** Predictors of student performance.

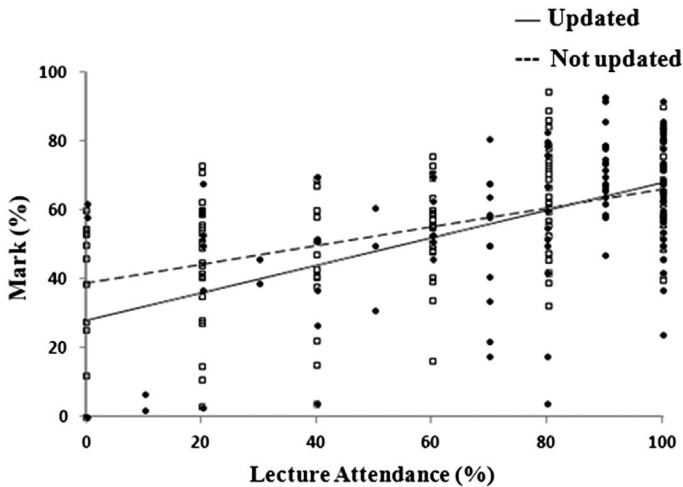
Student performance	Not updated			Updated			Interaction
	Coefficient	<i>t</i> Stat	<i>p</i> value	Coefficient	<i>t</i> Stat	<i>p</i> value	<i>p</i> value
Attendance (%)	0.273	7.081	0.000	0.446	7.492	0.000	0.021
Home language (English = 0, Non-Eng- lish = 1)	-8.104	-3.164	0.002	-8.968	-2.699	0.008	NS
Attempt (first = 0, repeat = 1)	NS	NS	NS	18.664	3.063	0.003	0.002
Tertiary entrance score (%)	0.34	2.426	0.017	NS	NS	NS	0.000
Employment (employed = 0, seeking em- ployment = 1)	-7.163	-2.629	0.010	NS	NS	NS	0.011

Note: Not updated model:  $R^2 = 0.364$ , adjusted  $R^2 = 0.345$ ,  $n = 139$ ,  $df = (4, 134)$ ,  $F = 19.21$ ,  $p < 0.000$ .

Updated model:  $R^2 = 0.369$ , adjusted  $R^2 = 0.352$ ,  $n = 113$ ,  $df = (3, 109)$ ,  $F = 21.25$ ,  $p < 0.000$ .

Combined model:  $R^2 = 0.380$ , adjusted  $R^2 = 0.360$ ,  $n = 252$ ,  $df = (8, 243)$ ,  $F = 18.65$ ,  $p < 0.000$ .

NS = not significant.

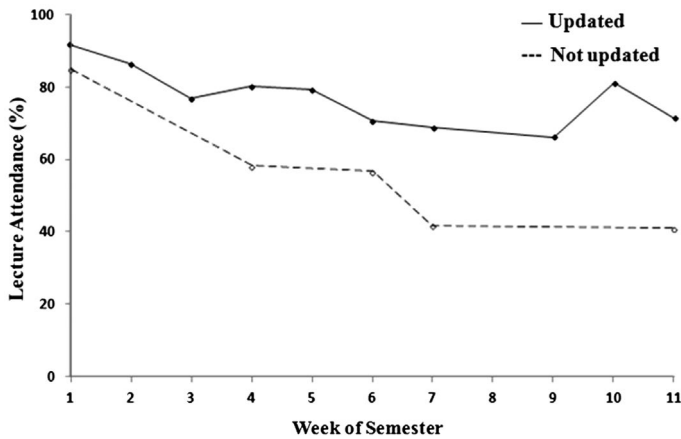


**Figure 2.** Relationship between non-standardized mark (%) and lecture attendance (%) for the students who were not updated ( $\circ$  ---,  $n = 139$ ;  $r = 0.4967$ ) and the students who were updated ( $\bullet$  —,  $n = 113$ ;  $r = 0.5319$ ) on their accumulated attendance.

lower ( $p < 0.010$ ) for students seeking employment than for employed, primarily part-time, students.

### Lecture attendance

Overall, mean attendance was higher ( $p < 0.0005$ ) in the cohort updated on their accumulated attendance (77.5%) than in the other cohort (56.5%). Figure 3 shows that weekly lecture attendance (%), relative to the number of students enrolled at census date (week 4), declined ( $p < 0.036$ ) over the semester and was higher ( $p < 0.009$ ) for the cohort updated on their accumulated attendance. At week 1, the non-updated cohort had a lower percentage of attendance because only 4.1% of the initial 145 enrollees withdrew prior to census date,



**Figure 3.** Weekly lecture attendance (as a % of students enrolled at census date in week 4) at 9 am each week of semester for the students who were not updated (○—,  $n = 139$ ) and for the students who were updated (●—,  $n = 113$ ) on their accumulated attendance.

compared with 11.7% of 128 in the updated cohort ( $p < 0.019$ ). Although not significant, absence from the final exam was lower in the cohort updated on attendance than the other cohort (4.4 vs. 7.2% of week 4 enrollment).

Table 3 shows the results of the regression analysis for both cohorts and for the interaction effects between the two cohorts, as they relate to predictors of lecture attendance. For both cohorts, lecture attendance was lower ( $p < 0.0005$  and  $p < 0.012$ ) for students repeating the unit, but this decrement was smaller ( $p < 0.017$ ) when repeating students were updated on their attendance. In the cohort updated on their attendance, lectures were better attended by students with a higher HE admission score ( $p < 0.003$ ), or who were male ( $p < 0.036$ ), than by other students. In the cohort not updated, lectures were better attended by students who were seeking employment ( $p < 0.002$ ), were high SES ( $p < 0.002$ ) or were older ( $p < 0.041$ ) than by other students.

### Student responses

Table 4 shows that, for a sample ( $n = 34$ ) of the 113 students who were updated on their attendance, 73.6% strongly agreed or agreed that signing the roll encouraged them to attend lectures in the first few weeks of semester and 61.8% that it encouraged them throughout the semester. 55.9% strongly agreed or agreed that the accumulated attendance updates helped them improve their time management.

### Discussion

Irrespective of the way it was recorded in our study, lecture attendance was voluntary. We found that updating students on their accumulated attendance increased both lecture attendance and performance. We also found that, for the students informed of their accumulated attendance, 2.5 times as many scored 80%+ and about one-third fewer scored <50%. These findings suggest that providing feedback on attendance is highly advantageous for both

**Table 3.** Predictors of lecture attendance.

Lecture attendance	Not updated			Updated			Interaction
	Coefficient	<i>t</i> Stat	<i>p</i> value	Coefficient	<i>t</i> Stat	<i>p</i> value	<i>p</i> value
Attempt (first = 0, repeat = 1)	-52.066	-10.007	0.000	-23.347	-2.566	0.012	0.017
Tertiary entrance score (%)	NS	NS	NS	0.586	3.086	0.003	NS
Sex (male = 0, female = 1)	NS	NS	NS	-12.666	-2.123	0.036	NS
Employment (employed = 0, seeking employment = 1)	14.904	3.203	0.002	NS	NS	NS	NS
SES (middle = 0, high = 1)	15.817	3.179	0.002	NS	NS	NS	NS
Age (year)	1.145	2.069	0.041	NS	NS	NS	NS

Note: Not updated model:  $R^2 = 0.457$ , adjusted  $R^2 = 0.441$ ,  $n = 139$ ,  $df = (4, 134)$ ,  $F = 28.17$ ,  $p < 0.000$ .

Updated model:  $R^2 = 0.163$ , adjusted  $R^2 = 0.140$ ,  $n = 113$ ,  $df = (3, 109)$ ,  $F = 7.10$ ,  $p < 0.000$ .

Combined model:  $R^2 = 0.391$ , adjusted  $R^2 = 0.376$ ,  $n = 252$ ,  $df = (6, 245)$ ,  $F = 26.17$ ,  $p < 0.000$ .

NS = not significant.

**Table 4.** Student responses to questionnaire concerning the value of the lecture roll with feedback.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Total
Encouraged to attend in the first few weeks of semester	26.5	47.1	20.6	2.9	2.9	100
Encouraged to attend throughout the semester	17.6	44.2	20.6	14.7	2.9	100
Helped improve time management	14.7	41.2	20.6	17.6	5.9	100

Note: Student percentage responses ( $n = 34$ ).

under- and high-achieving first-year Bioscience students. The most significant predictor of mark was lecture attendance: for the updated cohort, an extra week's attendance improved performance by an average of 3.7 percentage points, 63% higher than the 2.3 points for the other cohort. These findings suggest that simply updating students on their accumulated lecture attendance has a surprisingly strong effect on their performance, in health-related subjects. Further work is required to determine the factors responsible for the students' behavior and the relationship of these factors to engagement and self-regulated learning.

Several authors have forwarded models of the determinants of student performance (Biggs & Tang, 2011; Kahu, 2013; McCredden & Baldock, 2011; Rytönen et al., 2012). In these models, student engagement is often central and lecture attendance is listed as one of many factors contributing to performance. Prominent other factors included peer support, student aptitude and background, quality teaching, deep learning, study skills and self-regulation (Biggs & Tang, 2011; Kahu, 2013; McCredden & Baldock, 2011; Rytönen et al.,

2012). If we amalgamate the conceptual frameworks of these authors, possible explanations for the improved performance in our study include increased exposure to content delivery, peer pressure, and enhanced student motivation and self-awareness.

Most of the surveyed students agreed that receiving information publicly on their attendance improved their time management skills. Informal discussions with students revealed that they were not antagonized by the roll taking and appreciated the extra care that was shown by informing them of their accumulated attendance. In these discussions, most students commented that, rather than perusing the attendance of their peers, they signed quickly so they didn't miss the lecture content. As shown in Figure 2, some students performed well even though they attended only 20% of the lectures. Our discussions suggested that these students may have had legitimate reasons for being absent or late (e.g. consistent online viewing, dropping children at school).

In 2010, Hemers discussed the question of whether year 1 Bioscience students attend lectures because they are engaged or whether they become engaged because they attend. Bati et al. (2013) found that organized study, including time management and self-regulation, were the main factors affecting first-year Bioscience students' performance. Although Davis et al. (2012) studied students at an elite university, they never saw 100% attendance in year 2 and 3 Biochemistry and Pharmacology lectures. Barlow and Fleischer (2011) note that there is inconsistency in Health Science staff approaches to absenteeism and that, as posited by Hidayat et al. (2012), this needs to be addressed to foster a culture of attendance, maturity, accountability, and professionalism in students. Our study highlights the role that high-quality educators can play to improve attendance, without the disadvantages associated with compulsory attendance – as discussed for a Nursing course by Leufer and Cleary-Holdforth (2010).

### **Student performance**

We confirm earlier work showing that academic performance is positively related to lecture attendance (Clark et al., 2011; Crede et al., 2010; Gatherer & Manning 1998; Ghenghesh & Nakhla, 2011; Hemers, 2010; Moore, 2008; Newman-Ford et al., 2008; Romer, 1993; Salamonson et al., 2009; Thatcher et al., 2007; Woodfield et al., 2006). In agreement with Crede et al. (2010), we found that lecture attendance was the most significant predictor of performance, being greater than that of other demographic factors, such as HE admission score.

Although Gatherer and Manning (1998) found no difference in mean attendance or performance between anglophones and ethnic minorities, they did find a stronger positive relationship between attendance and performance in students from ethnic minorities than from anglophones. We found that, for both of our cohorts, performance was lower when the student's home language was not English. These findings suggest that language, and possibly culture and ethnicity, have an effect on performance, irrespective of lecture attendance. This is probably magnified in areas of health because the learning of numerous anatomical structures is very challenging if a student's home language is not based on Latin or Greek origins.

Unlike authors who excluded repeat students from their analyses (Hemers, 2010; Lockwood et al., 2006), we incorporated repeat students and found that their performance improves significantly if they are kept informed about their accumulated attendance. This

may be because tracking weekly attendance keeps students focused on the content, or perhaps they feel more engaged with their peers. Our findings suggest that substantial cost savings, improvements to progression rates and restitution to students' self-confidence levels may result if repeat students are given feedback on their time management skills.

The findings of Lu and Lemonde (2013) suggest that, although teaching format may be irrelevant for high achieving students, face-to-face format was best for students who struggle academically – particularly when engaging them in deep learning. Our finding, that HE admission score was positively related to performance in the cohort not updated on accumulated attendance, agrees with earlier findings that progression at university is influenced by HE admission score (Norton, 2013). However, we found that this relationship was absent with updating on attendance. This is an important finding both for underachieving students and for the less prestigious institutions where these students commonly enroll. Perhaps, when teaching numerous underachieving students, either in face-to-face or blended learning scapes faculty could adopt self-monitoring of attendance – as proposed in the current paper.

We found that, with updating, employment status was neither a predictor of attendance nor of performance. These findings suggest that, with updating, attendance at lectures was viewed as an important priority. On the other hand, we found that, without updating on accumulated attendance, employed (primarily part-time) students performed better than those seeking employment, even though their lecture attendance was lower. Our findings suggest that students who are consistently employed (primarily part-time) may be more highly motivated to obtain a degree, or may have better time management skills, than students who are seeking employment. Kelly (2012) reported that students believed that their studies were unaffected by work, whereas Salamonson et al. (2009), found that paid work impacted negatively on performance. This conflict may be partly accounted for by the difference in their proportions of students working (39 vs. 76%) and the mean hours worked per week (12.9 vs. 18.4).

### **Lecture attendance**

Lecture attendance rates have been shown to vary from around 30% to 80% (Clark et al., 2011; Davis et al., 2012; Hemers, 2010; Moore, 2008; Thatcher et al., 2007). When rolls were taken randomly, Thatcher et al. (2007) found attendances of 40–65%, with 48% of students attending less than half the lectures, and only 5% of students attending all lectures. Our results for the cohort which was not updated on accumulated attendance were somewhat similar: with average attendances of 56.5%, 39.5% of students attending less than half and 20.9% attending all lectures. When rolls were taken with compulsory attendance, Clark et al. (2011) found that year 1 attendance averaged 78%. Our results for the cohort updated on their accumulated attendance were similar: attendance rates averaged 77.5% and only 15.9% of students attended less than half the lectures. We found that 37.2% of students attended all lectures, which is higher than the 18% recorded by Moore's (2008) study with a consistent roll, but direct comparisons are difficult due to varying methodologies.

In agreement with previous authors (Davis et al., 2012; Newman-Ford et al., 2008; Thatcher et al., 2007), we found that attendance dropped from the start of semester to around the middle – when assessments are often due. We also found that, when students were updated on their attendance, the rate of withdrawal prior to census date increased, suggesting that students became more aware of their 'at risk' behavior. This offers advantages for both the student (avoiding

failure and fees) and the institution (lower failure rates). In contrast to Woodfield et al. (2006) who found absenteeism higher in males than females, we found, in our updated cohort, that attendance was higher for males. However, the contrasting finding may be accounted for by the higher proportion of males in Woodfield's study (47.4 vs. 22.1%). We found that, without updating, students from high SES backgrounds (mainly residents of suburbs which are distant from the university – which is located in a poorer outer suburban region) attended more than lower SES students. These findings may suggest that metacognitive skills, such as the importance of attendance, may be lacking in students from low and medium SES backgrounds or that high SES students are highly motivated to perform well in order to transfer to a more prestigious university closer to their home.

55.9% of our surveyed students stated that feedback on attendance improved their time management. Furthermore, unsolicited student comments about the monitoring of lecture attendance with updating were, overall, positive. We did not notice any increase in students using their mobile electronic devices during the lectures – as anecdotally noted by Leufer and Cleary-Holdforth (2010) when they instigated compulsory attendance. This may be because our lectures remained voluntary and the lecturer was non-confrontational. Our findings suggest that voluntary attendance, combined with informing students on their own attendance, is de facto compulsory attendance but without the student antagonism.

There are several limitations of our study. We cannot infer causality on the basis of correlation data. Our study was conducted in only one unit at one institution. So, the results may not be transferable to other discipline areas and other institutions. As we used two different yearly cohorts of students with unequal sizes and unequal numbers and different weeks of attendance recordings, our findings need to be repeated, using a different experimental design. As we did not allow latecomers to sign the roll, we were measuring punctuality as well as attendance. The results may have differed if we allowed students to sign at any time during the lectures. Also, we had no measurement of whether individual students actually perused the information on their accumulated attendance and reflected on their behavior. Furthermore, if accumulated attendance was conveyed privately (e.g. via adaptive learning strategies) rather than publicly, the results may not be replicated. Our method of updating was combined with highly interactive lectures. The results may have differed if lecture quality was poor. We did not relate attendance to performance on assessment tasks requiring simple recall versus deeper learning nor did we relate attendance to science subjects studied at high school. Finally, our regression model did not account for other potentially relevant factors, including prior content knowledge, metacognitive skills, motivation, social interaction, family pressures, time management skills, emotional intelligence, maturity, self-regulation, and a sense of responsibility for learning.

### **Educational implications**

As noted by several authors (Crede et al., 2010, Lu & Lemonde, 2013; Newman-Ford et al., 2008), face-to-face attendance has become an important issue for policy-makers because of its potential impact on educational quality and cost. We found that updating on attendance removed the performance advantage of high HE admission scores and stimulated low and medium SES students to attend lectures. Our findings have implications for third-tier institutions which have many students with poor HE admission scores and low SES backgrounds. Substantial savings could be made by introducing strategies aimed at improving students'

time management skills, engagement, and attendance. Future work, using blended learning, could easily incorporate attendance feedback as part of a suite of teaching strategies used to improve students' meta cognitive skills and engagement.

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