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Reflections on Seminar Attendance, Lecture Capture, and Other Factor Impacts on Postgraduate Student Performance

ABSTRACT

There are several factors which may influence student (exam) performance, some of which have been investigated, though there is little consensus in the results. This paper uses the unusual context of a face-to-face taught postgraduate (rather than undergraduate) Business Economics module taken by students on a variety of different Business/Management orientated MSc programmes. It explores the impact of seminar (but not lecture) attendance, lecture recording views, Disability Access Plans (DAPs) for students with mental/physical disabilities/health-issues, and other factors including prior subject experience and attainment in formative coursework. We find performance is positively associated with seminar attendance and weakly, with moderate use of lecture recordings. Use of an interim Formative Assessment was positively associated with performance, and this association was stronger for students towards the middle of the grade distribution. Prior experience demonstrates no association with performance, and neither does a DAP, although this actually suggests that DAPs work as intended.

Keywords: Lecture Capture/Panopto, Attendance, Disability Access Plans,
Prior Experience, Formative Assessment, English Proficiency.

1. INTRODUCTION

As academics teaching students, most of us want to provide (subject to any constraints in place) an effective environment for our students to learn. Experience, reflection, and training courses help many academics to develop an instinct for the best approaches to take with their teaching, including what leads to greater levels of student learning and hence assessment attainment. However, few of us have the time to continually engage with, let alone contribute to the pedagogic literature in order to check our intuition is actually supported, most especially in regards to studies that explore the impact of new technologies, such as lecture capture, or an increasingly diverse student body. In our own case we started this paper by wondering if all of the seemingly sensible advice we had long given to our students - such as the assertions that regularly attending lectures in person is associated with higher exam performance, that students should not substitute attendance for recorded lectures, or that students of all backgrounds can do equally well – was still supported by current evidence. This not only led us to re-explore the literature in this area but also to scientifically analyse our own experiences in light of the developments we have progressively implemented.

In this paper we therefore explore how a number of factors are associated with student performance in a face-to-face taught postgraduate (i.e. graduate) Business Economics module at a leading UK university, which lead to a

number of implications for provision/policy and future research. The prior university experience these students possess make this rather different to much of the existing literature, which has primarily focused on undergraduate level contexts (e.g. Jones and Olczak, 2016; Stanca, 2006). There is already some evidence about the differences between under- and post-graduate students (Lindsay *et al.*, 2002; Sabbir Rahman *et al.*, 2014; Shukr *et al.*, 2013). In line with this literature, and based on our experiences, postgraduates are generally older and better prepared, most likely because they have some experience of university-based learning (and often several years in work). Furthermore, there is a broad cultural expectation that young people participate in undergraduate education, with over 50% of English youth attending university (Bolton, 2020; Universities UK, 2018). To students university is therefore just a natural progression of school. However, there is no such expectation beyond gaining an undergraduate degree, with fewer choosing to pay the additional fees to study at the postgraduate level which suggests those that do, have a higher level of engagement given their deliberate choice to continue with their studies. Furthermore, there is a greater mix of international students on such postgraduate degrees, whose fees are higher than for Undergraduate degrees, suggesting they are also likely to have high levels of engagement (Bolton, 2020; Universities UK, 2018).

We particularly explore the impact of the use of the lecture capture system (in our case Panopto), and of seminar attendance, where there remains

considerable uncertainty. Unlike many existing studies (e.g. Chen, 2006; Edwards and Clinton, 2018), the attendance data included herein is neither self-reported nor linked with lectures. Instead, attendance was measured by the tutor in each of the supporting seminars, which were not captured. This allows our first contribution which is a novel and original independent exploration of both seminar attendance and lecture capture simultaneously. In addition, our second contribution is that for the first time that we are aware, we also explore the presence of a student Disability Action Plan (DAP), which are bespoke plans for each student that look to ensure they are taught in a manner that takes account of their particular situations. Our third original contribution is to aid understanding of pre-exam feedback through an original investigation as to how an interim formative assessment may particularly improve performance of weaker students. Our final contribution is to explore the importance of prior subject experience, as well as a number of other control factors, including gender, and whether English is a foreign language. We understand that wider factors and alternate measures for the concepts included may exist. However, given the reflective nature of our study, we can only use the data which is available to us.

The remainder of this inductive research paper exploring our own teaching experiences is set out as follows: Section.2 provides an overview of existing literature; Section.3 provides a detailed description of the module, as well as the wider variables and model specification; Section.4 reports the results of

both the descriptive statistics and the specified OLS model; the results are then discussed in Section.5, before Section.6 concludes.

2. EXISTING LITERATURE

2.1 Attendance

Contributions to the pedagogic literature identify a number of factors which likely influence student performance (i.e. their grades) on a particular module of study. To start with many intuitively expect that students benefit from physically attending lectures and other classes, presumably because it is taken to imply an engagement with their studies. While this is often just assumed in many studies (Johnson, 2006), the link between attendance and performance has been widely explored and it is often found that attendance benefits academic achievement (suggesting lectures have educational value) (Chen, 2006; Edwards and Clinton, 2018; Lin, 2008; Marburger, 2001; Stanca, 2006). The apparent benefit varies between studies, and exists in multiple contexts/subjects, including education, psychology, and economics (Johnson, 2006; Lin, 2008). However, other studies explore absenteeism and have generally found that while students do not suffer from missing a very small number of sessions, excessive absenteeism has a negative impact on academic performance (Chen, 2006; Durden and Ellis, 1995; Johnson, 2006). These results are in line with similar studies which investigate cumulative attendance (Lin, 2008). The strongest evidence was perhaps reported by

Marburger (2001), who found that in exams, students performed worse on the exact content of sessions that they missed.

Despite such studies there remains no clear consensus (Newman-Ford *et al.*, 2008), with a number of others reporting no link between attendance and performance (Durden and Ellis, 1995; Moore *et al.*, 2003). Indeed, while some research has found the link to be so strong that they advocated for attendance to be mandatory, others have not only suggested the opposite, but found mandatory attendance may harm performance (Moore *et al.*, 2003; Stanca, 2006).

2.2 Lecture Capture

Given this conflicting research, the impact of attendance on performance remains unclear, especially in a taught postgraduate context and in light of recent developments, such as the increasing use of lecture capture technology, which can act as a substitute for physical attendance. Indeed, the onset of COVID-19 has significantly hastened the need and use for lecture capture systems, as well as other forms of remote learning. We posit that it is through an understanding of existing usage scenarios, that we can better plan for wider use in the future. Here, we employ the definition of lecture capture technology as “*any technology that allows instructors to record what happens in their classrooms and make it available digitally*” (EDUCAUSE, 2008 p.1; Toppin, 2011). This broad definition allows for a number of different technologies

and methods of recording/distribution, and may include materials beyond a simple recording of the lecturer, such as slides and even the audience (Dey *et al.*, 2009; Edwards and Clinton, 2018). Lectures themselves may include material and/or explanations which go beyond what is available (for example) in textbooks, and this would be included in recordings (Johnson, 2006). However, it is also important to note that in some cases, not all content will be recorded (such as audience participation in detail), or can be recorded either due to technical limitations (not all rooms may have equipment) or the structure of some classes that do not lend themselves to recordings. Sloan and Lewis (2014) provide a very useful summary of the potential advantages and disadvantages of lecture capture, based on prior literature. In short, the suggestion is that it can, amongst other things, act as both a substitute for attending in person, but also complement attendance by allowing students to review some/all of the taught content. Furthermore, the review by O’Callaghan *et al.* (2017) found that the potential benefits of lecture capture outweigh the potential disadvantages. However, they also call for further research in other contexts, such as ours.

Students increasingly view lecture capture (and other online technologies) as essential to their studies (Aldamen *et al.*, 2015; Pierce and Carosella, 2016; Witton, 2017) and evidence suggests such technologies are becoming more widespread (Witton, 2017). Indeed many studies have shown that, irrespective of any link with performance, the mere presence of lecture

capture technology is linked with enhanced student satisfaction (Edwards and Clinton, 2018; Jones and Olczak, 2016; Sloan and Lewis, 2014; Witton, 2017). However, there remains considerable uncertainty as to whether such technology actually benefits students (Edwards and Clinton, 2018; Hadgu *et al.*, 2016).

The use of lecture capture technology is an area of growing research which generally focuses on two aspects: the impact of on (live) class attendance; and the link with student performance. In the case of the impact on physical attendance, there is again, little consensus. Much of the research explores changes in attendance during the introduction of some form of lecture capture. Such research is often beset with issues around how attendance levels are calculated, since lecture attendance is often not monitored in detail (Pierce and Carosella, 2016). There is also the issue of how other determinants of attendance are accounted for in such studies. It is predominantly found that lecture capture has a small negative effect on attendance (Edwards and Clinton, 2018; Pierce and Carosella, 2016), although a number of studies have found no such effect (Aldamen *et al.*, 2015; Pierce and Carosella, 2016), or even a positive impact (Toppin, 2011).

The link between lecture capture and student performance is a more nascent, but growing area of research (Terry *et al.*, 2015). As with the other areas of research explored here, there is little consensus with Hadgu *et al.*

(2016) citing various studies that demonstrate either positive or negative links. Furthermore, given the context of the module explored herein, Jones and Olczak (2016) offer a particularly relevant exploration of an economics module, and report an overall positive link. Further research explores the recorded lecture viewing patterns of high and low achievers (Pierce and Carosella, 2016), with for example, Sloan and Lewis (2014) finding that high achievers viewed fewer videos than low achievers. Moreover, wider research has since investigated exactly how students choose to use lecture capture, such as to replace physical lectures altogether or to supplement them by reviewing specific content (Edwards and Clinton, 2018; Newton *et al.*, 2014). Edwards and Clinton (2018) explore the issue at a deeper level in order to explore how the use of lecture capture may be affecting performance. They find a positive link between physical attendance and performance, as well as negative effect between attendance and the use of lecture capture. In their case lecture capture has no direct effect on performance, but it reduces attendance, which ultimately harms performance. In other words, lecture capture can be seen to lead students astray and thereby compromise their grades.

2.3 Other Factors Affecting Performance

Beyond attendance and lecture capture there are a number of other factors which may affect student performance, but which have been relatively under researched. One such factor is the relationship between performance and prior

experience in the subject at hand. Intuitively, it would be expected that such experience/knowledge would operate as an advantage and thus, improve student performance. Indeed, Durden and Ellis (1995) found growing evidence that previous experience (i.e. high school level education) in economics improved college level economics performance. Similarly, Jones and Olczak (2016) found that prior economics experience was a key determinant of performance in their (economics) module. However, our own (anecdotal) experience seemed to conflict with these findings in that it was common for students with significant past experience to do relatively poorly on the module in question (which we return to in the discussion section).

It is also important to recognise that a substantial proportion of students are identified as having some form of (mental or physical) disability – although for a number of reasons, any estimates are likely to be understated (Fuller *et al.*, 2004). Much of the existing literature explores the student experience for disabled students, generally finding a number of issues and ultimately suggesting future remediations (Wilson and Martin, 2017). One approach to dealing with such students are Disability Access Plans (DAPs), which are bespoke plans for each student that look to ensure they are taught in a manner that takes account of their particular situations. These accommodations can include a wide variety of measures, such as extra time and rest breaks in exams, flexible deadlines for coursework, giving students lecture notes in advance, leaving teaching material on screen for extended

periods of time etc. Recording lectures is the sort of advice that could be (and indeed, is) included in such DAPs, as it clearly offers a number of potential benefits for disabled students that covers many of the underlying benefits required, including: wider access to class materials; greater flexibility on when and how to view lectures (which can work around disability related restrictions); freedom from in-class time limitations (i.e. allowing students to go at their own pace); and acting as an alternative to in-class support staff, who are often limited by budgetary constraints (Holloway, 2001; Kandler and Thorley, 2016; Newton *et al.*, 2014; Sloan and Lewis, 2014). No literature that we know of, has explored the impact of such adjustments on student attainment, including whether it accurately, under- or over-compensates students for their disabilities. These adjustments are made by an expert team within the university, following an assessment of each student, where they select from a standardised menu of options and where the resulting recommendation applies to all modules on a degree. The accommodations are reviewed and may be changed throughout each academic year, as the expert team deem appropriate. Therefore, at present we can only explore the existence of the DAP, rather than the specific individual accommodations (which is not possible given the relatively small numbers involved). This is, however, an area which warrants considerable further research.

Further factors, including age, gender, country of origin (or home/international status) are often considered or controlled for (Chen,

2006). However, they are generally found to have little or no impact on performance despite their clear potential to do so, and are therefore reported briefly and quickly dismissed. Where such information is available, we posit that it is important to give a more thorough consideration, as even a lack of association can yield important insights since it suggests a module of study is accessible to a variety of different student types. Indeed, while common to include, country of origin may be better replaced by a student's proficiency in English (the language utilised on the module in question). Several studies have identified such a link between English proficiency and student performance, most likely because a student's capacity to digest, understand, and express taught concepts will be more closely tied to linguistic skill than cultural differences and similar aspects (Andrade, 2006; Fakeye and Ogunsiji, 2009; Martirosyan *et al.*, 2015; Vinke and Jochems, 1993).

Finally, we note Moore et al's (2003) important point that any link between determining factors and performance is likely affected by the content at hand. Students can be bored easily or may simply choose to not pay attention, whether they attend classes or watch recordings which speaks to their engagement with the subject matter (i.e. business economics in this case). However, since data on student engagement is not available in this context (and which is often difficult to measure or acquire in any case), we suggest that a detailed description of module and class structure will instead allow

researchers the opportunity to consider for themselves the likelihood of student general engagement. We therefore present such information below.

2.4 Summary

We have explored extant literature on the links between attendance and performance, as well as the links between lecture capture and attendance/performance. Additionally, we explored a number of wider factors which may affect performance. There is much literature on these subjects, some of which is contradictory, leading to some uncertainty. Given the range of findings and methods, there is an opportunity for a study which explores attendance using independent (i.e. not self-reported) data and does so using supporting seminars, rather than lectures themselves. There is also the need to explore wider possible determining factors, such as the use of student Disability Action Plans (DAPs), as well as pre-exam feedback and prior subject experience.

3. MATERIALS AND METHODS

3.1 Contextual Background

The module being explored herein is a one-semester introduction to business economics course taught using a non-mathematical approach. This approach favours critical thinking and the application of general economic concepts to

real-world business contexts rather than economic rigour for and of its own sake. It is taken by approximately 200 taught postgraduate students that are taking a variety of different MSc degree programmes in the broad area of business and management. The diverse student body comprises a mix of those with/without prior economics experience or background, a variety of different undergraduate degrees, and a mix of home/EU/international students (with English as a first or foreign language). The module is taught in two cohorts and is the only common module of study between all of the different programmes of study. Our sample consists of students who undertook the module during either the 2017/18 or 2018/19 academic years. The teaching team was consistent both throughout the semester and for the two years, and was well regarded in student feedback. The overall satisfaction score for the module on a Likert scale was approximately 4.5 out of 5 in both years. Furthermore, the ‘how the module contributed to my overall programme of study’ question scored approximately 4.4 out of 5 on the same Likert scale, suggesting students were generally well engaged with the material.

The teaching consists of 11 weekly two-hour lectures (which are each delivered twice, once for each cohort) and four one-hour tutorial seminars, which are taken fortnightly in the last eight weeks of the semester. Attendance of these lectures and seminars is voluntary. The lectures are delivered live and in person, dynamically ensuring that the students can keep pace (given their different background and potential economic knowledge). The content and

examples are also updated to be as topical as possible. The lectures are all recorded via the lecture capture system and made available through Moodle (the Virtual Learning Environment) within 24 hours of the lecture. These recordings include both a video of the lecturer and a copy of the active presentation slide. Students are regularly reminded of this resource in lectures and are advised that recordings may stop if lecture attendance falls significantly¹. Lecture attendance is not recorded in line with university policy (and it was felt to be impractical to attempt to record/measure this informally). The Moodle site also comprises extensive information including lecture slides, seminar worksheets, MCQ (multi-choice question) practice tests, past exam papers, supplementary readings, and useful media articles which demonstrate economic theories in action. The final two lectures include significant exam preparation/revision and incorporate MCQ practice via use of an electronic audience response system. The seminars, which are NOT recorded (and where attendance is noted by the tutor for each session), are structured as informal classes in which students are given a worksheet of questions (linked to the content of the previous lecture), to which they must prepare answers/diagrams beforehand. The classes themselves are collaborative in nature, with all students expected to participate to develop 'model answers' to the worksheets as a group, thereby building a working knowledge of the economic concepts. The informal approach creates an environment in which students feel free to contribute without fear of ridicule,

should their prepared answers be incorrect, while ensuring that all students leave with the correct solution. Therefore, between the relatively passive lectures and the more active seminars, student engagement with the subject, and thereby deep learning of the material is encouraged (Moore *et al.*, 2003).

Assessment is made through a two-hour end of module exam, which consists of 40 MCQ questions (worth 40%) to assess breadth of knowledge, and one essay-style written answer from a choice of three, to assess depth and application of knowledge (worth 60%). During the module, students undertake a Formative Assessment (henceforth referred to as FA), which consists of two essay-style questions that are indicative of the exam, which must be hand-written to act as exam preparation. While formally marked, this does not count towards the module assessment, but provides experience and an interim opportunity for feedback. Indeed, it was introduced following student feedback for further understanding of exam requirements. Formal assessment of the unit is subject to internal moderation and external review by an independent external examiner from a different university to ensure it is appropriate for the module, will allow students to be differentiated, and features original/fresh questions. Furthermore, great care is taken to ensure the FA (and any past exam papers available) do not significantly overlap with the formal assessment.

As is common at this University, relevant students have been assessed as requiring Disability Access Plans (DAPs) by the university student services team. These DAPs are study adjustments to allow full participation in learning in light of physical/mental health issues/disabilities or learning difficulties. Amongst other things they may include extra exam time and/or rest breaks, the ability to use a computer during exams, extensions to coursework deadlines, pre-lecture/tutorial access to learning materials, and ensuring that slides/diagrams/etc. are presented for a sufficient period of time. Once set/updated, these confidential DAPs are communicated to relevant parties throughout the university, including teaching staff, who must enact the arrangements wherever possible.

3.2 Model Specification, Variables, and Data Sources

In light of prior research and our inductive/exploratory aims, we sought data on student performance and possible determinants, which we examine using summary statistics and two versions of a formal OLS regression model as detailed below.

Exam score

$$\begin{aligned} &= B_0 + B_1 \textit{Year} + B_2 \textit{Lecture group} + B_3 \textit{Prior economics} \\ &+ B_4 \textit{Gender} + B_5 \textit{DAP} + B_6 \textit{English as main language} \\ &+ B_7 [\textit{Formative assessment score}] \textit{ OR } [\textit{Formative assessment grade category}] \\ &+ B_8 \textit{Seminar Attendance} + B_9 \textit{Recording view category} + \varepsilon_i \end{aligned}$$

Dependent Variable - Exam Score: the individual student percentage score from the final exam, as approved by the Exam Board (which was not adjusted from the raw score).

Independent Variables – Formative Assessment score: the individual student percentage score from the FA which does not count towards the final grade.

Formative Assessment Grade Category: the grade band (fail (<40%), pass (40-60%), merit (60-70%), distinction (>70%)) for each students FA score , Rather than just comparing Formative and final assessment scores (that explores the extent to which the overall module score is related to performance in the FA (Dixson and Worrell, 2016; Owen, 2016)), these bands allow us to explore the extent to which differently performing students have been able to absorb and then deploy the feedback / lessons from the FA, and that this benefit may vary between different groups of students.

Seminar Attendance: the number of seminar sessions which were attended throughout the course (from 0 to a maximum of 4), recorded via registers taken during every class.

Recording view category: a categorical variable indicating the number of times each student viewed recordings of lectures; coded (0, the base) 0 views, (1) 1-5 views, (2) 6-11 views, and (3) 12+ views. These categories were chosen from the raw data as they demonstrate students who do not use the

lecture capture system, those who use it a little (perhaps to accommodate an occasional missed lecture or review an uncertain concept), those who use it regularly to perhaps review most lectures, and those who appear to extensively rely on it. Lecture views as opposed to raw minutes viewed was chosen as the latter was too broad to allow such categorisation as it would not be possible to distinguish between someone who viewed all of a single lecture and someone who viewed a small fraction of multiple lectures. Lecture capture system use information was exported for each lecture once the module was completed and the marks approved.

DAP: dummy variable indicating the presence (1) or otherwise (0) of a Disability Access Plan.

Control Variables - Year: dummy variable indicating the 2017/18 (0) and 2018/19 (1) cohorts to account for any differences between year groups or unintentional differences if the difficulty of the relevant exams.

Lecture Group: dummy variable indicating both which lecture was attended and the degree on which the students were enrolled. Coded (0) for Wednesdays/the largest MSc programme, and (1) for Thursdays/other degree programmes.

Prior Economics Knowledge: dummy variable coded (0) for those with no prior economics knowledge and (1) for those who self-identified as having such knowledge.

Gender: dummy variable coded (0) for women and (1) for men.

English as Main Language: Dummy variable indicating students originated from a country where English is recognised as a national language (1) or otherwise (0). This has been utilised rather than a variable based on home/international status as there is evidence that language proficiency is more important than cultural/distance from home/similar aspects and thus, likely a greater predictor of performance (Andrade, 2006).

3.3 Data Validation

There is an inherent risk of omitted variable bias (Hosman *et al.*, 2010), given that there may be additional factors which influence exam score, or indeed, overall engagement in the module, which in turn could affect exam score and attendance (Durden and Ellis, 1995). Numerous prior studies have investigated several different aspects of this and there remains no consensus as to how the issue should be addressed. For example, some studies include grades from other modules or the student's overall GPA (Stanca, 2006). In our case, the particular module was taken by students on a range of different programmes with no other universally taken module available, thereby ruling out a consistent alternative module to utilise. Furthermore, the diverse nature of the degree programmes taking the module mean overall GPA would likely be biased in terms of their ability to perform well on the module being explored (since some students might struggle with economics but may

perform better elsewhere, while others might be good with economics but struggle elsewhere). We therefore adopt the approach of those studies that suggest that attendance can be viewed as an indication of engagement with the subject matter (i.e. business economics in this case), rather than a result of it (Edwards and Clinton, 2018). This seems appropriate given our postgraduate-taught context where students are not only paying considerable fees to attend, but also have purposely chosen to take the specific programme in light of previous university experience.

Furthermore, we have included every variable which we believe may influence exam score and for which data was available. Such an approach is suggested by prior literature (Breiman, 1992; Clarke, 2005, 2009; Mitra and Washington, 2012). Both the variables and the method are also similar to prior literature, such as Dancer *et al.* (2015), giving further credence to our approach.

One student with a DAP was excluded from the dataset as an outlier due to their exceptionally high exam performance (the highest over the two years) and the nature of their DAP, which did not include learning deficits or meaningful changes to exam conditions. We therefore believe the DAP did not materially impact their exam performance. However, their inclusion, as an outlier, risked biasing the model. We have also excluded students who did not participate in the FA (only 12.86% of the two-year cohort)², as by

definition they can have no Formative Assessment Grade or Grade Category and hence would bias the results. An independent assessment of these students found a similar grading profile (to the students included in our model), with mean=54.61, SD=13.11, and exam scores range of 14-76%. This is slightly below the requisite figures for the students who did complete the FA. Based on available data, we would cautiously attribute this to these students benefitting from the wider feedback delivered online and in seminars, but lacking any personal/individual feedback. In order to confirm there is no bias in our model from omitting student who did not do the FA we ran the same specification of our model, but without the Formative Assessment Grade Category or Score variables and with a dummy variable to distinguish between those who did/did not do the FA. This dummy was insignificant, suggesting no bias was created by omitted those who did not do the FA.

In addition, we verified the robustness of our model by examining the regression residuals, and found them to be randomly distributed with no major deviations from normality (Pallant, 2011; Pevalin and Robson, 2009; Tabachnick and Fidell, 2013). We also explored multicollinearity and found the VIFs to all be within an acceptable range (Hair *et al.*, 2010; Pallant, 2011), both of which suggest the model is robust. Further robustness checks using IV regression were not possible with the available data.

4. RESULTS AND DISCUSSION

INSERT TABLE.1 HERE

Table.1 presents the descriptive statistics for all of the variables detailed in Section.3.2. This shows the mean exam score to be 58%, indicating a high pass grade (i.e. neither a merit (>60%), nor distinction (>70%), but above the pass mark of 40%³), with a standard deviation of 12.59, which is consistent with a good number of students achieving merit and distinction grades in line with the normal distribution present around the mean value. This mark profile would be considered to be a typical distribution for grades at this university. There is a very small but statistically significant correlation with the year, which is to be expected as the mean exam score for 2018/19 was marginally higher than 2017/18. There are also positive correlations between Formative Assessment Grade Category / Formative Assessment score and exam score, suggesting that in general those who scored higher in the FA went on to also score higher in the exam. This is to be expected as a student performing well in the FA would have confirmation that a similar approach adopted in the final assessment would be rewarded. However, the fact that neither of these were close to being a perfect relationship (at 0.21 for Formative Assessment Grade Category and 0.24 for Formative Assessment Score) suggests that there may have been some successful utilisation of student learning from the FA. In that regard we note that 287 students increase their performance in the final

exam relative to the FA, while 76 students actually performed worse in the exam than the FA. We might cautiously attribute the latter to students ignoring their FA feedback, or doing well in the FA and then hubristically failing to adequately prepare for the exam.

There is a positive correlation between seminar attendance and exam score, suggesting a link between attendance and student performance. Finally, the mean of Recording view category indicates a preponderance for categories 1 and 2 (1-5 and 6-11 views, respectively), given the raw mean of 8.04 views (SD=10.32) and a range from 0 to 60 views.

INSERT TABLE.2 HERE

Table.2 presents the OLS regression models for exam scores, first with just the control variables (model 1), then with the independent variables, either including the Formative Assessment Score (model 2) or the Formative Assessment Grade Category (model 3). All estimations were conducted using STATA v13.0, and the model improves with the addition of the predictor variables (i.e. model 2 & 3), which also give respectable and consistent values for the adjusted R-squared.

Turning first to the impact of the FA. The results of Model 2 suggest that for each additional 1% attainment in the FA, a student will on average attain an additional 0.22% in the final exam. This in line with the results in Table.1, and likewise suggests there is a less than perfect relationship between the two

assessments, thereby implying that while there was some identification of overall student ability at the time of the FA, it was far from perfect in this regard. It might therefore suggest that the FA represented a useful opportunity for students to get feedback, learn what was required, and hence improve their performance by the time of the final exam.

Model 3 explores this possibility explicitly with the use of grade bands in the FA (in place of score). There are positive associations (at the 1% level) between the Pass/Merit Formative Assessment Grade Categories (relative to a fail) and exam score, but no significant association between a Distinction category (relative to a fail) and final exam score. If there was no possibility of students learning from the FA and indeed learning to different extents, then all categories should have been similarly significant and with coefficients that reflect the differences in grade boundaries (e.g. that a distinction is on average at least 11% higher than a pass – 59% is the highest pass and 70% the lowest distinction). That a pass on the FA is associated with a 4.08% increase in the final assessment relative to a fail, and a merit with a 8.34% increase relative to a fail, suggests the FA was particularly useful for students in the lower to middle part of the FA marks range. In contrast the results for those with a distinction in the FA suggest there was no particular advantage (or detriment) relative to those having achieved a fail. This is surprising as students who failed would have been able to gain the most constructive feedback and hence lessons for future application, while those scoring a

distinction the least but would have already demonstrated significant relevant ability. We might cautiously attribute this result to the fact that some students who failed the FA were likely already struggling with the subject matter and/or less dedicated, and hence continued to do relatively poorly, while those who achieved a distinction might have failed to heed the wider lessons of the FA and/or exhibited hubris in their exam preparations (despite explicit warnings of these dangers). In this regard it should be noted that the categorical nature of this variable, with a fail as the base category, means the overall impact of the FA on the exam performance cannot be ascertained. In this regard we note that the mean performance on the FA was 47% and 58% for the exam, which implies that on average students did benefit to some degree.

Turning to the impact of attendance, in both model 2 and model 3, there is a link at the 1% level between seminar attendance and exam score, suggesting that each seminar attended is associated with an approximately 2% higher exam score, which implies that the seminars provide a useful resource for students.⁴ For those with full seminar attendance, this essentially equates to an 8% increase and almost full grade uplift (e.g a movement from a merit to a distinction), which is particularly valuable to students. This is in line with prior research, which has found similar links with performance improvements ranging 3.5%-9.4% (Chen, 2006; Durden and Ellis, 1995; Lin, 2008) as well as more general positive links and correlations (Edwards and Clinton, 2018;

Stanca, 2006). It is important here to note that seminar attendance was measured as an absolute level recorded by the instructor, rather than as student self-reported data into broad categories (which is open to social desirability bias) (Edwards and Clinton, 2018; Karnad, 2013). It is equally important to note that the attendance was measured only for the seminar classes. This may go some way to explain why our results support this stream of research since the tutorial classes were designed to consolidate knowledge and practice skills valuable for the end of module assessment.

Table.2 also demonstrates a weak link between Recording View Category and Exam Score. Model 3 suggests that 6-11 views of the lecture recordings is positively associated with exam score at the 10% level, with a 3.21% higher exam score relative to those who did not access any lecture recordings. In model 2 the coefficient is similar but it is just beyond the threshold for 10% significance (p value 0.118, implying significant at the 12% level). Such results suggest students may find it beneficial to have reviewed most lectures once. However, those making 1-5 or 12+ views, have no statistically significant link with exam score in either model 2 or 3. The raw data suggests that students who viewed 6-11 lectures have generally reviewed (almost) every lecture once, or perhaps reviewed certain concepts multiple times to ensure their understanding. This suggests both the value of lectures (since pretty much all lectures have been accessed), as well as confirming the value of lecture capture. At the extremes of 1-5 or 12+ views, the students are likely

reviewing a missed lecture / occasional point of detail, or must be reviewing some, if not all, lectures multiple times, which we posit could indicate a number of issues. Perhaps they have missed the majority of lectures and must therefore review them later. While we cannot test for this, it is important to note that there is no correlation between views and seminar attendance, so it is unlikely that students with 12+ views are completely disengaged with the module. The high view count may also suggest there are lectures/concepts which required further explanation or suggest that such students may have needed additional preparation in order to understand the material. It is important to note that the association here is not statistically significant (but does have a positive coefficient) which suggests that extensive use of recordings may not benefit student performance, but also that it does not seem to harm it either. Ultimately, it may not be the best use of students' time, but it does not imply that students are being allowed to disadvantage themselves and might simply reflect individual student preferences for learning.

The postgraduate nature of the module may provide the reasons for this overall non-linear relationship (which was somewhat expected). The relevant MSc programmes are generally taken by students interested in the given area, who have paid significant course fees, and which by their nature are intensive (so students face a number of competing responsibilities).

These findings on the use of lecture capture are broadly in line with prior research, although much extant literature (such as: Newton *et al.*, 2014; Sloan and Lewis, 2014; Terry *et al.*, 2015) focuses on a single overall effect (often around the introduction of lecture capture to a module). Indeed, Jones and Olczak (2016), with a context very similar to ours, reports an overall effect, which they note is lessened when students replace live lectures with recordings. Our approach to analysing the number of views has yielded a more nuanced understanding by looking at different levels of use. A further qualitative study could explore this in greater depth.

The impact of a DAP is found to have no statically significant association with Exam Score. If this coefficient was found to be significant and negative, it would suggest that DAPs are insufficient, in that students with an identified disability are still more likely to achieve poorer grades. Similarly, if the coefficient was found to be significant and positive, it would suggest that DAPs go too far and offer an advantage to disabled students. Our results suggest a more favourable outcome, in that the DAP adjustments seem to provide disabled students with a level playing field, in which they are neither advantaged nor disadvantaged in relation to other students. We also explored the lecture recording viewing patterns of students with and without a DAP using a t-test, and found no significant difference in the mean number of views (or minutes viewed) between the two groups. We also explored the use of lecture recordings by students with a DAP using a multiplicative dummy

(to allow for different lecture recording viewing patterns by students with a DAP), but this additional dummy was also not significant (and hence was not included in the finalised model for simplicity). To further explore this issue, future research would need to examine how students with a DAP would score without the DAP accommodations, which would require an entirely independent study that would be challenging to design.

The lack of a statistically significant association between Exam Score and prior economics experience is interesting and counter to prior research, such as Durden and Ellis (1995) and Jones and Olczak (2016). It is also surprising considering that experienced students will have been familiar with a number introductory economic topics and concepts, such as demand and supply, and elasticity. It may be that the explicit business focus (i.e. business economics rather than just economics) and non-mathematical approach adopted provides a sufficient difference. Additionally, students were warned that prior economics experience would not automatically translate to greater success in the module and the FA was introduced to specifically help those students with limited relevant experience. Finally, it might simply be the case that those without a prior background did enough additional work to ‘level the playing field’. Anecdotally, the seminars consisting of students with prior economics experience were surprisingly somewhat slower to progress through the set material. This may be due students neglecting the ‘introductory’ material in an attempt to exceed expectations, or simply a lack of preparation in the

mistaken belief they already adequately knew the basic material. We would therefore suggest that this is an area that warrants further, dedicated study. Furthermore, in line with prior research and in addition to what is reported here, we also explored the lecture recording viewing patterns of students with and without prior economic experience using a t-test, and found no significant difference in the mean number of views between the two. We also explored the particular use of lecture recordings by students with prior economics experience by including a multiplicative dummy (to allow their use to be different from those students without prior knowledge). This additional dummy was not significant and hence not included in the final model specification for simplicity.

There is an association between exam grade and year, which is unsurprising given that, as noted earlier, the mean exam score was slightly higher for the second cohort. This is most likely to be due to a slight (unintentional) difference in the perceived difficulty of the end of module exam paper set for each year group.

Finally, we are also pleased to note the absence of associations between Exam Score and gender, lecture group, prior economic knowledge, and English as a main language. This suggests consistency in the course delivery, assessment, and marking between the lecture groups and to a lesser extent between years. Most notably it also provides evidence of an accessible

module that was free from bias relating to either gender or the proficiency of English presented by students. In the case of the latter, this appears in contrast to much prior literature, such as Andrade (2006). However, we posit that it speaks to the appropriateness of English language requirements and provisions (both preparatory and continuing) within the university for admission to the relevant taught postgraduate programmes.

5. CONCLUSIONS

We started to explore the determinants of performance on this taught postgraduate module in order to inform our own future teaching, but in doing so we found results that offer broader insights into a number of issues facing those teaching Business/Management students, and perhaps social sciences more broadly. As suggested by Stanca (2006), it appears safe to claim that as academics, our efforts in providing effective education environments do promote student learning. With the results presented here, there is evidence that both lectures and seminars provide information which is engaged with and then absorbed by students. It is clear that seminar attendance is linked with enhanced student performance, as is the moderate use of lecture capture technology. This will be an important area of study given the shift towards online delivery due to COVID-19.

This leads us to a number of implications for Higher Education provision/policy and future research. We can conclude that academics should promote both attendance and the use of lecture recordings, while also highlighting students would be unwise to entirely substitute away from live lectures for watching recordings. This should not be difficult as Edwards and Clinton (2018) suggest that students appear to appreciate lecture capture and would likely reject its removal in the future. Therefore, and unlike Edwards and Clinton (2018), we find no need to devise means to degrade the usefulness of recordings to encourage live attendance and instead recommend that future research focus on how best to use it.

Furthermore, we propose that, should the lecture capture technology support it, academics are given the appropriate time and training to more extensively explore how students use the recordings. For example, if a particular lecture has a high number of views, it would suggest the content/delivery of that lecture may benefit from revision to make it more accessible. Indeed, exploring more detailed viewing statistics would provide the timecodes of parts of lectures which are extensively reviewed, thereby highlighting the specific content that students review. A sufficiently sophisticated system could even be set to flag such use automatically, to make this process easier and more efficient.

In addition, we have explored a number of other factors determining student performance. The use of a FA ultimately has a direct association with student performance, and seems to offer the most benefit to those in the middle of the grade scale, Modules with no interim assessment or similar feedback may therefore benefit from the introduction of FAs. However, prior experience of the subject is found to have no impact on performance, although a number of reasons for this have been explored. Given the limited data available to us, this is an area for future research but may help to explain the benefits of the FA.

Finally, we have found that the Disability Access Plan system appears to offer an appropriate level of support, ensuring that students are neither disadvantaged nor overly advantaged. Since this is the first study we know of to explore the link between such adjustments and performance, it would be beneficial to explore this further, both from the university perspective (i.e. beyond the confines of the single module in this case) and from a student perspective, perhaps through interviews with students who hold a DAP. For example, much extant literature suggests disabled students are not satisfied with (other) university actions, but our results suggest that while the DAPs appear to work as intended, presently we have no way of knowing if students perceive them to be effective. Future studies may wish to explore the effectiveness of the individual accommodations within DAPs, in order to go beyond their mere presence, as we have done at this early stage.

In order to address an obvious limitation in our data, examining student attendance of both seminars and lectures would allow for easier comparison with prior research and a more nuanced understanding of the impact of attendance. Similarly, detailed attendance records would allow for an assessment of performance on specific exam content like in Marburger (2001), and might also allow further investigation of the effectiveness of lecture recordings as a substitute for physical attendance for individual sessions. However, lecture attendance is more difficult to capture than the smaller, closed environments of seminars, most especially in large modules such as the context herein. Future research may also want to consider student engagement as well as attendance. Indeed, the sole use herein of ‘available data’ has presented a limitation to the possible analyses and verifications we have been able to conduct. While a ‘fully planned’ research project may yield more information, we remain firmly of the belief that academics have much to gain by examining and sharing the information available to them, as we have done here. In particular, the changes that were required due to COVID-19 can be similarly explored, and hence such work, alongside this contribution, can provide a baseline for peri- and post- COVID-19 comparisons.

Our findings also suggest a number of wider areas for further pedagogic research. Much of the extant literature, this study included, focuses on a single module, but it would be beneficial to explore a broader range of modules,

perhaps at several institutions (Terry *et al.*, 2015). This would, of course, be exponentially more difficult, but would provide evidence with greater generalisability.

FOOTNOTES

¹ This reminder is designed to encourage lecture attendance over sole reliance on recordings, but is essentially an idle threat in that it has never been actioned.

² Informal feedback suggests this is mainly due to time constraints, rather than general motivation, which is not usually considered an issue with fee-paying post-graduate students.

³ These are the standard grade boundaries for the university in question over which we have no control. Assessments are written with these grade boundaries in mind so, for instance, only those deserving of a pass are able to score over 40%.

⁴ We additionally explored the same model and variables with a categorical dependent variable of exam grade (fail, pass, merit, distinction) using ordered-probit techniques. In this case, we found that for each seminar attended, students had a 3% greater chance of achieving a merit and 4% greater chance of achieving a distinction-level grade. However, since ordered-probit results are harder to interpret and require the loss of data variation due to conflating performance to only four possibilities, we adopted the OLS approach for our main results. It is nevertheless important to note that the results of these ordered-probit estimations are consistent with the main findings presented herein. Full details of our ordered-probit findings are available on request.

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TABLES

TABLE.1: DESCRIPTIVE STATISTICS

| | Mean | SD | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|-------|-------|-------|--------|--------|-------|--------|--------|--------|-------|------|------|
| 1. Exam score | 57.94 | 12.59 | - | | | | | | | | | |
| 2. Year | 0.53 | 0.50 | 0.10* | - | | | | | | | | |
| 3. Lecture Group | 0.47 | 0.50 | 0.06 | 0.02 | - | | | | | | | |
| 4. Prior Economics | 0.16 | 0.36 | -0.01 | -0.19* | -0.27* | - | | | | | | |
| 5. Gender | 0.34 | 0.48 | -0.03 | 0.06 | 0.10* | 0.09 | - | | | | | |
| 6. DAP | 0.02 | 0.13 | 0.03 | 0.06 | 0.10* | -0.06 | 0.06 | - | | | | |
| 7. English as Main Language | 0.31 | 0.46 | 0.01 | 0.10 | 0.10* | 0.03 | 0.36* | 0.11* | - | | | |
| 8. Formative Assessment Score | 47.27 | 13.10 | 0.24* | -0.05 | 0.01 | -0.01 | -0.02 | -0.13* | -0.02 | - | | |
| 9. Formative Assessment Grade Category ^a | 0.90 | 0.69 | 0.21* | -0.03 | -0.01 | -0.04 | -0.02 | -0.09 | -0.04 | 0.88* | - | |
| 10. Seminar Attendance | 2.99 | 1.19 | 0.21* | -0.12* | 0.01 | -0.08 | -0.29* | -0.08 | -0.29* | 0.10 | 0.08 | - |
| 11. Recording View Category ^b | 1.40 | 1.20 | 0.12* | 0.01 | -0.01 | -0.02 | 0.02 | 0.01 | 0.15* | 0.04 | 0.07 | 0.05 |

* $p < .05$ ^a NB this refers to the mean of the category for Formative Assessment Grade Categories given the categorical nature of the variable (i.e. 0-4). ^b NB this refers to the mean of the category for Recording Views Categories given the categorical nature of the variable (i.e. 0-3). The mean numbers of recording views is 8.04 per student, with each viewing lasting a mean length of 35.46 minutes.

TABLE.2: OLS REGRESSION.**DEPENDENT VARIABLE: EXAM SCORE**

| Independent Variables | (1) | (2) | (3) |
|---|-----------------|-----------------|-----------------|
| Intercept | 56.08*** (1.18) | 36.90*** (3.36) | 43.44*** (2.82) |
| Year | 2.59** (1.27) | 3.91*** (1.27) | 3.74*** (1.28) |
| Lecture Group | 1.71 (1.31) | 1.61 (1.33) | 1.78 (1.34) |
| Prior Economics | 0.11 (1.81) | 1.00 (1.83) | 1.29 (1.85) |
| Gender | -1.35 (1.41) | -0.64 (1.49) | -0.89 (1.51) |
| DAP | 2.78 (4.86) | 6.99 (5.44) | 5.86 (5.46) |
| English as Main Language | 0.24 (1.44) | 1.48 (1.52) | 1.65 (1.54) |
| Formative Assessment Score | | 0.22*** (0.05) | |
| Formative Assessment Grade Category (Fail, base) | | | |
| Pass | | | 4.08*** (1.46) |
| Merit | | | 8.34*** (2.08) |
| Distinction | | | 7.37 (5.08) |
| Seminar Attendance | | 2.08*** (0.66) | 2.16*** (0.67) |
| Recording View Category (0, base) | | | |
| 1-5 Views | | 1.51 (1.75) | 1.70 (1.77) |
| 6-11 Views | | 3.02 (1.93) | 3.21* (1.94) |
| 12+ Views | | 1.95 (1.63) | 1.77 (1.65) |
| R ² | 0.02 | 0.13 | 0.12 |
| Adjusted R ² | 0.01 | 0.10 | 0.09 |
| F | (6, 408) 1.23 | (11, 350) 4.68 | (13, 348) 3.69 |
| N | 415 | 362 | 362 |

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Note: Standard Error in parentheses.