Educating the Netflix Generation: Evaluating the impact of teaching videos across a Science and Engineering Faculty

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ABSTRACT

In 2017, the Faculty of Science and Engineering at Manchester Metropolitan University began an initiative that led to the creation of over 2000 teaching and learning videos to support students across eight distinct STEM disciplines ranging from Engineering to Geography. The primary aim of the video initiative was to improve teaching metrics across the Faculty; specifically, around retention and progression. Student feedback on the videos via staff comments and student surveys has been consistently positive since the initiative began. However, evidence of the videos' direct impact on students' performance has until now not been measured. This paper reports the findings of the quantitative component of a mixed methods study to investigate the effectiveness of the video initiative on unit performance. Our sample consisted of 1248 first year and second year undergraduates (L4 and L5 in the UK). Whilst controlling for other factors, regression analysis revealed that viewing more videos, positively correlated with final unit mark.

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Although effect size was small, video view was the only significant contributor to improved unit performance besides entry qualification and ethnicity. When repeating the analysis to measure the probability of passing the unit, and of obtaining a good honours degree outcome, videos significantly improved the chance of getting a good honours degree but did not predict pass rates significantly.

A further qualitative study is now underway to investigate why, how and when students at Manchester Metropolitan make use of the video resources, and how students' use of video impacts on their learning and academic performance.

1. INTRODUCTION

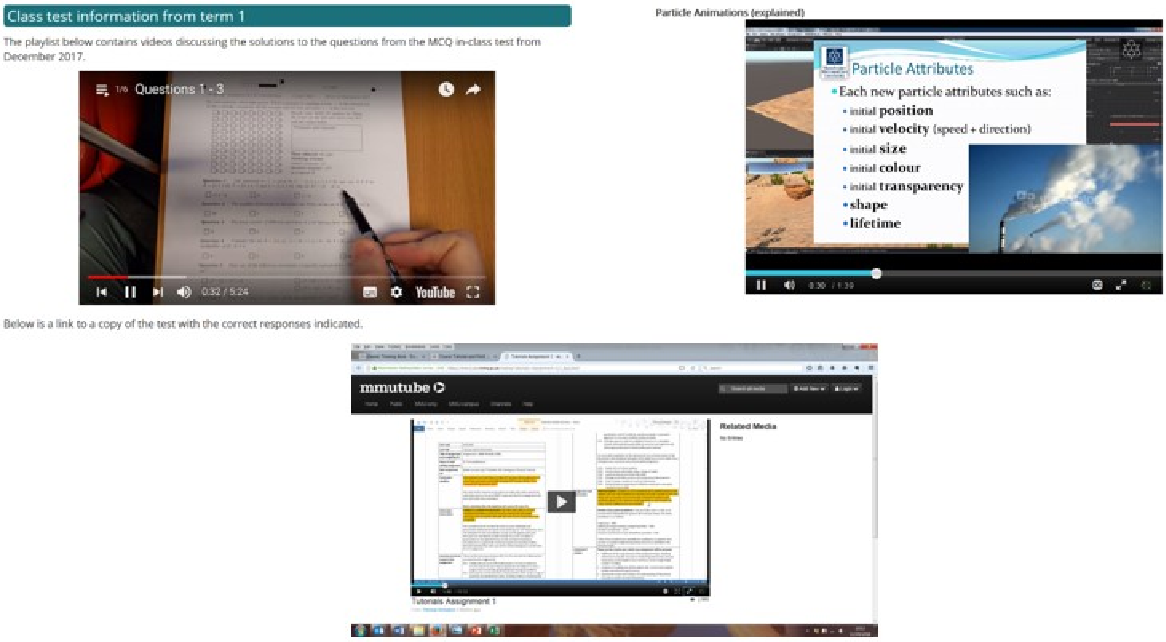
Video and other forms of rich media materials are now an important part of higher education (Saunders and Hutt, 2014; Gillie et al., 2017). Video resources are either integrated into the Virtual Learning Environment as part of on-campus face-to-face courses or often form the main information-delivery mechanism in on-line courses. Multiple studies have shown that technology can positively influence learning (e.g., Means et al., 2010; Bernard et al., 2014), and that it can be a highly efficient educational tool (e.g., Allen and Smith, 2012; Rackaway, 2012; Stockwell et al., 2015). Taslibeyaz et al. (2017) conducted several case studies to show that watching videos was beneficial for changing attitudes, encouraging cognitive learning and retaining knowledge. Similarly, Yousef et al.'s (2014) review of qualitative and quantitative papers found some evidence that use of video-based learning saw improvements in teaching methods and learning outcomes.

Video support, however, is not necessarily effective: Guo et al.'s (2014) study demonstrated that large segments of support videos are disregarded by students, while others argue that some videos contribute little to student performance (e.g. MacHardy and Pardos, (2015)). Furthermore, Dash et al. (2016) have shown that video support may not have the same value across all disciplines, but that it might be the best suited to illuminate abstract, hard-to-visualise phenomena and conceptual frameworks that are the foundation of STEM disciplines. Yet, there is no clear scientific consensus on what works for whom and in what circumstances, a question that this study begins to address.

The project began in 2017 in the Department of Engineering as a means of providing students with different ways of engaging with the core course material, of practising worked examples and revising at a time and place that worked for them. Since then, over 2000 videos have been made across the Faculty of Science and Engineering to support student learning and assessment. Our primary aim was to improve student performance at all levels of Undergraduate and Post Graduate Taught programmes, and to thereby increase rates of retention and progression across the Faculty. Secondary aims of the project were to improve the student learning experience and to offer increased flexibility in how and when students studied the course material. The videos were all designed and produced to be supplementary to existing on-campus face-to-face teaching, which is delivered primarily through lectures, seminars and laboratory classes. Short (5-7minute) videos were uploaded to the Virtual Learning Environment. Videos were made on each unit for core concept explanations, worked examples of seminar problems, past examination solutions, and laboratory information and training videos. Assessment briefings and feedback videos were also added to the suite of videos across each unit. The videos are made by academic staff, and by students in some cases, using a variety of tools (e.g. Kaltura; PowerPoint; Explain Everything). Staff either talk over prepared slides or pdfs, often annotating as they go, or they may make a YouTube style video. The students could access the videos via the Virtual Learning Environment anytime thy wished- either before or after lectures or during revision for the examinations. The videos were not generally used as part of the lecture or seminar sessions.

Figure 1 below shows screenshots of three different types of video that were made; talking through solutions to an examination paper, explaining the concept of “particle attributes” in animation and talking through a coursework briefing document.

Figure 1. Exemplar videos made in the Faculty



Student feedback on the video support materials (via staff comments and student surveys) has been consistently positive since the initiative began in early 2017. Students have told us that the provision of videos improved their engagement with their course of study and that the videos help them better prepare for examinations and familiarise themselves more quickly with “hard to understand” or threshold concepts that are prevalent in Engineering, for example.

However, the evidence we have had up to now for the direct impact of the videos on student performance in a particular unit of study is empirically unproven. There is therefore a pressing need to find evidence for the effectiveness of video on student learning and performance. This is the primary contribution of this study.

Our aim was to investigate whether students' level of engagement with the videos impacted on their academic performance in a specific unit. To achieve this, student cohorts enrolled to several units with video materials (in engineering, natural sciences, life sciences and computing) were compared to each other based on their level of engagement with videos. Regression analyses were applied that allowed us to assess the impact of video engagement when other key independent variables were neutralised. The analyses are then used to show whether the impact of video support on academic performance is significant and calculates the size of the effect through regression coefficients.

2. METHODOLOGY

Our study used a quantitative research design, which relied on secondary data exclusively from 8 units across the Faculty (4 first year and 4 second year units). Each selected unit had at least 80 enrolled students for academic year 2018/2019 and at least 5 videos (core concepts, exam paper solutions, coursework briefing etc) uploaded onto the Virtual Learning Environment (VLE). This gave us a sample size of 1442 students. Of those, we excluded those studying part-time (30) and those who did not engage with any VLE material in general (164). Final sample size was therefore 1248 students.

Our regression modes included multiple demographic characteristics and admission data of each student as a way of adjusting for (or accounting for) potentially confounding variables. The demographic data included the followings: gender, age, ethnicity, disability, socio-economic status (based on POLAR data, which is a geographically based UK measure of social and economic deprivation), and whether the student is registered as Home/EEA or overseas. Admissions data included the entry points and the level of study at entry (e.g. Vocational/A-level).

The outcome variable we used was academic performance (final unit marks). The independent variable of interest was the level of engagement with video materials, which was collected from the Institutional VLE. As the VLE only provides a binary information of views (e.g. someone viewed/did not view the material), a video engagement index was developed for each individual that shows the percentages of engagement (i.e. if a student engaged with 8 out of 20 videos, the index of 0.4 was assigned to the individual). The complete list of variables used in the study is shown in Table 1.

3. RESULTS

After establishing initial correlations and tendencies through descriptive and bivariate analyses, multivariate models were developed. Regression diagnostics were conducted to detect biases, based on the assumptions that (1) there is a linear relationship between outcome variables and predictors; (2) residuals are normally distributed; (3) no high correlations between independent variables; and (4) residuals are equally distributed (referred to as homoscedasticity) (5) no influential cases nor outliers.

Table 1. Complete list of variables used in the regression analysis

Independent variables

Variable Name	Level of measurement	Note
Level of Study	Nominal	*Level 4 (1st year undergraduate)/level 5 (2nd year undergraduate)*
Disability group (2-way)	Nominal	*Disabled/no disability*
First generaltion	Nominal	*Yes/no*
Gender	Nominal	*Male/Female*
Age	Nominal	*Young/Mature (mature students are those aged 21 or over)*
Overseas	Nominal	*Splits students based on fee status: Either Home/EU OR Overseas*
Entry Qual	Nominal	*Academic/Vocational: If students have at least one academic and no vocational qualifications (of equivalent size to an A level), they are classed as academic; if they have at least one vocational and no academic qualifications they are classed as vocational;*
Commuter	Nominal	*Commuter group is based on the students' term time postcode's distance from university (whether their travel time is more or less than 30 minutes) and their answers to the travel survey asked on enrolment*
Index of multiple Deprivation	Continuous	*POLAR4 quitile (most deprived neighbourhoods in UK)*
Ethnicity	Nominal	*White/BAME (Black and Asian Minority Ethnic)*
Above average Video views	Nominal	*above average/below average*
View / No view	Nominal	*Viewed at least one VSM (video support material)*
Video Engagement Index	Continuous	*standardised video engagement index was split by Units using z-score standardisation*

Dependent variables

Variable names	Level of measurement	Note
Final mark	Continuous	*standardised by unit*
70% or above (First Class Honours)	Nominal	*yes/no*
60% or above (Good Honours)	Nominal	*yes/no*
40% or above	Nominal	*yes/no*

3.1 Linear Regression – Unit Performance vs Video views

Multiple Linear Regression was run to assess hypotheses in relation to standardised unit marks. The model included the following predictors: video view, level of study, disability, first generation, age, entry qualification, clearing, commuting, multiple deprivation and ethnicity. The model produced R^2 = .186, F(11, 784) = 17.51, p < .001, suggesting that the model containing those predictors is significantly better than the one which does not rely on those predictors. Moreover, adjusted R^2 indicates that 18.6% of the variance in unit mark is explained by those predictors.

Regression coefficient results show that entry qualification (*b* = .725, p < .001) and ethnicity (*b* = .311, p < .001) act as the strongest predictors of unit mark. Video engagement also functions as a significant predictor of unit mark (*b* = .110, p < .001), whereas other factors do not predict unit performance significantly.

3.2 Logistic Regression – View/no View against Pass/Fail, above 60 and First

Logistic Regression analyses were also run to see whether viewing at least 1 video changes the likelihood of either passing the unit (requiring a mark of above 40%), or gaining a good honours grade (requiring a mark of 60% or above). The analysis included gender, entry qualification, ethnicity and view.

Findings suggest that looking at least one video does significantly improve the likelihood of getting an above 60% mark, and it is an even stronger predictor of getting a 1st class degree outcome (a mark of above 70%). However, it does NOT predict unit failure (a mark of below 40%) significantly. In other words, video support seemed to positively impact those students who are predicted to pass the unit but does not impact those who are about to fail on their units. Findings suggest that the better a student performs the more impact viewing video support materials have on their performance. The significant predictors are highlighted in bold in Table 2 below.

Table 2. Key predictors of unit performance

"40% or above" - prediction							
	coeff b	*s.e.*	*Wald*	*p-value*	*exp(b)*	*lower*	*upper*
Intercept	0.922	0.350	6.917	0.009	2.514		
GENDER (M=1)	-0.103	0.216	0.227	0.634	0.902	0.591	1.378
Entry Quals (Acad=1)	**1.659**	**0.227**	**53.366**	**0.000**	**5.254**	**3.367**	**8.201**
Ethnicity 2-way (White=1)	**0.455**	**0.218**	**4.337**	**0.037**	**1.576**	**1.027**	**2.418**
Viewed?	0.383	0.324	1.404	0.236	1.467	0.778	2.766

"60% or above (Good Honours)" - prediction							
	coeff b	*s.e.*	*Wald*	*p-value*	*exp(b)*	*lower*	*upper*
Intercept	-2.191	0.279	61.800	0.000	0.112		
GENDER (M=1)	**0.287**	**0.136**	**4.446**	**0.035**	**1.333**	**1.020**	**1.740**
Entry Quals (Acad=1)	**1.326**	**0.137**	**94.331**	**0.000**	**3.767**	**2.882**	**4.923**
Ethnicity 2-way (White=1)	**0.570**	**0.132**	**18.753**	**0.000**	**1.768**	**1.366**	**2.288**
Viewed?	**1.064**	**0.242**	**19.345**	**0.000**	**2.897**	**1.803**	**4.653**

"70% or above (First Class Honours)" - prediction							
	coeff b	*s.e.*	*Wald*	*p-value*	*exp(b)*	*lower*	*upper*
Intercept	-3.251	0.348	87.341	0.000	0.039		
GENDER (M=1)	**0.522**	**0.145**	**12.927**	**0.000**	**1.685**	**1.268**	**2.239**
Entry Quals (Acad=1)	**1.086**	**0.150**	**52.098**	**0.000**	**2.963**	**2.206**	**3.980**
Ethnicity 2-way (White=1)	**0.654**	**0.137**	**22.791**	**0.000**	**1.924**	**1.471**	**2.517**
Viewed?	**1.261**	**0.305**	**17.063**	**0.000**	**3.529**	**1.940**	**6.419**

4. DISCUSSION

As stated earlier, student engagement with and feedback on video support materials has been consistently positive since the initiative began in early 2017. Students had told us that the provision of videos improved their engagement with their course of study. In particular, the videos enabled students to prepare for examinations, better understand the coursework requirements and familiarise themselves more quickly with “hard to understand” or threshold concepts that are prevalent across all Science and Engineering disciplines. Such findings are not new, having been already reported by (Bernard et al., 2014, Stockwell et al., 2015 and Taslibeyaz et al. 2017).

The primary contribution of this study, however, is to build on this emerging consensus that video helps student learning, to show a direct correlation between viewing videos and unit performance. Our findings provide new evidence to counter the view of MacHardy and Pardos (2015) that videos contribute little to student performance. Our study shows that, controlling for other factors such as ethnicity and entry qualifications, a correlation between students level of engagement with the videos and improved unit performance. Although effect size was small, video view was the only significant contributor to improved unit performance besides entry qualification and ethnicity.

Importantly, given the current focus on teaching metrics and good honours (a mark of 60% or above)) outcomes in the UK, this study also shows the correlation between viewing the videos and student performance is most pronounced at the 60% mark. When repeating the analysis to measure the probability of passing the unit (requiring a mark of 40% or above), getting a good honours (>=60%) or getting a 1st class mark (70% or above), our findings indicated that higher engagement with videos significantly improve the chance of getting a mark >60% and a mark above 70% , but does not predict whether students pass the unit.

However, these findings do need to be treated with caution, as correlation does not necessarily imply causation. One possible effect that we were not able to adjust for, is that better students will reach better results in general, and that more motivated students are usually also more motivated to watch and engage with the additional video support. In other words, we cannot be sure that there is a direct causal relationship between viewing the videos and unit outcomes, despite our regression analysis.

Nevertheless, these findings are important for educators, particularly in STEM disciplines such as Engineering, where concepts and frameworks can be abstract and difficult. Without a proper understanding of the theoretical building blocks of the discipline - the so-called threshold concepts (Meyer and Land, 2003) - students' performance may be hindered and they may struggle to progress through their studies. Producing videos to support the teaching of engineering and other STEM disciplines can offer educators alternative ways of explaining concepts, practising worked examples and preparing students for assessment, which we have shown to correlate with improved unit performance. Additionally, by using video, educators can deliver their one best explanation to all students, available to view 24/7. Similarly, videos provide an alternative and additional means for students to engage with their studies, at a time and place which suits them as argued by (Matulich, Papp, & Haytko, 2008). With many of today's students coming from widening participation backgrounds, and having more complex patterns of study (for example combining study with part-time working or caring responsibilities), the provision of additional support resources such as video has become even more important to enable students to continue and succeed in Higher Education. And, as the Covid-19 pandemic continues to run its course around the globe, it is likely that more and more students will require on-demand access to additional support resources such as the types of videos described in this study, to help them progress successfully through Higher Education.

Whilst this study has shown a direct and positive correlation between students viewing the video resources and their unit performance, we now need to improve our understanding of why and how students used the videos. For example, what were the viewing/usage patterns for the videos?, which of the different types of video (examination solutions, assignment briefings, core concepts etc.) were most useful to students and why ?, and how did the videos compare to face-to face lectures and lecture captures as a tool for learning? Addressing these important questions will form the basis for the second part of this mixed methods study – a qualitative study based on student focus groups, which is currently underway.

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