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The Use of Virtual Learning Environments and their Impact on Academic Performance

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Abstract

Links have been reported in the literature between lecture attendance and academic performance. However, the effect of a student's use of a Virtual Learning Environment (VLE) on their academic performance is not an area which has been the subject of extensive research, but is likely of much interest both to students and

to the lecturers who develop resources for a VLE. This paper presents an examination of two modules from the 2010-2011 final year BEng Civil Engineering course at Loughborough University. Data from the students' academic performance is combined with usage logs of the VLE to search for relationships. Although correlations were generally weak, it was observed that the correlation was slightly stronger for the coursework only module than for the module with an exam assessment. It was also noted that the trend was more obvious for male students than for females, although female students were a small minority in the modules studied

Introduction

Virtual Learning Environments (VLE) have recently emerged as an important topic in education theory and practice (Weller, 2007). In theory, a well-maintained VLE should enable students of all learning styles to receive the best possible education, in a way that they may not in an exclusively lecture-based environment where the lectures tend to be focused on auditory learners only – those who learn best by listening (Williams & Fardon 2005, Vigentini, 2009). If the resources on a VLE do not cater to the needs of the students – both in terms of their format (text files, audio files, videos etc.) and their content – the VLE is rendered effectively useless as it does not add to the students' learning experience. Ideally (for co-located students rather than distance learners) it should contain just enough information to allow students to reinforce their work in lectures and to gain a broader and deeper understanding of the subject (Ofsted Report, 2009), preferably in a range of presentation styles, such as videos or audio files.

A student's experience in the classroom or lecture theatre depends on how well the teaching style fits with their individual learning style. The same issues exist with virtual systems and a variety of resources is needed in order to provide adequately for all learning styles. Many higher education institutions are increasingly fragmented and lacking in cohesion or unity (Whitworth, 2005) and regard VLEs as a way to help them overcome the problems introduced by the national increase in the number of students coming to university and the higher workload that this entails for lecturing and support staff (Richardson, 2001). There is, however, a danger that, if the resources available online are too comprehensive, students could cease attending lectures (Bromage, 2003), preferring instead to access lectures materials online and to carry out their studies from the comfort of their homes (Boyle et al, 2008). It can, therefore, be said that there are three types of VLE – those with too much information, which discourage students from attending lectures, those with too little, rendering the VLE largely useless, and those with just enough to allow students to reinforce their work in lectures and to gain a broader understanding of the subject (Ofsted Report, 2009).

The aim of this paper is to link data of students' academic performance with logs of their use of the VLE. Although direct causality may not be inferred between VLE use and academic performance, any correlations between VLE use and academic performance for different classes of students or for different types of modules can yield insights into the effective use of VLEs. Two modules from the final year of the BEng Civil Engineering programme at Loughborough University were studied: the Design Project and Geotechnics 3. Using students' VLE use logs and their corresponding final grades for the modules (both coursework and examinations),

evidence was sought for the existence of a link between their use of the VLE and their academic performance in each module. Two interviews of current students were also conducted in order to see whether the quantitative data aligns with students' views.

Related Research

Links have been established between lecture attendance and academic performance in fields as diverse as biological sciences (Gatherer and Manning, 1998), economics (Stanca, 2006), geography (Stewart et al., 2011) and psychology (Gunn, 1993). On the other hand, some researchers argue against relying on lectures alone. Lake (2001) found that physical therapy students in an "active learning" environment performed better than those in a more passive purely lecture-based environment, whilst St. Clair (1999) questions some of the research reported in the literature and articulates the case against compulsory lecture attendance.

The emergence of VLEs has added momentum to pedagogical research on the use of information technology. Being relatively new technologies, there have been fewer long-term studies of their usage, with studies usually focusing on the benefits of a VLE to a learning institution, or on the pedagogical deficiencies they help overcome (Coates et al., 2005).

Regardless of how well structured a VLE is, there will always be a difference in how diverse students use the resource. In a study of 209 students from Coventry University, it was found that whilst 57% of the students read learning materials and 52% downloaded learning materials, only 14% accessed external web pages

(Bromage, 2003). This implies that students tend to look at VLE resources simply as online versions of lecture notes rather than as a source of additional information to further their understanding. Mimirinis and Bhattacharya (2007) also note the challenge of designing a VLE for *deep* learning. Von Konsky et al. (2009) found that uploading audio recordings of lectures to the VLE did not impact lecture attendance, and students who both attended lectures as well as listened to online recordings tended to perform better. The positive impact of multimedia educational content was also indirectly reported by Issa et al. (1999) and Porta et al, (2008). The more general question of the link between VLE use and academic performance has received less direct attention. Maltby and Mackie (2009) analysed links between academic performance and VLE "click count tracking data" in a set of Business School undergraduates. The introduction of the VLE was found to have mixed effects. Lee et al (2009) observed a clear positive correlation between VLE use and academic performance in the university study of Japanese language. Similar results were reported in psychology (Beaman and Harvey 2005) and medicine (Johnson 2008).

Research Methodology

Assessment records for the Design Project and Geotechnics 3 modules from academic year 2009-2010 were made anonymous by a member of academic staff by assigning unique identifiers to each student. The same identifiers were also applied to render the VLE usage logs anonymous. Each student's sex and the first two characters of their university registration number (denoting the year they joined the university only) were retained in the process of data preparation. This distinguished

those students who had completed an industrial placement before taking the modules from those who proceeded directly from the second year to the third year. The Design Project module had 56 students in total, and Geotechnics 3 had 101 students in total. Of those cohorts, 54 students took both modules. The instructors from both modules adhered to the university's policy of making as many resources as possible available on the VLE, and encouraging (but not mandating) VLE use by the students.

The VLE logs detailed the action taken (e.g. looking at 'course view'), the date and time at which the action was taken, what information was accessed and the IP address of the user, for all visitors to the VLE over the duration of the module.

In order to establish the number of visits of each student, the dates and times of their actions were grouped together in blocks. If more than 30 minutes had elapsed between actions, the student was considered to have ended a visit and any subsequent actions would be counted as a separate visit.

Not all actions taken were views of resource material posted to the site by a lecturer. Other actions, such as looking at the module homepage ('course view') or at the list of students enrolled on the module ('user view') were included in the analysis, despite not necessarily aiding the students academically. The definition of an 'action' was therefore refined to include only resource, forum and user views, excluding course views and blog views. These were the most commonly occurring actions and, it was felt, were the ones which could most benefit the students. When displayed graphically it was clear that few students used either 'forum view' or 'user view' and that by far the most common action was 'resource view'. Although forums are

generally considered to be a useful tool (Stimson, 1997, Crook, 2000, Bromage, 2003), the low numbers of students using them and the low frequency of use (no student viewed the forums more than 3 times in Geotechnics 3 and 11 times in the Design Project) lead to the conclusion that little useful information was being conveyed via the forum pages and that they therefore had a negligible impact on students' academic performance. This low use of forums is not unique to these modules, but has been observed in different studies (Bromage, 2003, Crook, 2000, Wells et al., 2008). Subsequent analysis therefore considered only the number of *resource* views, when accessing resources such as tutorial sheets, web links or exam papers and answers.

It is generally accepted that male and female students tend to learn best in different ways (Philbin et al. 1995). In order to allow for this, the data was split by the students' sex and was shown separately where possible. In an effort to form a clearer impression of the true relationships between the number of resource views and final grade for male and female students, the data from both modules was combined and split by sex, showing overall trends.. As there is too little data on the female students to enable confident identification of any trends, it was decided that the analysis should focus on the male students or on all of the students when considered irrespective of their sex.

Following on from the graphical analysis of the data, Spearman's Rank-Order Correlation Coefficients and Pearson's Product-Moment Correlation Coefficients were calculated for the various combination of modules and sex: male students in the Design Project, Geotechnics 3 or both modules combined, female students in the

Design Project, Geotechnics 3 or both modules and all students (both male and female) in the Design Project, Geotechnics 3 or both modules combined.

Two interviews were conducted in order to establish a link between the quantitative data and students' actual perceptions. The sample size of two was deemed to be necessary and sufficient to supplement the quantitative data with subjective, qualitative perceptions. A convenience sampling strategy was adopted, with the sample stratified by sex so that one male student and one female student were interviewed. The interviews were audio recorded and transcribed.

Results and Discussion

Figures 1 and 2 are histograms showing the distribution of VLE visits among students from the Geotechnics and Design Project modules respectively.

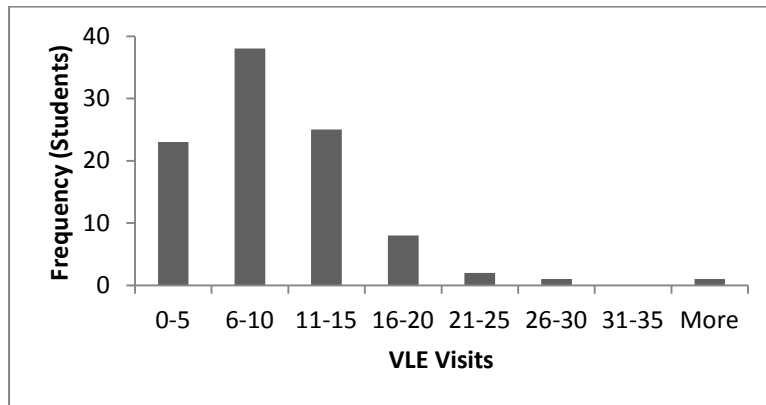


Figure 12: Histogram showing frequency of visits to VLE by Geotechnics 3 students.

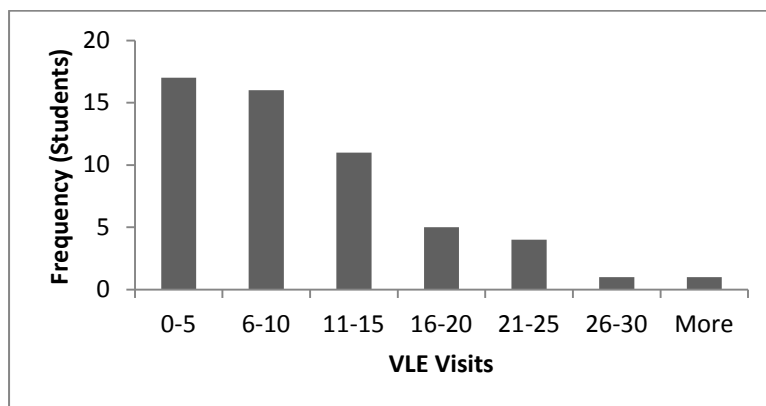


Figure 13: Histogram showing frequency of visits to VLE by Design Project students.

It is clear from Figures 1 and 2 that few students in either module made more than 20 visits to the VLE, with an average view count of 9.7 views per student in the Geotechnics module and 10.7 views in the Design Project. Although it may appear that the Design Project was visited more often, it ran over two semesters with a total of 24 taught weeks and 8 weeks of holidays (Easter and Christmas) whilst Geotechnics 3 ran for one semester with 12 taught weeks and a 4-week holiday at

Christmas. It would then be expected that the Design Project VLE would be visited twice as often as that for Geotechnics as it is twice as long but this was not the case. However, Figures 3 and 4, which show the distribution of final grades for the Geotechnics and Design Project modules respectively, show that the final grades achieved in the Design Project were in a tighter grouping, with the majority of students receiving 60-70%, compared with a spread of 50-80% in the Geotechnics module.

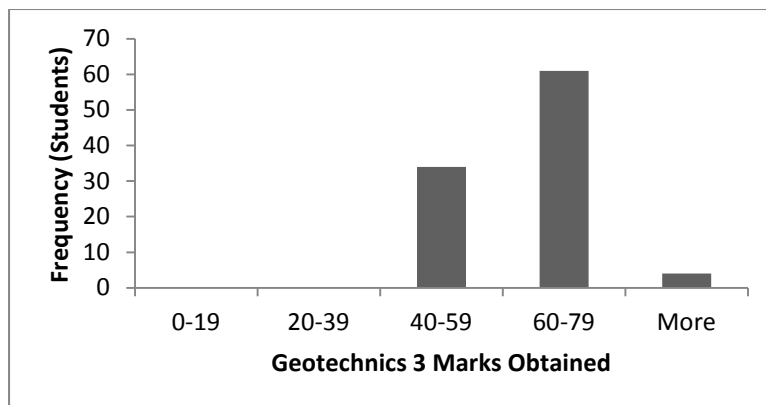


Figure 14: Histogram showing marks obtained by Geotechnics 3 students.

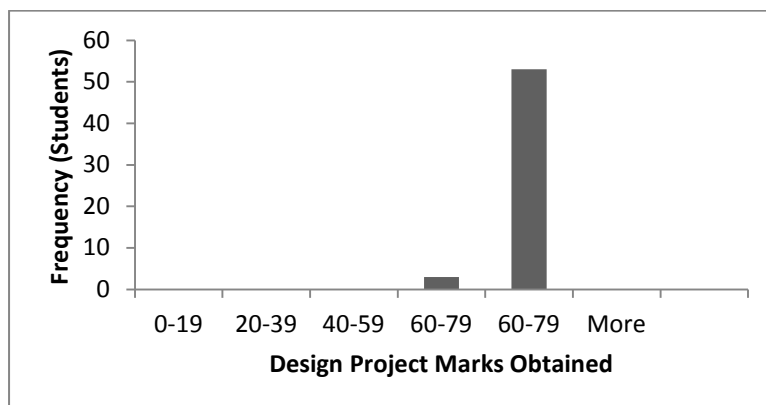


Figure 15: Histogram showing marks obtained by Design Project students.

This finding implies that the resources for the Design Project are better suited to enabling students of all learning styles to achieve similar grades. This observation

might also be due to the inherent nature of design work, assessed entirely using group coursework and its depending somewhat on the instructor's subjective judgement. If we were to consider this in relation to the fewer number of times that the Design Project page was visited, we could infer that the resources for the Design Project are perhaps more focused towards the students' needs than those for Geotechnics.

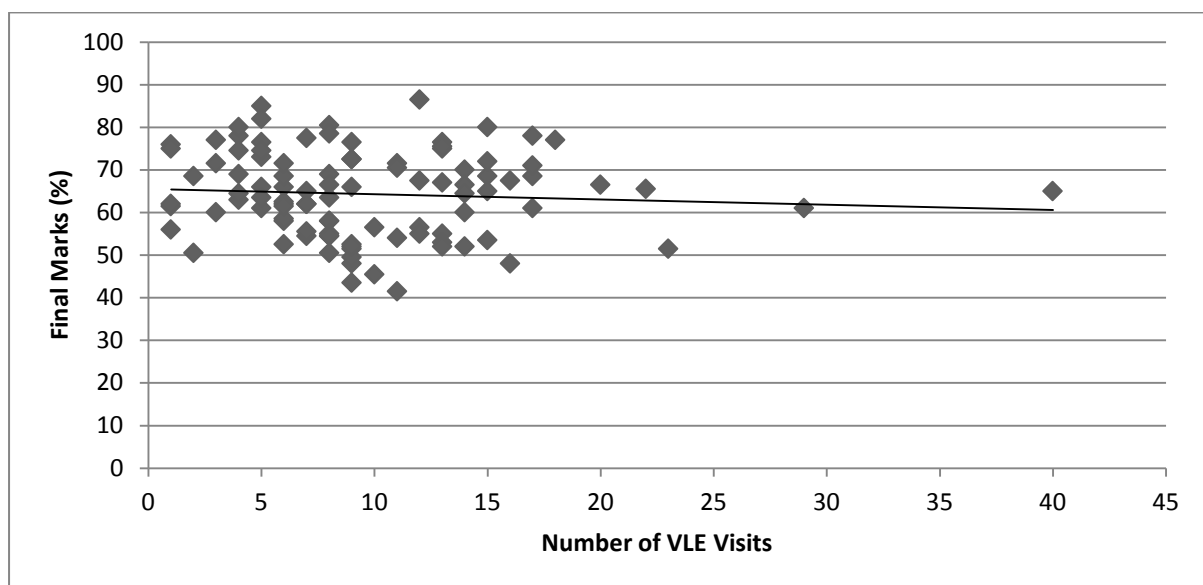


Figure 16: Number of VLE visits vs. Final Marks for Geotechnics students.

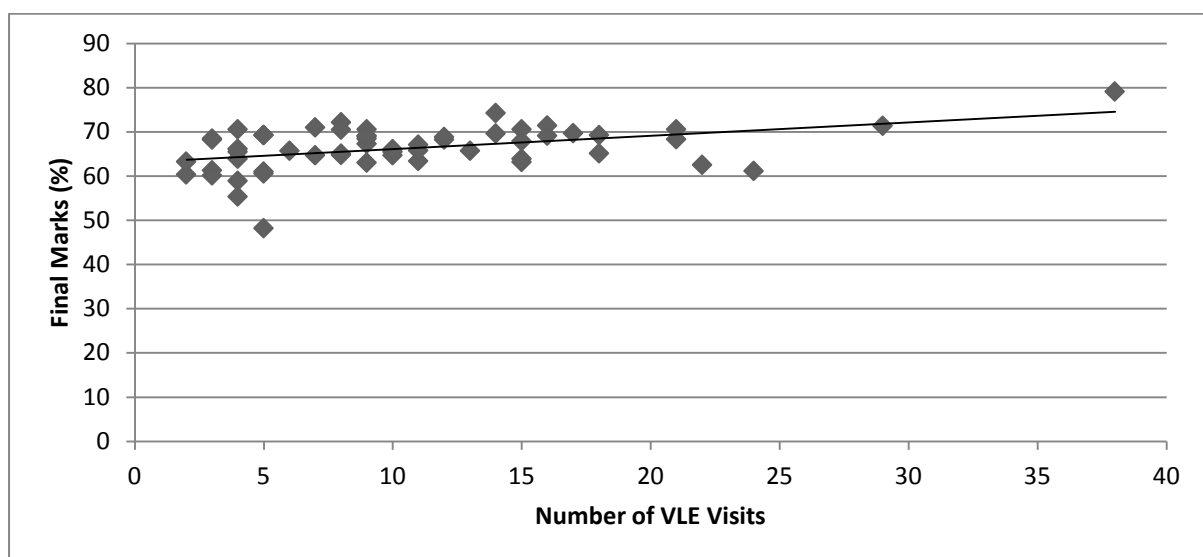


Figure 17: Number of VLE visits vs. Final Marks for Design Project students.

Figures 5 and 6 show the final marks against the VLE visits for Geotechnics and Design Project students respectively. Figure 6 supports the positive evaluation of the Design Project VLE resources, showing a moderate positive correlation between the number of times a student visited the Design Project pages on the VLE and their final grade in that module. However, Figure 5 shows a weak negative correlation between the two variables for Geotechnics, suggesting that the more times a student visits the VLE, the lower their final grade in this module becomes. Logically, this is unlikely to reflect a causal relationship as we would expect that increased use of the VLE resources for a subject would either increase a student's grade or have no impact at all and is highly unlikely to lower their grade. A more in-depth analysis of the data is required to establish why the Geotechnics module suggested a negative correlation.

One of the most common actions taken on any visit was to look at the module homepage ('course view') from which point a student may access any part of the VLE relating to that module. As this is merely a gateway to relevant information, and does not contain any academic resources, it was discounted from the analysis. The frequencies of the three remaining actions – resource, forum and user view – are shown in Figures 7 and 8;

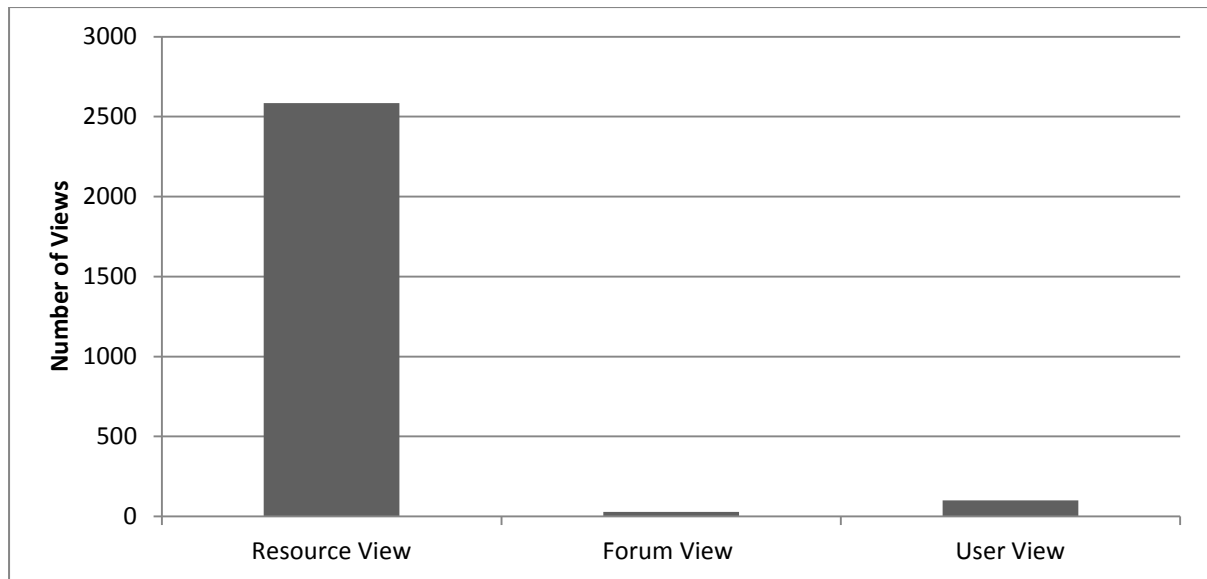


Figure 18: Frequency of various types of views by students in the Geotechnics VLE.

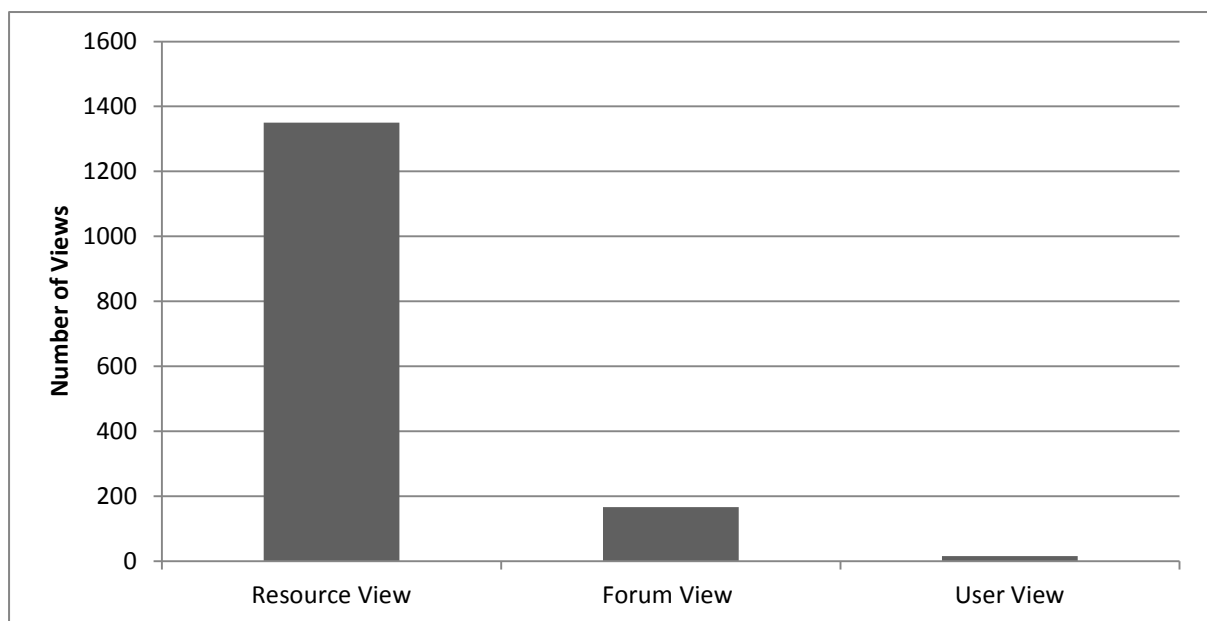


Figure 19: Frequency of various types of views by students in the Design Project VLE.

The vast majority of the actions were resource views. Therefore only resource views were considered in all further analysis, as they would have the strongest impact on student performance.

Figures 9 and 10 show the number of resource views against the final marks received for each student in the Geotechnics and Design Project modules. Those figures are refinements of Figures 5 and 6 respectively, but considering only resource views rather than all VLE visits.

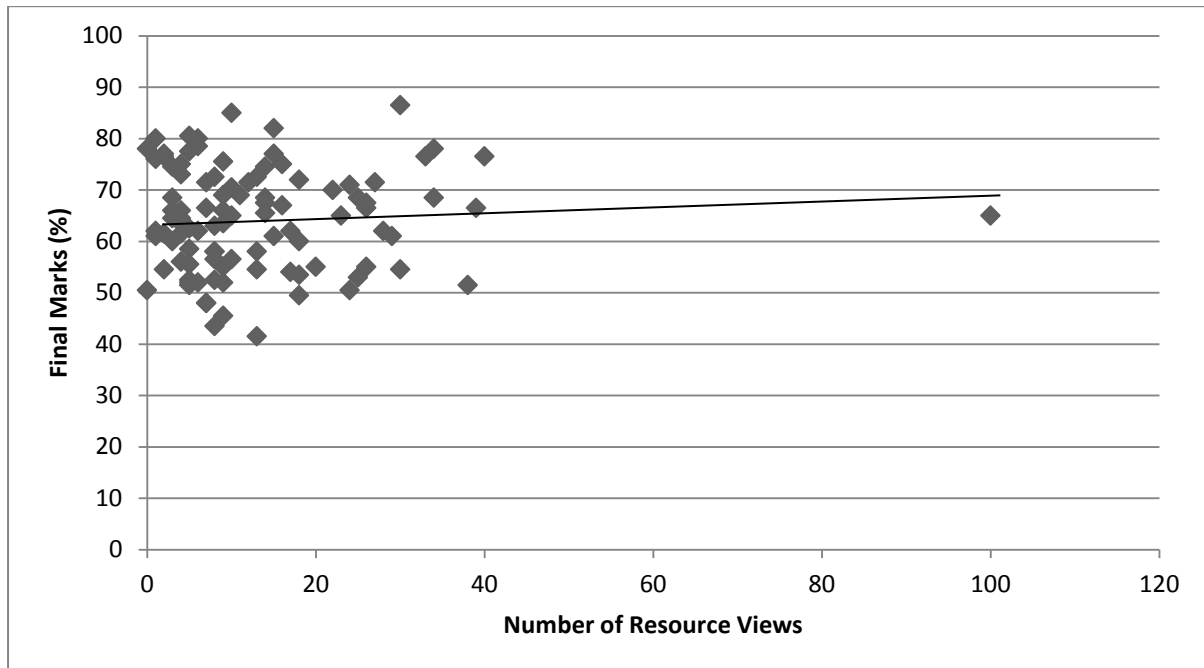


Figure 20: Number of resource views vs. Final Marks for Geotechnics students.

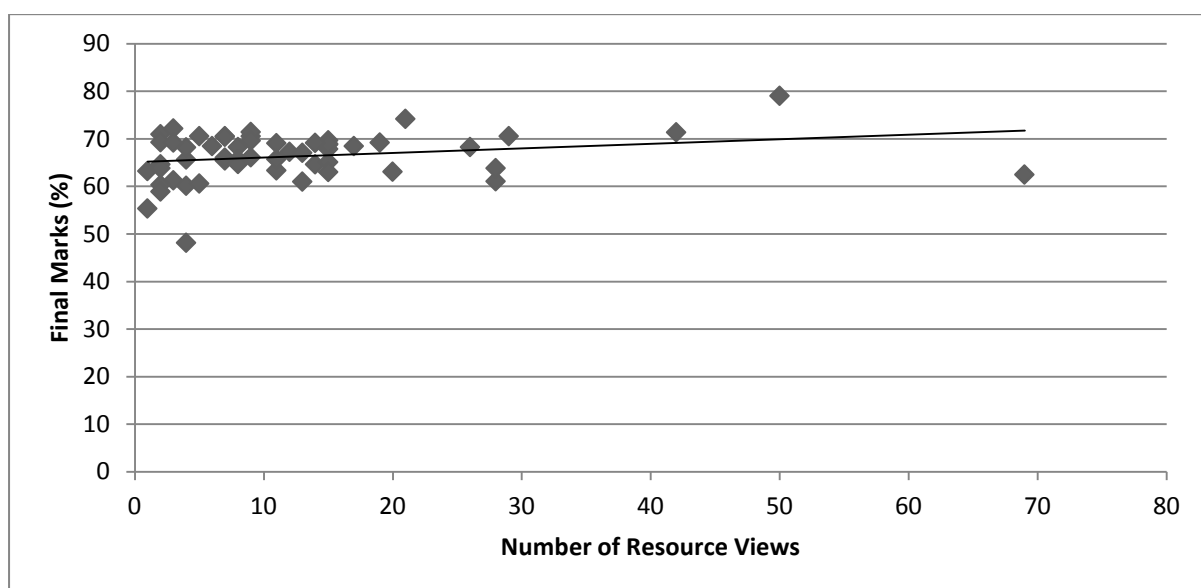


Figure 21: Number of resource views vs. Final Marks for Design Project students.

We can immediately see that this refinement of the data has a positive effect in the case of the graph for Geotechnics (Figure 9), showing a slight positive trend between the two variables, which is far more reasonable than the negative trend in Figure 5. Little change can be observed between the two graphs for the Design Project (Figures 6 and 10), which may indicate that the students were quickly and easily finding the resources they needed without needing to search through general pages or areas on the site in order to find for the resource needed. Additionally, Figures 9 and 10 also show that few students on either module made more than 30 resource views in total, with an average of 0.8 views per week for the Geotechnics module and 0.4 views per week for the Design Project. Once again, the difference in the number of views between the two modules is not consistent with the difference in their lengths. The two modules are, in some respects, not directly comparable as the Design Project is a 100% coursework-assessed module whereas Geotechnics consists of both coursework and an exam.

There were a few female students on the two modules. The data was divided by the sex of the students to uncover any difference in learning styles between males and females. Figures 11 and 12 show the same data as Figures 9 and 10 – the number of resource views logged for each student against the final mark that the student received – but are split by the student's sex.

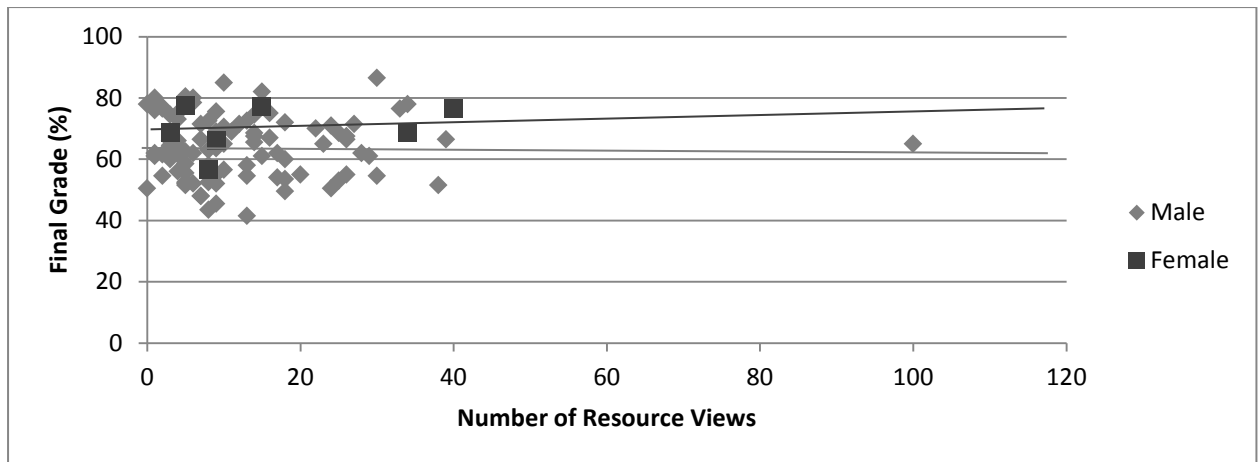


Figure 22: Number of resource views vs. Final Marks for Geotechnics male and female students.

Whilst figure 11 shows a positive correlation for the female students, it shows very little – if any – correlation for the male students, implying that whilst increased resource views are beneficial to female students, there is little impact for male students. Indeed, we can clearly see that some students who have looked at fewer resources have received similar – if not higher – final grades than those of their peers who looked at more resources. Inevitably, the students' learning styles will play a large part in this, with some students learning better by utilising paper resources such as lecture notes or library resources than by using virtual resources, as found on a VLE.

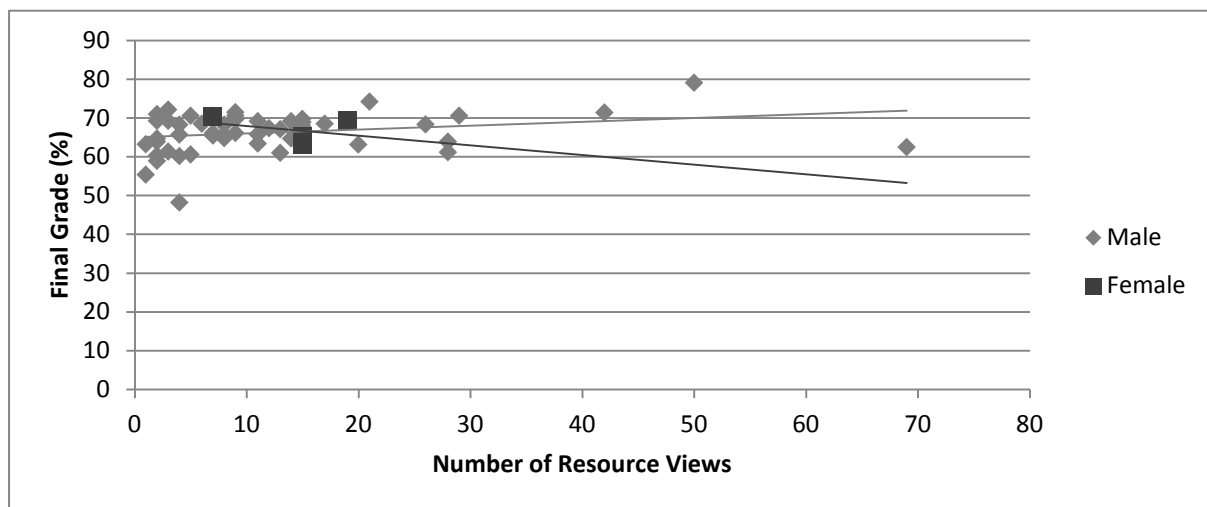


Figure 12: Number of resource views vs. Final Grade for Design Project male and female students

Conversely, Figure 12 (for the Design Project) shows a moderate positive trend for the male students, but a moderate negative one for the female students, leading us to conclude that the VLE resources are far more useful for the male students on the module. It should be noted for these analyses that the trends for the female students are far less statistically significant due to the low numbers of data points. As this introduces uncertainties into the analysis, it is inadvisable to attempt to draw firm conclusions from the data.

Whilst we are able to compare students' use of the VLE for the Geotechnics and Design Project modules, we cannot as yet compare them to students' general use of the VLE over all of their modules. In order to provide some basis for comparison, Figures 13 and 14 were developed, showing the number of resource views and final grade for all students in the study, considering both modules, with graph 13 splitting the students by sex.

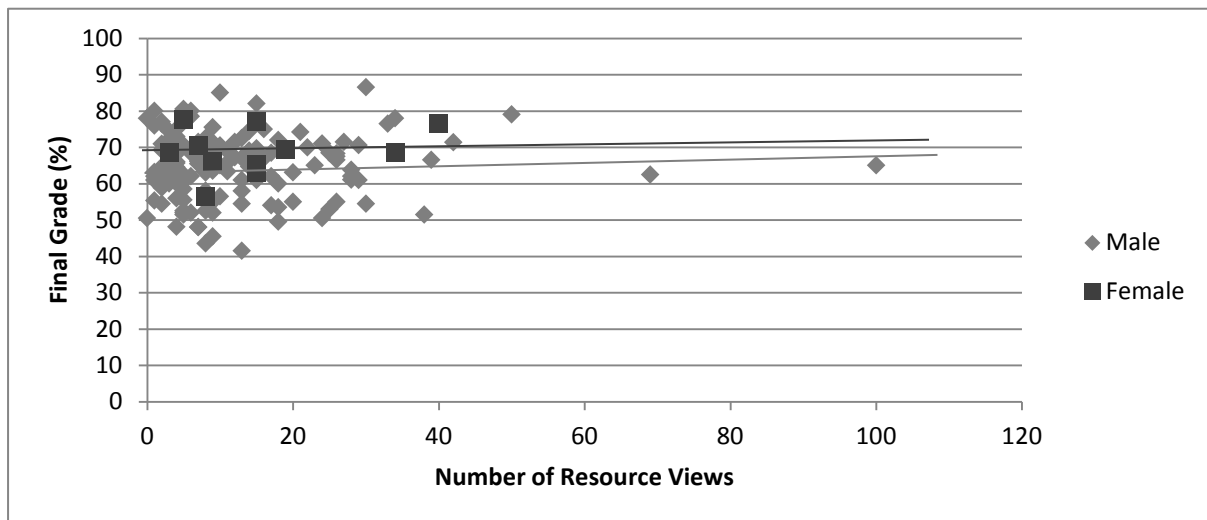


Figure 13: Number of Resource Views against Final Grade (both modules combined)

Figure 13 shows a slight positive trend in the case of the male students, but no real relationship for the female students. The latter observation will be due, in part, to the shortage of data that for female students.

When the data for the male students was considered separately, it was seen that the relationship in the Geotechnics module is far weaker than the overall trend. It is therefore possible to say that the resources on the VLE for Geotechnics do not significantly aid male students. Those students who have obtained higher marks than their peers will most likely either have a natural affinity for the teaching methods employed in the lectures and have a lesser need for additional information or resources, or make greater use of library resources (or other sources of additional information) than they do of the VLE.

By contrast, VLE use in the Design Project appears to have a far greater correlation with students' grades. Whilst the Geotechnics module is largely based around

lectures, with much of the information that the students need being given out as lecture notes or hand-outs, the majority of the work for the Design Project takes place outside of lectures in the students' own time with far less paper-based information being distributed. The Design Project students will therefore have a greater reliance on the VLE as the primary source for information. Having the majority of the required resources available via the internet allows the group members to work independently, and meet solely to 'touch base' and assist each other as required. This flexibility of working is aided by other synchronous and asynchronous communication media such as email, social network sites and mobile telephones.

Following on from the graphical analysis, Spearman's Rank-Order Correlation Coefficients and Pearson's Product-Moment Correlation Coefficients were calculated for the various combinations of student categories; male students in the Design Project, Geotechnics 3 or both modules, female students in the Design Project, Geotechnics 3 or both modules and all students (both male and female) in the Design Project, Geotechnics 3 or both modules and were displayed in Figures 14 and 15;

		Gender		
		Male	Female	Both
Module	Design Project	0.288	-0.316	0.248
	Geotechnics	-0.018	0.127	0.005
	Both	0.065	0.000	0.077

Figure 14: Spearman's Rank-Order Correlation Coefficients for all combinations of gender and module

		Gender		
		Male	Female	Both
Module	Design Project	0.247	-0.341	0.238
	Geotechnics	0.020	0.296	0.044
	Both	0.062	0.268	0.077

Figure 15: Pearson's Product-Moment Correlation Coefficients for all combinations of gender and module

If we again disregard the data for the female students, we can see that the Spearman's Correlation values (figure 14) for the male students and for both sexes combined are very similar for the Design Project and for both modules combined, further highlighting how little that female data influences the analysis. The values for Geotechnics are also similar, ranging from 0.005 combined to -0.018 for male students only. As a value of 1 indicates a strong positive correlation between the two variables, -1 a strong negative correlation and 0 no correlation, we can say with some confidence that there appears to be little benefit for students' grades in

increased viewing of the VLE resources for Geotechnics. Although the values for the Design Project – of 0.248 combined and 0.288 for the male students only – do not suggest a *strong* correlation, they do show that there is a positive relationship between the two. Further analysis into this could suggest methods of improving this correlation, allowing the students to improve their performance that module.

The Pearson's Coefficients suggest similar relationships, with small positive correlations of 0.247 and 0.238 respectively for male students and both genders combined on the Design Project. A negligible correlation is also observed in Geotechnics for male students and both genders combined, with values of 0.020 and 0.044 respectively suggesting again that increased VLE usage has little effect on the students' final grades in this module.

Interviews

Two students were interviewed and there was some agreement in their responses. Both students felt that the VLE was best suited as a source for additional information, rather than as a primary teaching resource, and found the past papers to be the most useful resources available on the VLE for modules assessed by exams. However, they also noted that they tended to utilise them more during the exam seasons, often ignoring the VLE for the rest of the semester and focusing on lecture notes or their own notes taken in lectures. Neither the time and date of students' actions nor the number of views of past exam papers compared with other resources were considered in any of the above analyses, so few direct comparisons may be made. This may, however, help to explain the poor relationship between the number of resources viewed and grade observed in the Geotechnics module as the

majority of students are perhaps not making full use of any links or background information posted to the VLE and are relying primarily on lecture notes for their studies for most of the semester.

Neither interviewee was aware of the forums on the VLE, with both stating that they felt they would have used them if they had been told about them at the beginning of the course. As Crook (2000) noted, many students tend to avoid posting on forums for fear that their questions would make them look foolish to their peers. With minimal student use of the forums, lecturers will also be less inclined to post there or check for queries and the forums can quickly become obsolete. Conversely, if anonymous posting or posting under usernames is permitted, students can feel over-secure in posting, leading to the forum boards becoming a tool for bullying, as found on the forums at the University of Edinburgh by de la Varre et al. (2005).

When it came to their preferred methods of contacting lecturers with queries, the female interviewee stated that she would always prefer to talk to a lecturer face-to-face whilst the male interviewee preferred to email the lecturer with questions, but would meet in person if further explanation of an issue was required. Inevitably, different students will have different preferences which will be affected by their individual circumstances. The male interviewee did much of his work away from campus, so felt it was easier to use email to ask questions than having to travel onto campus to meet a lecturer in person. He is also less likely to experience difficulties in understanding a lecturer's email than the female interviewee, who was an international student.

Whilst both students found the past papers and tutorials highly useful for Geotechnics, they felt that the resources were better in the Design Project. The male interviewee felt that this was partly because there was less contact time for this module, so lecturers had little choice but to distribute information via the VLE or email. It was also noted that the availability of the information on the VLE allowed the students to work on their coursework wherever and whenever they chose, without having to meet to share paper resources between their coursework groups.

Conclusions

This study found that the VLE had very little effect on students' academic performance within the Geotechnics module, but a moderate effect on their performance in the Design Project in the final year of the BEng Civil Engineering programme at Loughborough University. Both the Spearman's and Pearson's Correlation Coefficients showed negligible relationships between VLE use and academic performance within Geotechnics and a small positive relationship in the Design Project. It therefore appears that the inclusion of VLE resources into modules which are comprised of 100% coursework – such as the Design Project – is more beneficial than for modules which are split between coursework and exams, such as Geotechnics.

By far the most common action taken by students visiting the VLE was resource view, although the study did not investigate what resource was most utilised. The forums were used far less, however this may be more due to lack of awareness rather than an indication of their uselessness. Both students who were interviewed

gave positive reactions to the possibility of forums and believed that they could be a useful tool. They also stated that neither module in the study made use of alternate media in the presentation of resources uploaded to the VLE. It may be that if lecturers were encouraged to develop a wider range of resources for the VLE, and also to make use of the forums as a method of answering students' queries, the VLE could be used to its full potential and may better aid students in achieving intended learning outcomes.

A limitation of this research is its comparison to two modules with contrasting subject matter and assessment. A suggested direction for future research is to compare more similar modules, isolating the effect of VLE use and reducing other confounding factors.

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