

Investigating the relationship between engagement and learning outcomes in an online learning environment

In the UK and globally, higher education providers are transitioning to remote learning approaches to meet the needs of their students. As digital pedagogy and online learning approaches become more mainstream, understanding the role of student engagement is critical.

None of this is new to Kaplan Open Learning (KOL). Working closely with their partner universities, their vision is to become a world leader in online learning, making higher education accessible to anyone with the potential and drive to succeed. KOL develop, deliver, support and market sector-leading online higher education programmes to a global student audience. Their innovative and unique online pedagogy utilises the latest digital learning technologies to provide teaching excellence and a world-class student experience.

Providing their students with eTextbooks via VitalSource Bookshelf® produced insights into student learning behaviour and outcomes. This research paper is based on Kaplan Open Learning students studying 100% online courses and uses module data from the bespoke, KOL Learning Analytic System (LAS) as well as learning analytics from VitalSource. It examines the relationship between the student's final module grades and their engagement with their core eTextbooks for that module.

Although causality cannot be directly inferred, findings suggest a statistically significant relationship between the level of engagement and the outcome for that module. The relationship is clear at a high level and, for the most part, persists when the data is viewed at a more granular level to consider course level and discipline. In this whitepaper we discuss the findings in more detail, including possible explanations for those few programmes which did not follow this pattern.

KEY FINDINGS

Evidence of impact in educational resources is hard to measure due to the number of variables at play and, therefore, the following findings do not attribute causality.

- The results suggest a statistically significant positive relationship between the number of study sessions with the VitalSource eTextbook and a student's final grade.
- This relationship is apparent across almost all courses, regardless of subject and level.
- Other student behaviours were also identified as having a relationship with the module grade: the duration of the session, accessing content on a mobile or cell phone, and the use of learning tools built in to the platform.

BACKGROUND

Embedding Student Engagement

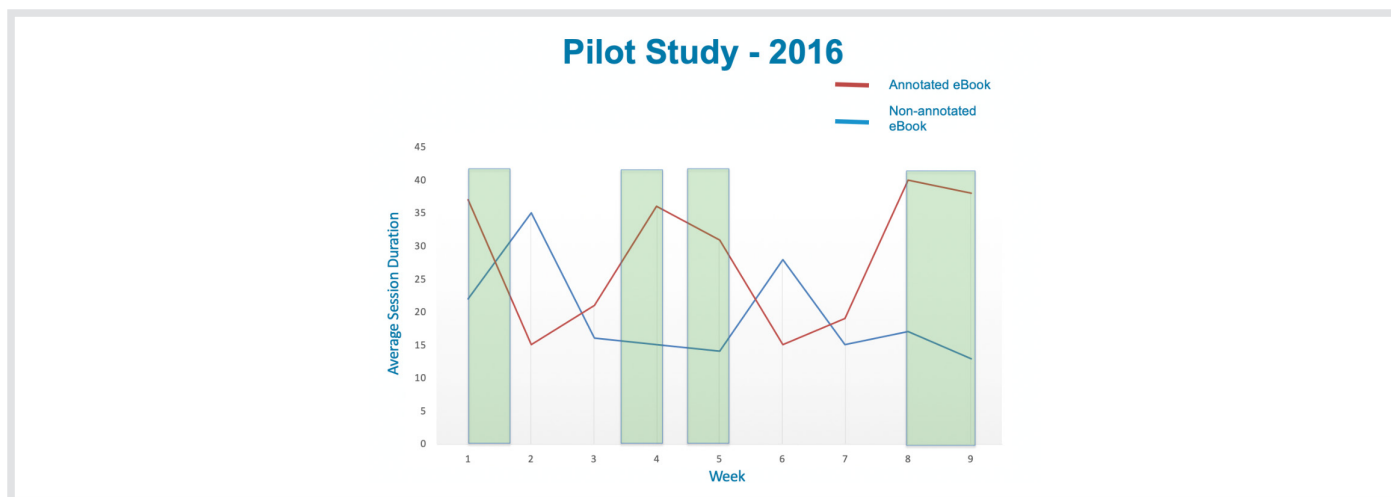
Kaplan Open Learning degree programmes follow a constructivist approach to course design which encourages the student to engage on a regular basis with a variety of different learning materials. We believe that a student's engagement with their learning, the learning community, and the learning platform depends on their agency, and to encourage students to engage actively and more frequently on a deeper level, we facilitate a wide variety of activities in a collaborative learning environment (Orcutt & Dringus, 2017). We actively seek student feedback through a variety of channels so that we can continually improve and develop the online learning experience.

Each module in a programme is made up of week-long units. Each of these includes various activities to work through, including passive and active learning activities, and formative and summative assessments. Asynchronous learning activities are supplemented with regular live online sessions, led by a tutor. This systematically structured learning environment, stemming from purposeful curriculum design, is particularly important in online learning, where students are not living on campus and wholly immersed in the university experience (Martin et al., 2019; Northcote, 2008). It is enhanced by aligning each course with a core eTextbook which students use for self-study and assignments.

2016 eTextbook pilots

In 2016, KOL began exploring the impact of incorporating eTextbooks into learning. Anu Laitakari, Learning Technology Manager, describes the pilot they ran across their business courses:

"Each module we offer has at least one core eBook, which is provided by the VitalSource platform. We implemented annotations and additional reflective questions into undergraduate Business eTextbooks, to see if this would change student behaviour."



Findings

Comparing the data for modules with tutor annotations to those without:

1. The modules with tutor annotations had a higher number of study sessions. Students on these courses were using their eTextbook more often in comparison to those modules without tutor annotations.
2. The duration of the average eTextbook session was longer, suggesting students were studying for a longer period.
3. The sessions took place in a more relevant time period for the students. Students benefiting from teacher annotations were more likely to use their eTextbooks immediately prior to and during summative assessment points, shown in green above. This suggests their reading was more focused towards the learning outcomes.
4. Students responded positively to the addition of tutor annotations.

"The questions you placed at the end of each paragraph encouraged thoughts and ideas."

"...the tips and advice, and the notes help me understand what is being asked and what needs to be applied where it needs to be applied."

RESEARCH: INVESTIGATING THE RELATIONSHIP BETWEEN ENGAGEMENT AND OUTCOMES

Methodology

In order to explore the impact that engagement with eTextbooks has on students' grades, we opted to run linear mixed model regression on usage data across 9,848 completed modules.

The data contained results for 2,527 learners, across 9,848 completed modules with usage and final grade data provided at the module level. All data was fully anonymised.

Results were explored at module level rather than aggregating individual students' usage and results across the modules they had undertaken. This provided a larger data set and ensured possible differences in individuals' behaviour across multiple modules were reflected. Linear regression models are common in analysis of educational datasets. However, a module level focus meant we had multiple data points for the individual learners, and this violates a fundamental assumption of many linear analysis methods that the data points are independent. This was addressed by using a linear mixed model regression approach, which is designed to handle such situations. Linear mixed models are an extension of simple linear models to allow both fixed and random effects, and are particularly used when the data points are not independent, as in this case with multiple module grades per student. Variables of interest such as textbook usage and demographic variables were modeled as fixed effects, with each student having their own random intercept in the model to account for multiple observations of the student.

For this research, the dependent variable is final module grade (recorded as a score out of 100%). The data set also included data on the following, which were considered for inclusion in the model:

eBook usage <ul style="list-style-type: none">• Number of sessions• Time spent each session• Use of eTextbook features, e.g. highlighting, bookmarking• Mode of use, e.g. mobile	Learner characteristics <ul style="list-style-type: none">• UK and non-UK students• Disability classification	Module characteristics <ul style="list-style-type: none">• Broad subject studied*• Level of study*
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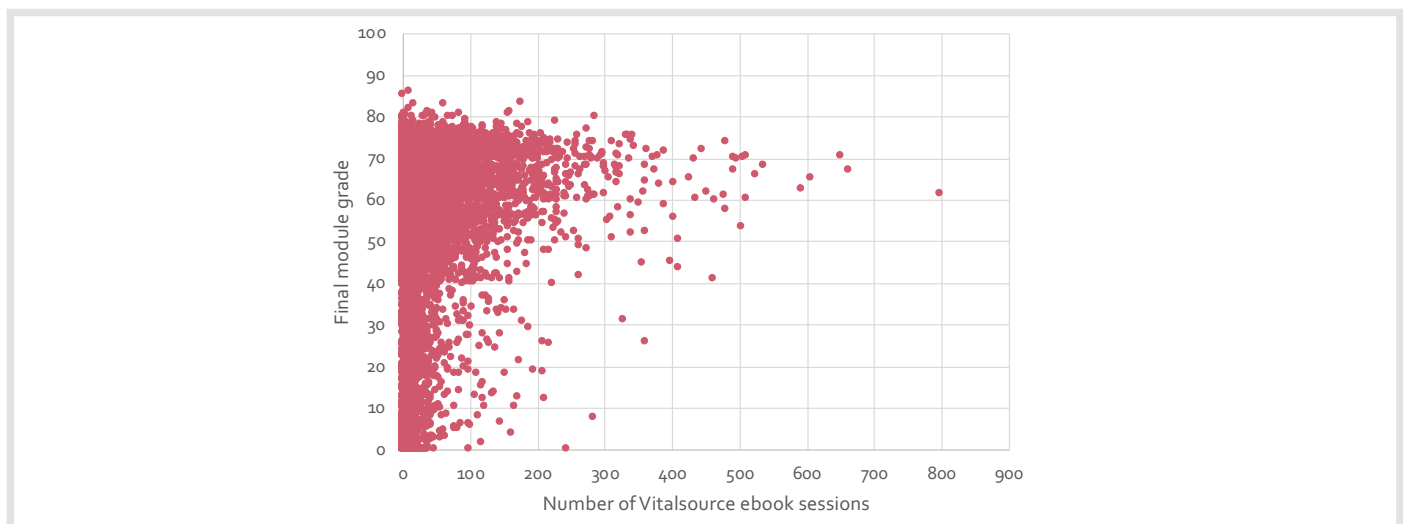
**This data was matched at module level from an additional data source Shift Learning 2019*

Missing data was removed during analysis to allow us to work with a full data set.

Data around modules that may either run across multiple subjects or be shaped around the individual student were removed (e.g. dissertation, work-based learning, research methods). The analysis focused on the eTextbooks that were identified by teaching staff as core resources and provided seamlessly via the course module in the Virtual Learning Environment (VLE), at no cost to the students. It is unable to incorporate or assess the impact of other resources that students may have independently consulted.

Students with high levels of engagement with their core eTextbook had average higher module scores

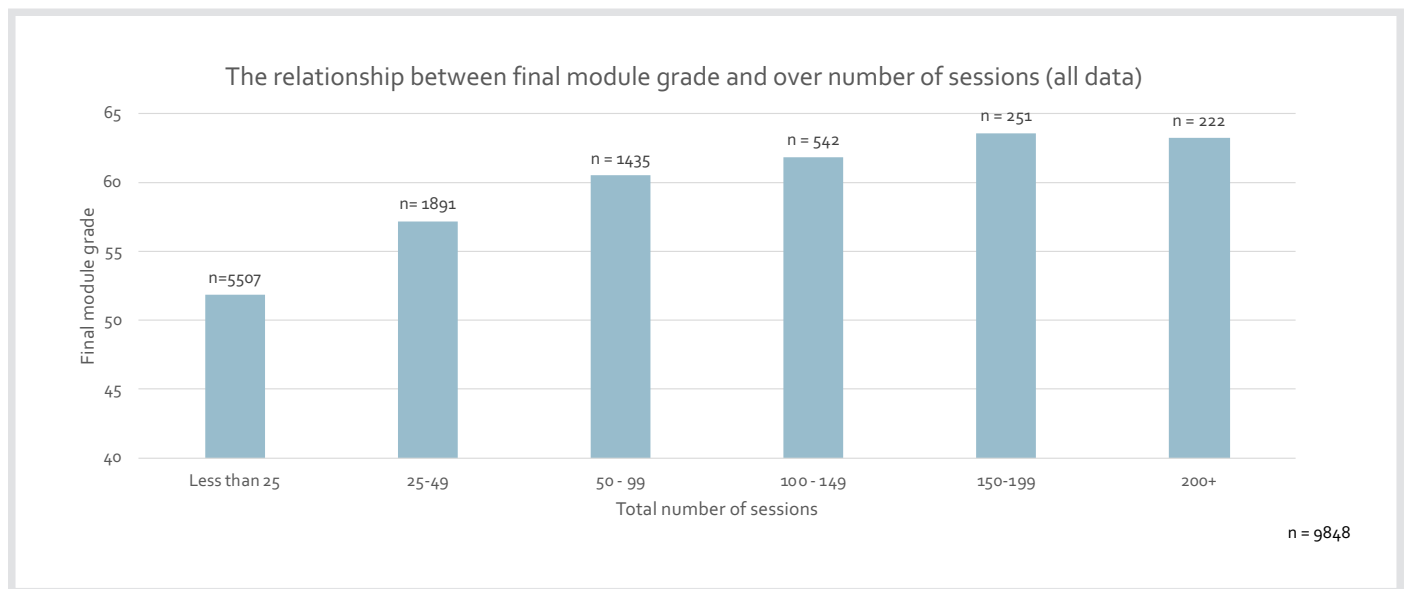
The study found that the students with high levels of engagement with their core eTextbook or eTextbooks had on average higher module scores, even after controlling for nationality, disability status, module subject and module level as covariates. Note that the data is not perfectly linear (doubling the number of sessions cannot be expected to double one's grade, for example), but linear models typically pick up on monotonic relationships in the data even when they are not strictly linear (e.g. Koedinger et al., 2016). Linear mixed effects models are also robust to deviations from normality in the data when estimating fixed effects, which is our interest here.



Shift Learning 2019

Although we can't attribute causality, as eTextbooks were one variable of many, and part of a broader teaching approach, the analysis does suggest a positive relationship between number of sessions overall and final module grades. So, in other words, the more eTextbook sessions completed by the student, the higher the final grade.

The relationship between engagement with the VitalSource eTextbook platform and final module grade was further emphasised by exploring the average module grade of groups of learners with differing levels of engagement with the platform



Shift Learning 2019

Using the number of sessions to group the results clearly shows the relationship between the level of eTextbook engagement and the final module.

Students with less than 25 study sessions had an average final module grade of 51.8% in contrast to those with 150 - 199 study sessions, who had an average grade of 63.4%.

To put this in context, the grade boundary for a pass at undergraduate level is 40-59% and for a merit is 60-69%. The grade boundary for a pass at postgraduate level is 50-59% and for a merit is 60-69%.

It is important to note that the effect of engagement will plateau. Students who studied 200+ sessions saw no additional benefit to their final module grade. However, it has been shown that students who distribute their study across several study sessions, such as those students with a high number of sessions, generally benefit from this approach (Peach et al., 2019). Distributed or spaced practice can reduce cognitive load and lead to greater retention and long-term learning (Ambrose et al., 2010; Busch & Watson, 2019).

OTHER MEASURES OF STUDENT ENGAGEMENT

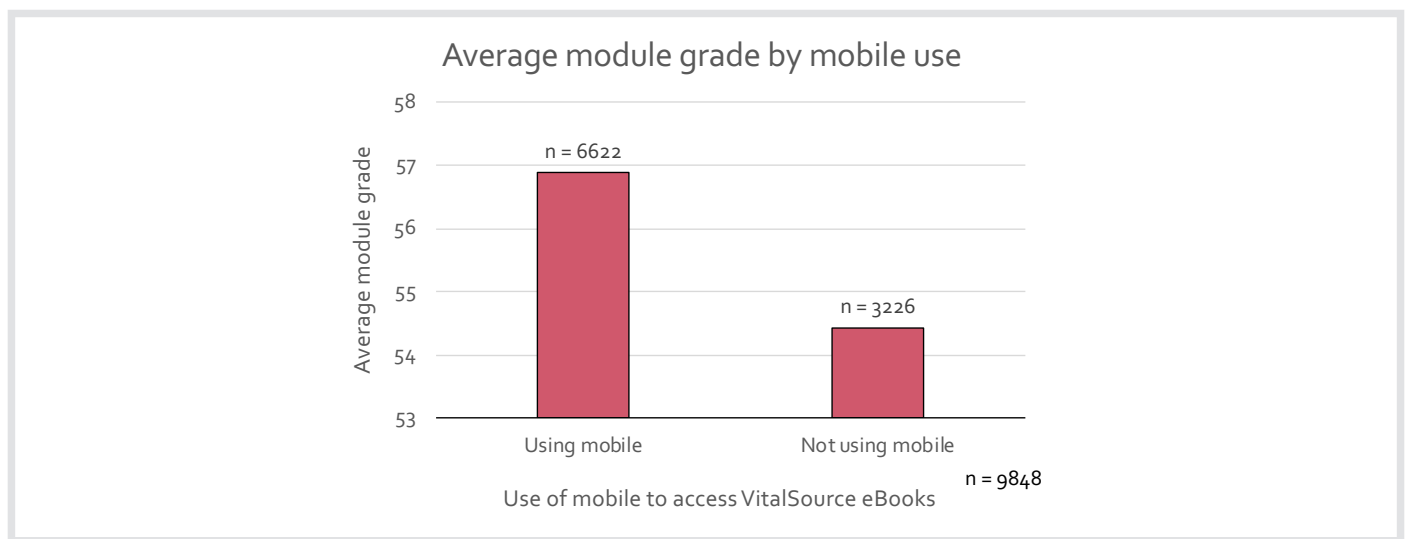
In addition to the number of sessions, VitalSource analytics capture the duration of sessions and student interactions with their eTextbook during those sessions:

- Page views
- Searching
- Page printing
- Highlighting content
- Making notes
- Bookmarking

The research showed a strong relationship between number of sessions and average duration. Those students that were studying more frequently were also studying for longer periods, although the number of sessions had a closer relationship to outcomes than the duration of study. The data suggests that between 10 and 25 minutes is a useful duration. Studies on human cognitive ability and the capacity of our working memory (Ambrose et al., 2010) suggest that if the capacity of working memory is exceeded, learning can be impacted negatively (Gathercole & Alloway, 2007).

Mobile/cell phone access

A number of students were using mobile technology to access their eTextbooks for some of their sessions.



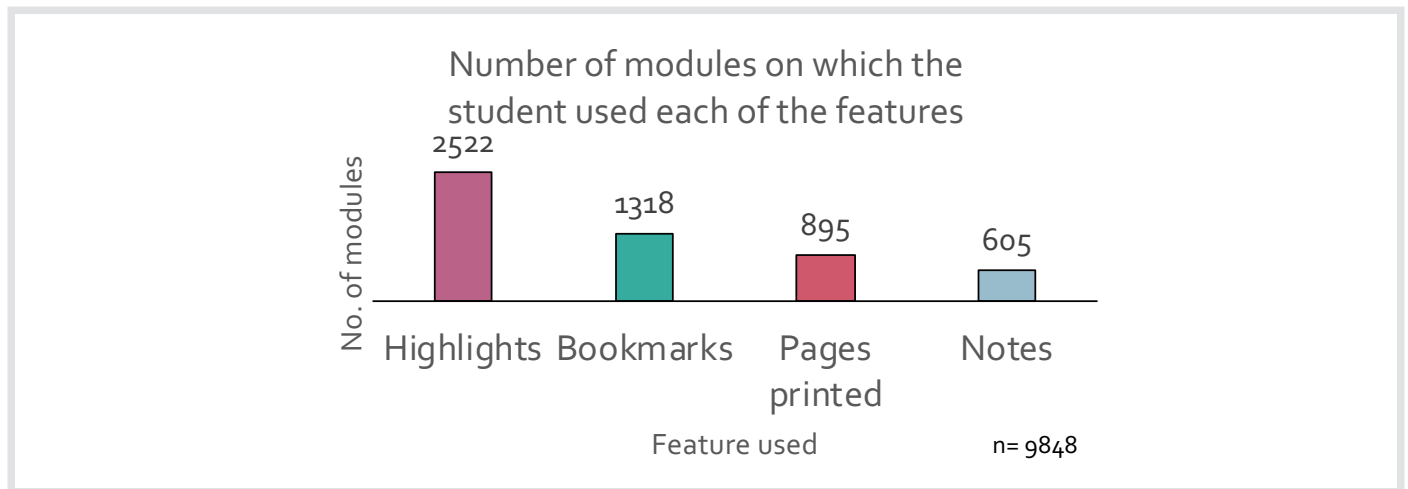
These students were reported to be undertaking about twice as many sessions on average as those who did not, perhaps due to convenience. The average module grade for those students using mobile was over two percentage points higher.

Many factors can be associated with increased mobile use, for example, socio economic background, but it seems that encouraging access via mobile devices can support flexible learning and the more frequent access that appears to be associated with improved outcomes.

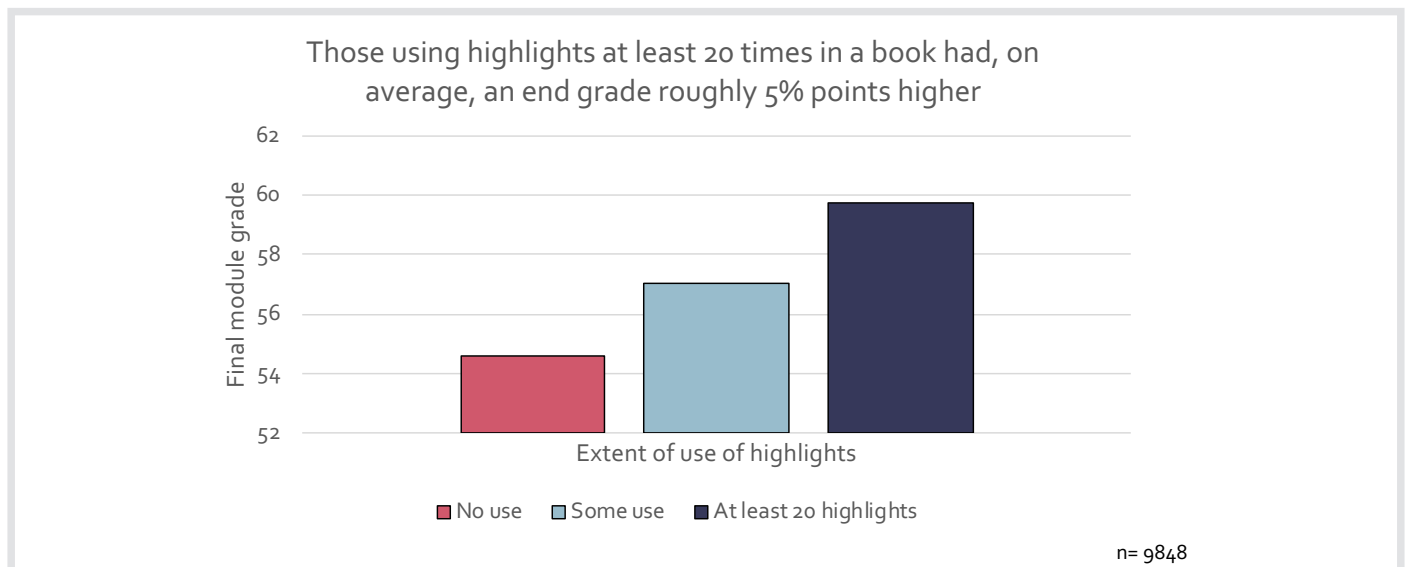
VitalSource understands that learners study using a variety of devices. Whether it be on a laptop or a mobile device, VitalSource is committed to providing a superior learning experience by focusing on performance and feature consistency across all of it's platforms.

Interaction

VitalSource eTextbooks have a number of features such as the ability to highlight text, create bookmarks, make notes, and print. Learners used at least one of these features in 35% of cases. Of those features the use of highlights was the most popular.



The most commonly used feature was the highlighter.



Shift Learning 2019

Some students were low level users, but any use of highlights was found to have a positive relationship with higher levels of engagement and higher end of module grades. The effects were stronger for those using highlights more than 20 times in a book.

Despite previous research suggesting that the highlighting of content by students has a limited impact on learning (Dunlosky et al., 2013), it remains a popular strategy and can help students identify and isolate key concepts. The positive relationship with improved grades may indicate that students were using highlighting in combination with other learning strategies. Alternatively, it may be that those students who actively highlighted content were more motivated to learn.

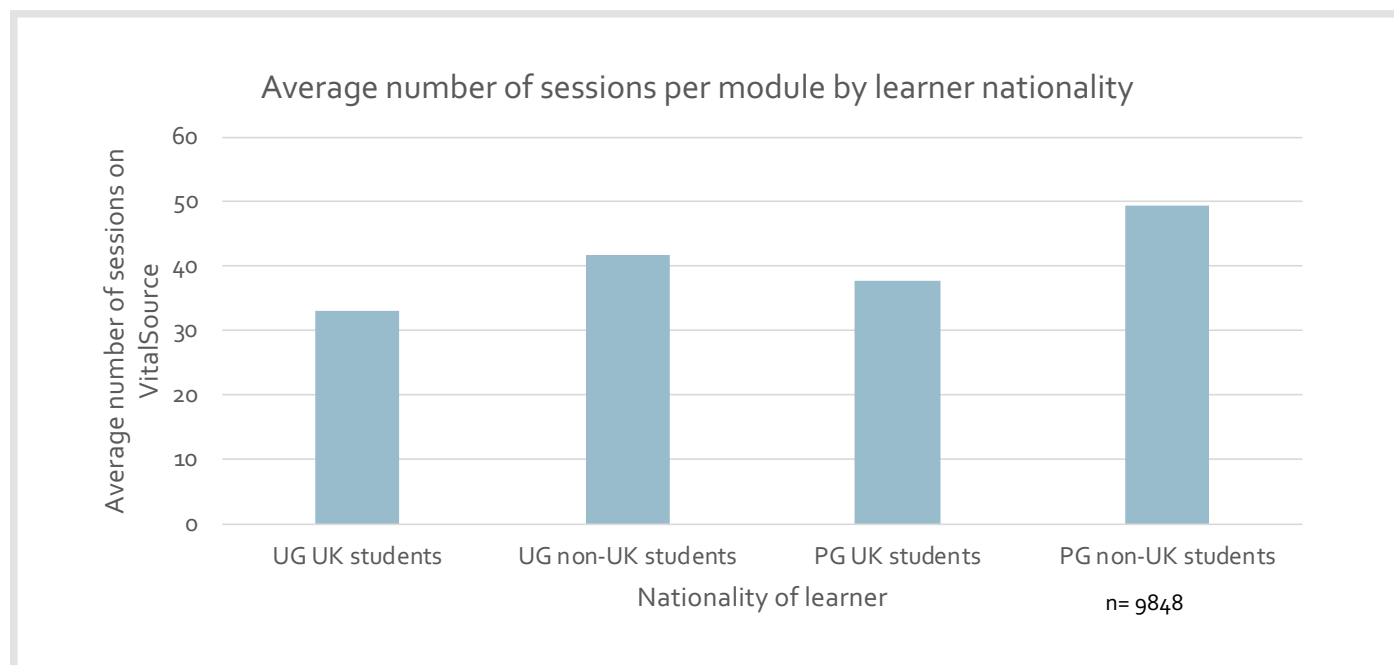
The usage of mobile devices, and especially the active engagement, such as highlighting shows that students are engaged at the time of access, which means that they're more likely to actively learn during that time, instead of just adopting a surface learning approach.

LEARNER CHARACTERISTICS

Nationality

56.7% of the students had a non-UK nationality.

The 'non-UK' group is very varied, including students from the EU, and non-EU students. The most common nationalities were Nigerian, Canadian, South African, American, Italian, Kenyan, Indian, and Greek.



Overall, non-UK students achieved equivalent grades to UK learners, however they undertook significantly more VitalSource eTextbook sessions to obtain this grade. This suggests that a higher level of engagement is needed, perhaps due to studying in a second or a third language instead of in their native language, or due to other cultural differences.

Disabilities

Disability status was taken from university data. Only 5.9% of students had declared a disability, with learning disabilities such as dyslexia being the most common, followed by mental health conditions. Students with declared disabilities were unevenly distributed across the subject areas and were under-represented in business and law, and overrepresented in criminology, and psychology.

There were no statistically significant differences in the relationship between eTextbook use and module grade for students with a disability when compared to other groups.

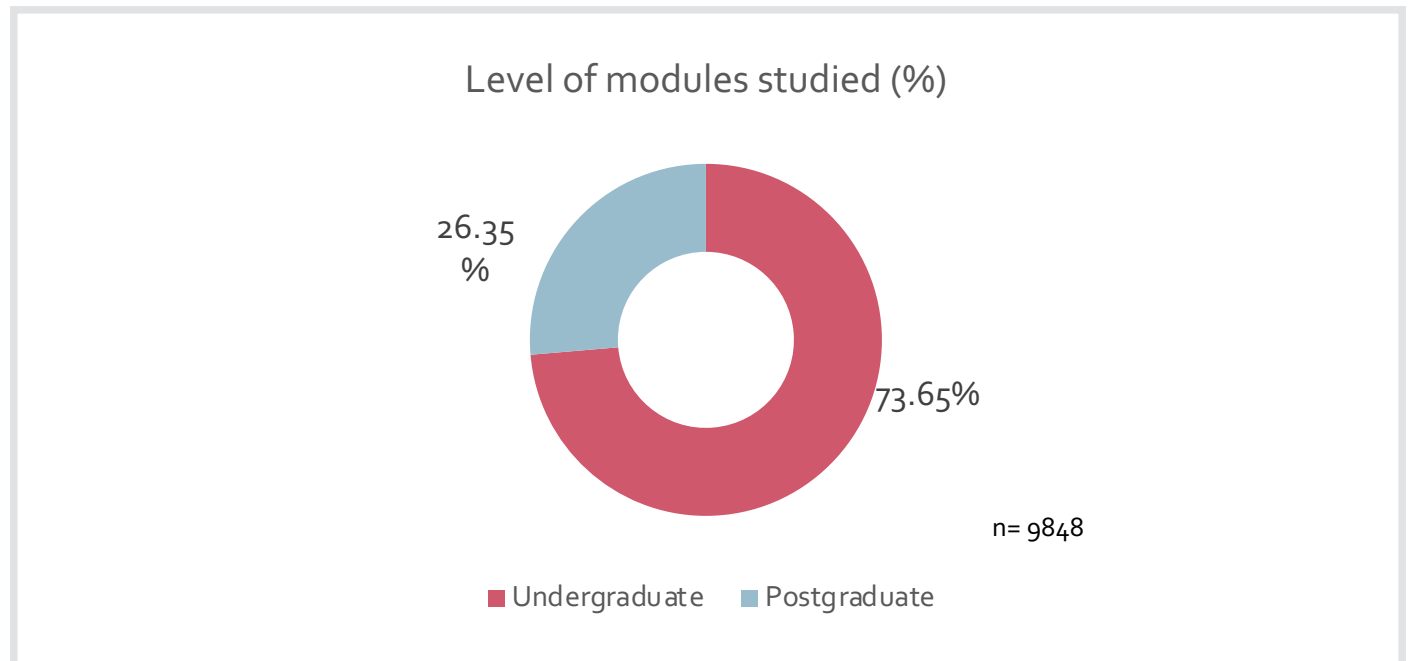
Those non-UK students with disabilities fared less well overall than other students. Their final grade was 5% lower than other students, including those UK students with a disability. This group was extremely small, less than 3% of the sample, and therefore the findings were not statistically valid, however, it may be worth building in additional support for this group.

VitalSource has led the industry in it's [unrivalled commitment to accessibility](#). Truly committing to accessibility means accessibility by design; it is building products and platforms with consideration for the accessibility needs and features of users. Bookshelf® works with assistive technology to enable important accessibility functions such as visual adjustments of the content through content controls, including altering screen colours, night mode, and font size/magnification.

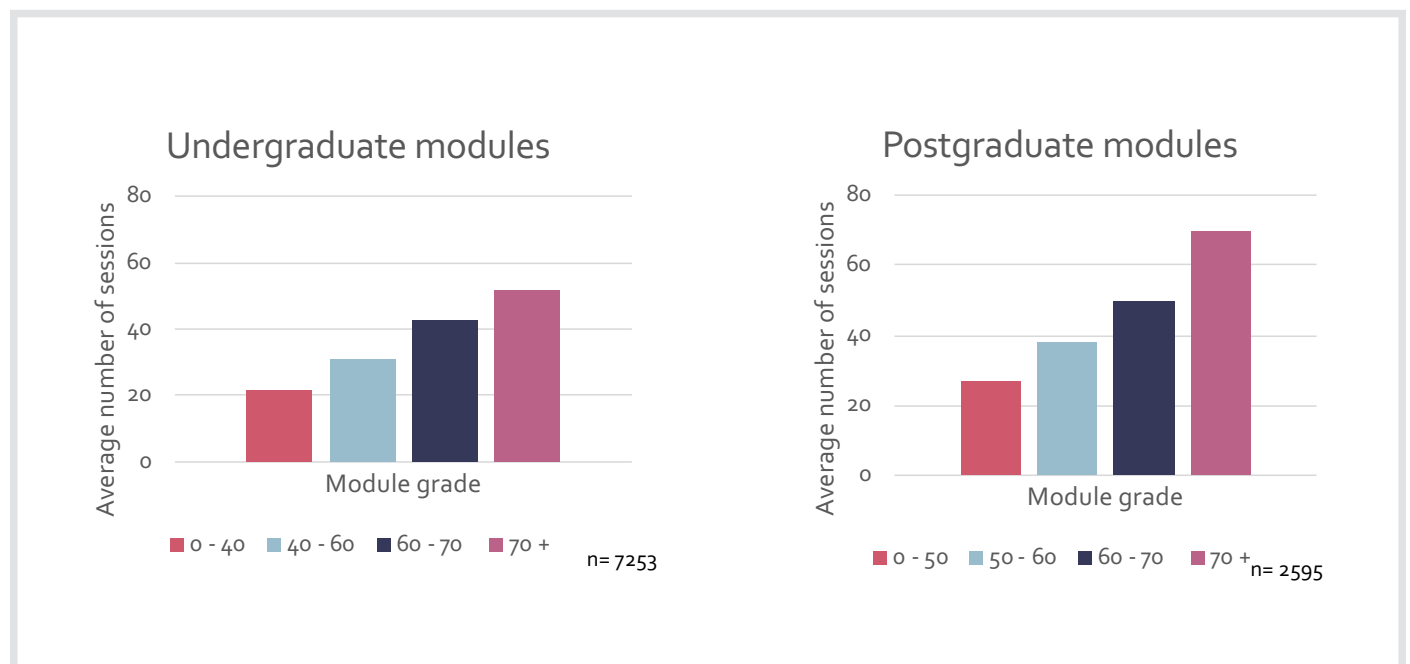
MODULE CHARACTERISTICS

Level of module

Both undergraduates and postgraduates were included in the study. At 73.65%, undergraduate modules made up almost three quarters of the data.



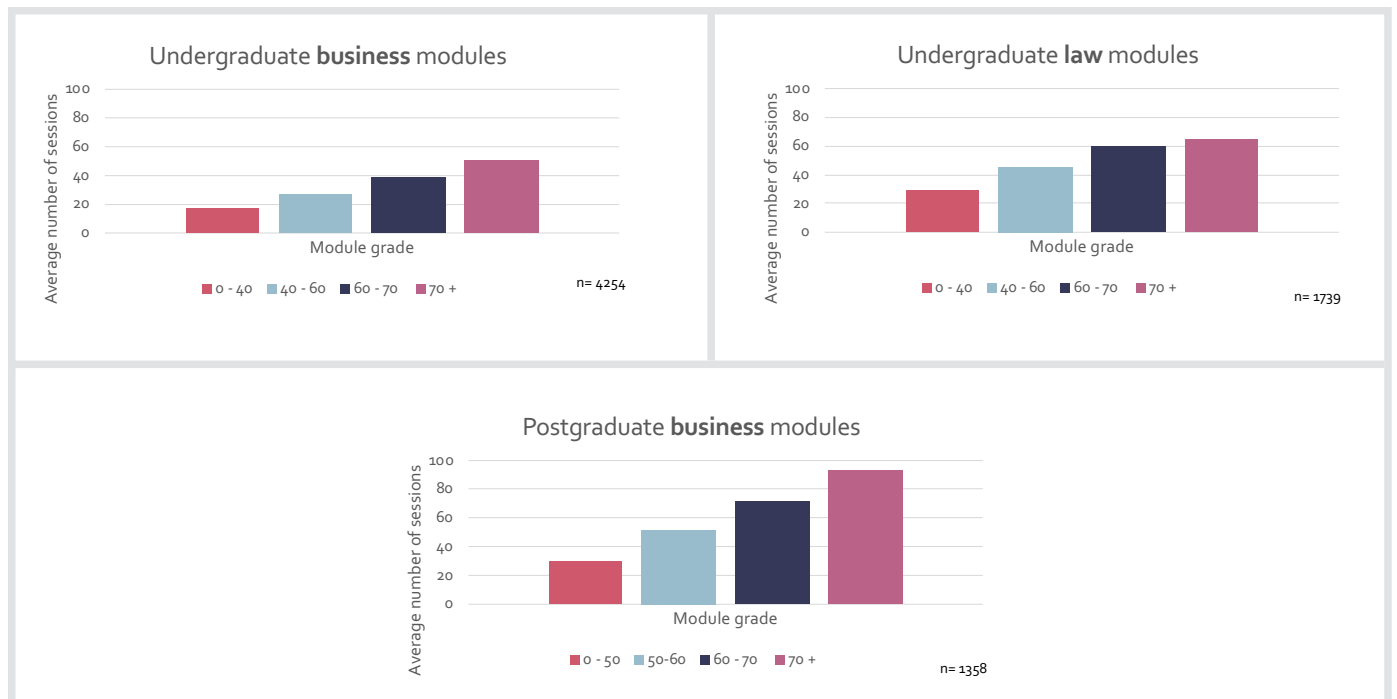
Overall, the postgraduate students tended to have higher grades, but also to undertake more sessions using the VitalSource eTextbook platform. Undergraduate students achieving a grade of 70% or above had used their eTextbook an average of 51 times. In contrast postgraduate students in that grade band had an average of 70 eTextbook sessions.



The mixed-model regression, which controlled for other covariates and accounted for multiple module grades per student in the dataset, found a relationship between module outcome and number of sessions in both cases, with no meaningful difference in the relationship between engagement and grade found by level.

Subject of module

Data was analysed at a subject level. Most subjects had a small number of records, and although they were not significant, for the most part they showed a similar pattern. The subjects with the highest representation were Law and Business. Analysis of the undergraduate data for both subjects suggests that the relationship between a higher number of sessions and a higher engagement seen across the full sample is also reflected at subject level.

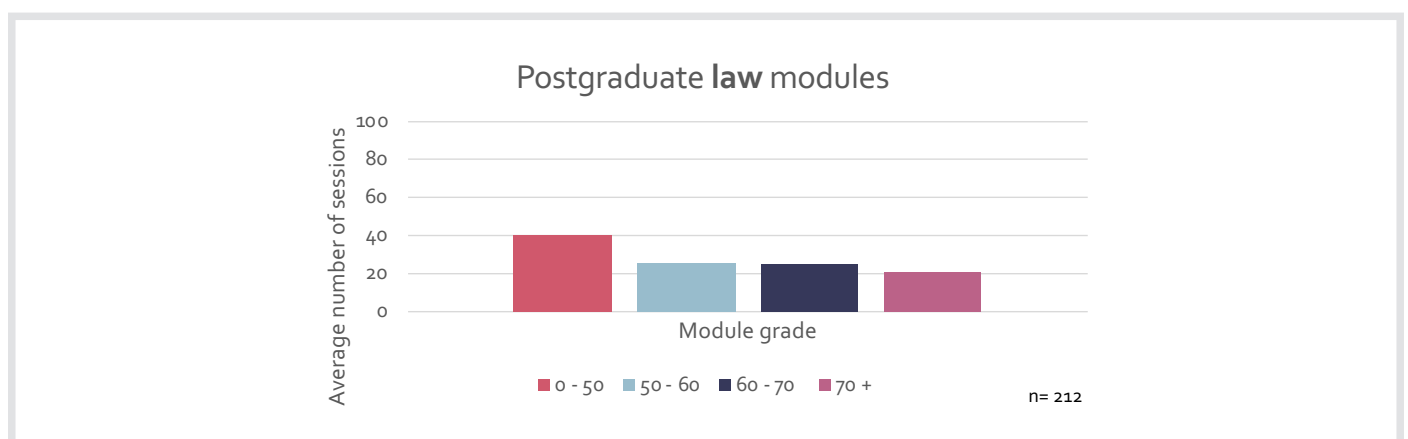


At postgraduate level, the business data shows the same pattern. However, postgraduate law is one of two anomalies. For this course, the relationship appeared to be reversed, with those students achieving the highest grades spending the least time on their eTextbooks. This result is surprising, but illustrates that educational outcomes are influenced by many variables, including those that are specific to the institution, the student demographic, subject, and the curriculum design. Some possible reasons for this are explored below.

Anomalies: Course specific case studies

A more granular analysis at subject/course level revealed two areas where the data did not match the broader findings of a positive relationship between sessions and outcomes. Here we briefly explore possible causes.

Postgraduate Law



The LLM ITCL (International Trade and Commercial Law) postgraduate Law Programme is a very specialist subject which, as with any law programme, requires students to read beyond the textbook. On this programme, essential reading includes case law, case law interpretation, and international treaties, for example, EU articles, etc.

While the eTextbook is core to developing their understanding, students are expected to use it as an entry point to help them interpret and engage with this other content. A student is expected to engage with primary sources of law **and to demonstrate that wider reading in assignments**. Those students who over-relied on their eTextbooks, at the expense of primary content will have been unable to demonstrate that wide reading and deeper learning, resulting in a lower grade.

Master of Education

The Kaplan Open Learning Master of Education was a very new programme when the study was taking place, it had just launched. This means there was a very small sample size of 58 students. In addition, the curriculum design was somewhat different, with students being required to undertake far fewer sessions on the eTextbook than other groups. As with law, it required students to read more widely, beyond the textbook, and demonstrate their understanding in assignments.

In addition to primary data, this involved reading seminal works in education which are not available as eTextbooks or EPUBs. Therefore, the textbook on this course is less core, and less closely aligned to the learning outcomes.

CONCLUSIONS, DISCUSSION AND RECOMMENDATIONS

As part of a broader, engagement focused strategy, student use of eTextbooks has a positive relationship with student outcomes across multiple subject areas and levels of study.

- 1 There is a statistically significant positive relationship between the number of sessions on the VitalSource platform and final grade. And while causality cannot be attributed, the results are consistent with the platform having an impact on outcomes.
- 2 Those students with higher levels of engagement had on average high module scores. This pattern persisted across the different courses and levels, although different numbers of sessions were associated with the grade bands on the different modules, with post-graduate and law courses requiring a higher level of engagement.
- 3 The research suggests that the choice of content and its alignment to the course is a critical factor. On courses such as the Law postgraduate course and the Masters of Education, students needed to build on their eTextbook learning by applying their knowledge to primary research content.
- 4 The research also points to effective learning behaviours, which institutions can encourage. Students who actively engaged with their content by using the learning functionality built into the VitalSource platform, saw an increase in grades. Students who accessed their eTextbooks via their mobile phones also saw improved grades. This was associated with a higher number of sessions, so it seems likely that this relates to the convenience of having the content with them at all times, and being able to easily reference them.

Insights into student behaviour, and its relationship to outcomes, can support an effective, research led teaching strategy. As a result of this research, Kaplan Open Learning has started to produce a series of additional support materials to help students utilise all the features available to them through their eTextbook. These materials aim to improve students' awareness of the key tools available to them through their online eTextbook and suggest how they could be used to improve their learning experience.

Academic Director David Dixon said "Overall, the use of VitalSource eTextbooks supported Kaplan Online's goals of providing engaging and effective online learning. Hopefully this gives us the foundation to scale up our model and provide the offer to a bigger audience. VitalSource is one of the elements that enables us to do that. The eTextbook programme allowed us to provide a consistent approach across the institution, which in turn gave us the data to understand and therefore improve the learning experience for our students."

LIMITATIONS AND FURTHER RESEARCH

This research focused on a specific group of students learning in a wholly online context. While the delivery, format, and functionality of the core textbook is an important factor in module design, it is a single component in a much wider range of learning materials. The online degree programmes delivered at KOL contain a variety of learning materials. This variety is a key component and consideration when designing and building online learning experiences. The core textbook can be used to provide a useful scaffolding for a module but should always be augmented with a range of engaging learning materials.

While this study provides an interesting introduction to the relationship between engagement and learning outcomes in an online learning environment, further research could combine qualitative data to understand:

a) The student experience

- What motivated students to engage?
- What were their perceptions of the experience and its impact in comparison to other initiatives?
- How did the use of eTextbooks support their actions and goals (i.e. assessing impact on the various stages of the learning journey)?
- What distinguishes a high user from a low user (demographics, previous experience, support, personality)?
- How can a student be motivated to higher levels of engagement?

b) Lecturer experience and behaviours

- What approaches did they use?
- Were eTextbooks largely self-study or deeply integrated?
- How did the eTextbooks support their learning outcomes?
- What were the subject differences?
- How did they motivate students to these relatively high levels of engagement?
- What other insights do they have?

c) The institution

- How did the institution approach training and support and for teaching staff?
- What scaffolding did they provide for students?
- What effect did these factors have?

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ABOUT

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Becky Hartnup is an independent ed-tech consultant working with universities, content creators and tech suppliers to research and implement technology in education, while never losing sight of the people involved. She was awarded an MBA with distinction from Imperial Business School, having studied on their Global Online programme. Research interests include student experience, human centred design and immersive learning.



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Anu Laitakari is the Learning Technology Manager for Kaplan Open Learning. She has over a decade of experience in managing learning technology platforms, and has project managed the deployment of LT applications for up to 16,000 users. She has worked in FE and HE as well as for commercial and charity sectors and now specialises in online learning. Anu is currently undertaking an MEd with the aim of completing her research project focusing on the role of online tutors due for completion early next year.



Stephen Livesey, Kaplan Open Learning

Stephen Livesey is the Director of Learning Technology at Kaplan Open Learning. Stephen has been working in online education for over 13 years and has a wide range of experience supporting, developing and delivering online degree programmes. He is currently working on a research project to measure the impact of goal setting on student success.

About Kaplan

Kaplan Open Learning develop, deliver, support and market sector-leading online higher education programmes to a global student audience. Our innovative and unique online pedagogy utilises the latest digital learning technologies to provide teaching excellence and a world-class student experience.

About VitalSource

VitalSource helps our partners scale and manage the complex technology infrastructure that underpins amazing digital learning experiences. Our solutions portfolio gets content and courses in front of learners and faculty quickly and easily, delivers meaningful learning and engagement data, and significantly simplifies your digital lift in terms of time, budget, and resources. Together, the Bookshelf®, Launch and Acrobatiq portfolios form your flexible, end-to-end content and course creation-to-consumption solution.

About Shift Learning

Winner of an Education Investor Award, 2019, Shift Learning is a leading market research consultancy with a passion for the education and learning sector. We help some of the most exciting and successful organisations in the sector make decisions based on robust evidence and insight.