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Fostering and evaluating learner engagement with academic literacy support: Making the most of Moodle

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Fostering and evaluating learner engagement with academic literacy support: Making the most of Moodle

Abstract

This paper reports on the evaluation of an ambitious attempt to embed academic literacy support within a core content course for first-year students at the University of the South Pacific. The course is offered in both blended and online modes, catering for on-campus and off-campus students, respectively, using Moodle as the virtual learning environment (VLE). We begin by explaining how we have made the most of Moodle as a learning platform, enabling us to supplement the core content resources with additional components that support students' academic literacy development, rather than sacrificing content to create this space. Since the additional material is embedded into the main learning design of the course, students acquire academic literacy within the disciplinary context of their academic programme, rather than through standalone 'study skills' provision that is devoid of content. We then devote the majority of the paper to discussing the evaluation of this course design, again explaining how we have made the most of Moodle to do so. We have used learning analytics data from Moodle tracking and completion reports to calculate engagement scores for each student, focusing on a composite of their access to resources, their compliance with sequencing and timing, their investment in activities, and their overall achievement. We have then examined the extent to which the different elements of engagement appear to impact achievement in assignments, demonstrating that the students who achieved the highest grades were those who accessed more materials, kept up with the intended schedule, and invested more than they needed to in activities, despite no immediate rewards for doing so.

Keywords

academic literacy, embedded course design, virtual learning environment (VLE), engagement, learning analytics

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Introduction

This paper discusses the design and evaluation of a new introductory linguistics course that has been created at the University of the South Pacific with the aim of supporting academic literacy at the same time as disciplinary content. For the purpose of this paper, academic literacy is defined as “the ability to communicate competently in an academic discourse community” (Wingate 2015, p. 2). In other words, as students learn new subject content, they must become literate in the practices through which that content is produced, debated, challenged and presented in oral, written and multimodal forms. The learning design of the new course takes an embedded approach such that matters of academic literacy are covered within the specific context of introductory linguistics topics and assignments. This can be contrasted with what Wingate (2006) has criticised as a ‘bolt-on’ or ‘study skills’ approach to academic literacy development, in which standalone courses, workshops or study guides present a range of academic tasks (such as essay writing) and skills (such as note-taking) as context-free practices that can be mastered and then applied to specific disciplinary situations later on.

The design is ambitious and presents a very different learning experience from a typical course. This paper describes the way we have made the most of Moodle both to provide this learning experience and to evaluate the way students engaged with it during its first offering in 2018.

Theoretical background

Following Wingate (2015, 2006) and others (particularly McWilliams & Allan 2014; Purser et al. 2008; Thies 2012), the assumption made here is that the acquisition of academic literacy is a process that can only take place with reference to the way knowledge is constructed, shared, debated and presented within a specific discipline. From this perspective, academic literacy is far more than a discrete set of academic skills that can be applied in any disciplinary context. While surface-level elements (such as the formatting of in-text references or strategies for making notes more concise) may indeed be broadly applicable to different disciplines, it is what goes on below the surface that drives disciplinary difference. Deeper questions about whether secondary sources are being used to acknowledge the origin of empirical evidence, explain the framework within which the current work is situated, or to support a position within a widely-contested debate, for example, are essential to explore before learning how to find the right type of sources, and deciding what kind of information it would be useful to make notes about. The mechanics of formatting and note-taking (the skills) can be considered simple matters of convention or stylistic preference once the purpose for which they are being carried out is understood.

The challenges of acquiring discipline-specific academic literacy may be compounded when students make the transition to tertiary studies in an online learning environment, in which they have limited face-to-face interaction with either peers or teaching staff, and in which they need to learn to navigate the new tools, platforms and assessment types expected in university courses. Off-campus students may struggle to work out expectations and practices by themselves, they may have to travel further or take more independent initiative to access available support, and they may have to grapple with *double e-culture shock*: learning how to get the academic literacy support they need in an online-only environment, at the same time as having to acquire e-literacy, the “awarenesses, skills, understandings and reflective-evaluative approaches that are necessary for an individual to operate comfortably in an information rich and IT-supported environments” (Martin 2006, p. 97).

Whether the use of technology to deliver discipline-specific academic literacy support has simply digitalised a familiar issue or whether it has compounded one literacy challenge with another is a question that deserves greater attention than it currently receives. When technology is used to support academic literacy, Ellis (2004) notes that three additional discourses begin to interact with the main content discourse of the subject: students and lecturers need to talk about the process of constructing and presenting content knowledge (pedagogical discourse), they need to talk about the specific features of spoken and written texts (linguistic discourse), and they need to talk about how to access and navigate materials (technical discourse). Care must thus be taken to ensure that the content discourse is not undermined in such a way that it prevents the main learning outcomes of a course being met.

A range of approaches have been taken to support academic literacy through online platforms and technologies. Some have used optional self-paced online modules that help students master a range of skills and practices that might broadly be interpreted as both academic literacy and e-literacy, but without being embedded into any particular discipline or the requirements of any programme (e.g. Roche & Martin 2006). Others use a blended approach, combining online components to cover the introductory elements and mechanical skills of a practice with face-to-face sessions in which these are tried out in context, either targeting students from a range of disciplines (e.g. Greenhough 2016) or tailored to a specific programme (e.g. Levy, Dickerson & Teague 2011). Others again use a pre-induction model, customisable to specific disciplines, through which students can be guided into the expectations and conventions of their forthcoming programme before it begins (e.g. Wingate & Dreiss 2009; Wingate 2008). However, to date, we are unaware of any attempt to build an entire online or blended content course that embeds discipline-specific academic literacy support throughout.

Context

This paper discusses the design and evaluation of one such course, which attempts to assist new students at the University of the South Pacific with the transition to tertiary level learning through either online or blended mode. The university is a regional institution, headquartered in Suva, Fiji, but co-owned by 12 different countries. Geographically, there are vast distances between these countries and the university has invested heavily in flexible learning in order to make programmes available in a range of modes (face-to-face, print, online, and blended) and from any location. Access to these opportunities is not uniform across the region, however, with issues such as patchy internet connectivity, high data costs, unreliable electricity supply, and vulnerability to climate disasters regular features of the students' living and learning environment. English is a second language (if not third or fourth) for most students and staff, although it is also the medium of instruction throughout most secondary education across the region, and also primary education in many cases. Discussions about how to foster the development of discipline-specific academic literacy are thus frequently muddled both by the limitations of the technological infrastructure and by concerns about basic proficiency in the medium of instruction.

The university's current model for supporting academic literacy comprises a generic academic English course that is compulsory for all undergraduates during their first year, and a range of optional skills workshops and drop-in support offered by a very small student learning support team within each faculty. Students located outside Suva may well not even have access to the latter, particularly if they are based in a remote area or on a different island from their national campus. In line with the arguments posed by Wingate and others, a small group of staff at the university (representing specialists in content subjects, academic English, student learning support,

and education technology) have been experimenting with alternative approaches. In particular, we are interested in opportunities to move academic literacy support into the mainstream, recognising that becoming academically literate is part of the transition to tertiary education for all students. The new introductory linguistics course discussed here is one such initiative.

LN111 Introduction to Language Studies is a core course on the linguistics programme, which was developed in 2018 using an embedded model of academic literacy development. The guiding principle for the course is that we want to introduce our students to foundational concepts and principles from the discipline of linguistics, while also ensuring a smooth transition into being an effective student of this discipline. More specifically, we focus on helping students learn how to learn within this discipline, how to work with written texts from the field, how to explore ideas about language, and how to communicate effectively about the discipline through English as a second language. Learning outcomes are therefore broken down into content outcomes (e.g. explain processes through which languages change; give examples of lexical change from a Pacific language), and academic literacy outcomes (e.g. focus on the main ideas of lectures without getting distracted by small details; support a position with evidence from written sources; use effective strategies to search linguistic archives and databases). The purpose of spelling out both types of outcome is to make explicit the ‘hidden curriculum’ (Christie, 1985) that is often subsumed within course assessments.

On LN111, there are two major coursework assignments. The first (worth 10%) is a heavily scaffolded written task, in which students develop a response to a question about linguistic diversity using only information from three assigned readings. The purpose of this assignment is to walk students through the process of breaking down an assignment question, searching texts for information that enable them to answer this question, synthesising similar ideas from different sources, and integrating this information into a well-organised written response using effective summarising and referencing. The second assignment (worth a total of 35%) is broken down into three stages, through which students mirror a similar process with less scaffolding. Firstly, working in groups, they conduct independent research into a new topic before presenting an oral summary of their findings. Secondly, they write an individual plan for an essay on the same topic, using sources from a reading list as well as their own independent research. Thirdly, making use of the feedback from the presentation and plan, they submit a final written essay supported by a range of sources. The final exam (worth 40%) assesses both content knowledge, using a range of short answer questions, and the ability to write an essay under exam conditions, using a series of very short extracts to support their answer. The remaining 15% of the grade is allocated to the assessment of written English proficiency and online participation on an ongoing basis throughout the semester.

In 2018, the year of this study, 180 students registered for the course. 93 students from six countries were studying in blended mode at the main campus in Suva. The remaining 87 students were studying in online mode, either in different parts of Fiji or in one of six other countries.

Learning design: Making the most of Moodle as a learning platform

With such a determined focus on the academic literacy requirements of a course, it might appear that the discipline content is pushed into the background. Indeed, as Wingate (2015) notes, one of the main impediments to encouraging academics to incorporate a language focus within their teaching is the perception that content would have to be sacrificed in order to do so. Traditional face-to-face courses have a limited number of contact hours in which to cover their content,

leaving two possible options for lecturers who wish to incorporate ‘skills’ or ‘language work’. Either they must sacrifice core content in order to accommodate the new material, or they must add the new material via additional components—standalone workshops or self-access resources. The first option likely reduces the depth and quality of the content coverage, while the second option relegates academic literacy to a matter of secondary or peripheral concern. In both cases, language and content appear to compete for space in the curriculum, rather than viewing them as inseparable elements of academic work.

However, by utilising a VLE such as Moodle as the basis of the learning design, it is relatively easy to provide both content and language simultaneously. The amount that can be covered is limited only by the number of learning hours that a university expects its students to devote to each course (at USP, this is ten hours per week), rather than by the number of contact hours allocated (at USP, this is three hours per week for a face-to-face course). Moreover, the design features of a VLE enable academic literacy materials to be integrated alongside the core content materials, without creating an artificial divide between them.

For example, LN111 utilises short online lecture videos to cover core concepts and principles from each weekly topic. These have an entirely content-driven focus. However, immediately before these videos are presented in the Moodle book, additional ‘preparing for lectures’ notes and activities are inserted. These focus on a range of macro-level aspects of listening (such as the purpose of lectures and the level of detail needed in lecture notes) and micro-level aspects (such as the type of language that lecturers typically use to transition between ideas, define concepts or build up arguments), and they use excerpts from the forthcoming lectures slides or audio scripts to exemplify the points made. Academic listening is thus supported in the context of the specific lectures that students are about to watch, rather than being taught as a generic skill to be applied at some unspecified time in the future.

Similarly, like many academic courses, students are expected to do some reading each week. However, in recognition of the challenge that students face with academic reading, a set of ‘As you read ...’ notes is provided on Moodle alongside each text, which directs students to key sections of each text, gives them strategies such as how to ‘tune in and out’ of long texts following textual cues, and focuses primarily on getting through a text rather than understanding everything within it. In addition, the tutorial activities help students drill down into the meaning of the relevant sections of these texts, and start to focus on how to use information they read to support their own writing. Using a VLE enables a flipped classroom approach to be used for the blended students, freeing up class time for interactive discussion of the texts, and it enables the equivalent Moodle-based tutorial activities to be embedded for the online students alongside the reading.

In addition, Moodle provides a platform from which students can be directed easily to other online resources, which helps them learn, as novice academics, which types of web-based resources are useful and trustworthy. LN111 thus incorporates a weekly *exploring ideas* strand, through which students are directed to an online resource that helps them explore the content of the weekly topic in more detail, usually requiring them to apply the content to their own contexts. Initially, the resources are non-specialist, so the students begin by exploring a list of blogs, podcasts and video channels about language, and selecting any item of their choice that they want to share with their classmates, posting the link on the class discussion forum along with a comment about why they chose it. The following week, they search media and social media for an item or discussion about language within their own countries, again sharing their findings on the forum. Gradually, the resources become more specialist, leading students to explore linguistic archives, databases and

online dictionaries, for example to see what they can find about their own languages, and then finally moving to more traditional library catalogues and databases to find sources that will help them in their assignments. As well as exposing students to a range of practical sites that are used by professional linguists, this strand focuses on ensuring that students are introduced to research as a process through which they seek sources for a clear purpose, and can evaluate whether what they have found is useful or interesting, rather than simply training them in the technical skills needed to access resources. Moodle enables the task instructions, weblinks and a class discussion forum to be integrated in a single activity, and its consistent weekly structure presents the tasks in a connected sequence that gradually builds up necessary research skills.

Finally, the ability to include activities that are marked automatically means that Moodle can host additional assessments without creating additional marking. In LN111, an *effective communication* strand has been built in that takes advantage of this feature. This strand aims to improve students' grammatical accuracy when communicating through English as a second language, through a series of notes and quizzes that tackle a different language feature each week. Each set is based on the content from the weekly topic, such that the week on language change incorporates a focus on verb tense and aspect, while the week on linguistic diversity covers usage of plurals, articles and quantifiers. In most cases, extracts from the week's reading are used as examples, so that students can examine the way grammatical structures are utilised in very familiar and relevant contexts. Once again, by using a VLE, it is easy to embed these language-based activities directly into the content-focused unit, presenting 'grammar study' within a meaningful, discipline-specific context.

By making the most of Moodle in this way, we provide academic literacy support without reducing the amount of content taught. In fact, given that the additional learning activities also make use of the same topics and texts from the weekly units, students actually interact more with the disciplinary content than they would in a typical course. Our design therefore counters the concern that content would have to be sacrificed in order to incorporate attention to language and academic skills.

Research design: Making the most of Moodle to evaluate learner engagement

As Tang (2014) notes, most academics and institutions would agree that 'being engaged' in learning is generally considered a desirable trait amongst students, despite a very wide range of definitions and interpretations of what exactly this 'engagement' refers to or how to achieve it (see Trowler 2010, for a comprehensive review). A starting definition for our project was "participation in educationally effective practices, both inside and outside the classroom, which leads to a range of measurable outcomes" (Kuh et al., 2007, in Trowler 2010, p.4). We were interested particularly in the behavioural aspect of Fredricks, Blumenfeld and Paris' (2004 p. 65) three-factor model of engagement, which can crudely be defined as "doing the work and following the rules".

In order to evaluate the way LN111 students were "doing the work and following the rules", we first examined the extent to which they *accessed* the learning resources and activities intended to support their academic literacy development. We then examined how they *complied* with the sequencing and timing of these resources and activities. Thirdly, we examined how *invested* they appeared to be in completing tasks beyond the bare minimum, without any tangible reward gained for doing so. In order to establish the effect of such engagement, we examined how these three components interacted with *achievement* in assessments.

Individual student scores for access and compliance were computed based on learning analytics data from Moodle. The access score comprised the percentage of readings downloaded, Moodle books completed, and either face-to-face tutorials attended or online tutorial activities downloaded. It should be noted that these indicators demonstrate access in a very literal sense: the students put themselves in a learning environment in which the resources were co-present, but we have no way of knowing what they did with them. We thus consider access to be a necessary but insufficient indicator of engagement. The compliance score comprised the proportion of learning resources and activities that were accessed and completed within the week in which they were allocated. We wanted to understand whether keeping up with the schedule of the course had any impact on students' ultimate achievement.

Investment scores were derived from reanalysis of two assessed activities. The first was the weekly discussion forum on which students had to post about what they had found during that week's *exploring ideas* task. The main purpose of the forum post was to encourage students to complete the research task and to socialise them into the practice of posting publicly in class discussions without too much pressure, so we simply awarded 0.5% each week to all posts that related to the task and were posted by the end of the relevant week. Within these parameters, some students posted one or two sentences that met the requirements, while others wrote several paragraphs that demonstrated deep engagement with what they had found and how they felt about it, but all posts were rewarded equally. We therefore reanalysed all posts according to how far beyond the minimum requirements students had gone despite receiving no ostensible credit. The second component was the weekly *effective communication* quizzes, which could be retaken as many times as students liked, with their highest score counting. Given that each quiz was only worth 0.5%, the impact on their overall course grade of retaking the quiz multiple times was relatively small, so we made an assumption that repeated attempts indicated an investment in either improving their grammatical accuracy for its own sake, or simply the satisfaction of getting as many answers right as possible.

Tests were run on the resultant data set (separated into blended and online modes) to determine whether there were differences in achievement between students who varied in their levels of access, compliance and investment. A one-way ANOVA test was initially chosen, and its assumptions tested using boxplots, the Shapiro-Wilk test of normality and Levene's test for equality of variances. If the data met the three assumptions, then the one-way ANOVA test was used. If the test indicated significant difference between the groups, then a Tukey post hoc analysis was conducted to determine pairwise difference. On the other hand, if the data met the first two assumptions but the homogeneity of variance was violated then a one-way Welch ANOVA was conducted followed by a Games-Howell post hoc analysis if there was significant difference between the groups. If all three assumptions were not met, then the non-parametric Kruskal-Wallis test was chosen and, if it proved significant difference, then a pairwise comparison using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons followed. These tests were run twice, once with the data from the full semester, and once with a small subset that enabled us to focus on the resources and activities that fed into the first major assessment, the heavily-scaffolded written assignment that was submitted at the end of Week 7. To see the different contribution that access, investment and compliance made towards overall achievement, a hierarchical multiple regression was conducted.

The data reported here comes solely from quantitative data obtained from Moodle analytics and assessment, although we recognise the limitations of what can be read into such data about students' intentions (Ellis et al. 2017). For this reason, we also gathered data through multilingual

screencast-assisted interviews and a feedback questionnaire posted at the end of the course, analysis of which is reported elsewhere (Willans et al. forthcoming).

Findings: Did our students make the most of Moodle?

Access as a predictor of overall achievement

The first tests examined whether there was a difference in overall achievement (i.e. total scores) on the course due to frequency of access to the learning resources and activities. Figure 1 shows the percentage of students who had high, medium or low levels of access.

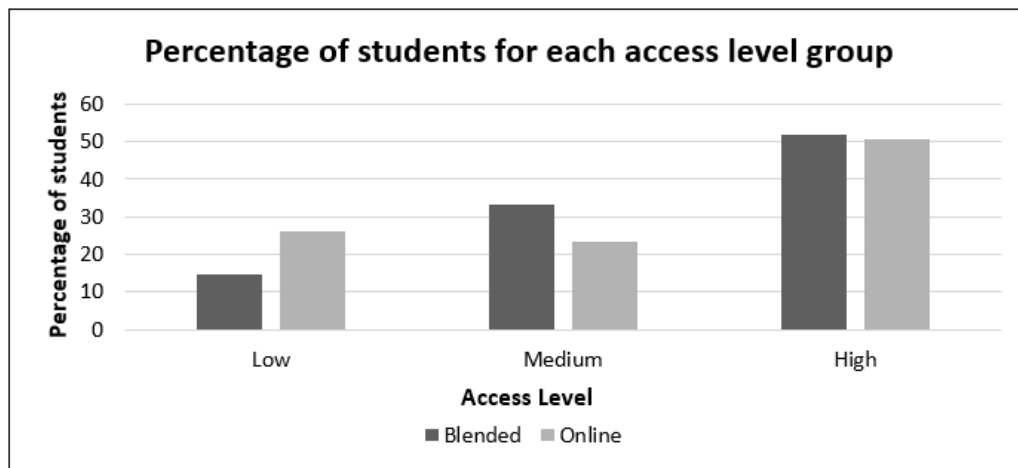


Figure 1. Students in each access level group

For the blended students, a Kruskal-Wallis test was conducted to determine if there were differences in total scores between groups with different access level: "low" ($n=12$), "medium" ($n=27$) and "high" ($n=42$). Distributions of total scores were not similar for all groups, as assessed by visual inspection of a boxplot. Total scores were statistically significantly different between the access level groups, $H(2)=22.798$, $p<.0005$. Pairwise comparisons using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons revealed statistically significant differences between the low (11.75) and medium (42.52) ($p < .0005$), and between low and high (48.38) ($p<.0005$) access level groups.

For the online students, a one-way Welch ANOVA was conducted. There were no outliers and the data was normally distributed for each group, as assessed by boxplot and Shapiro-Wilk test ($p>.05$). Homogeneity of variances was violated, as assessed by Levene's test ($p=.004$). Total scores were statistically significantly different between different access level groups, Welch's $F(2, 35.518)=36.636$, $p < .0005$. The total scores presented as mean \pm standard deviation, increased from the low ($n = 20$, 18.87 ± 14.6), to medium ($n=18$, 43.0 ± 24.6), to high ($n=39$, 54.8 ± 16.0) access level. Games-Howell post hoc analysis revealed that the increase from low to medium (24.1, 95%CI, 7.6 to 40.7, $p=.003$) and low to high (35.9, 95%CI, 25.8 to 46.0, $p<.0005$) are statistically significant.

Figure 2 highlights the distribution of the total mark for students in each access level group for the two modes. There is a statistically significant difference in the achievement scores of those who

had accessed the learning resources and activities to differing amounts. The biggest effect was observed between those with low and medium access scores. It could be inferred that a certain threshold level of access is required in order to do well, while there is a less noticeable gain from increased access past the threshold. If this is the case, the implication for future offerings of the course is that a concerted effort must be made to get all students into the habit early on of accessing the materials in the hope that this will engender some of the other positive aspects of engagement.

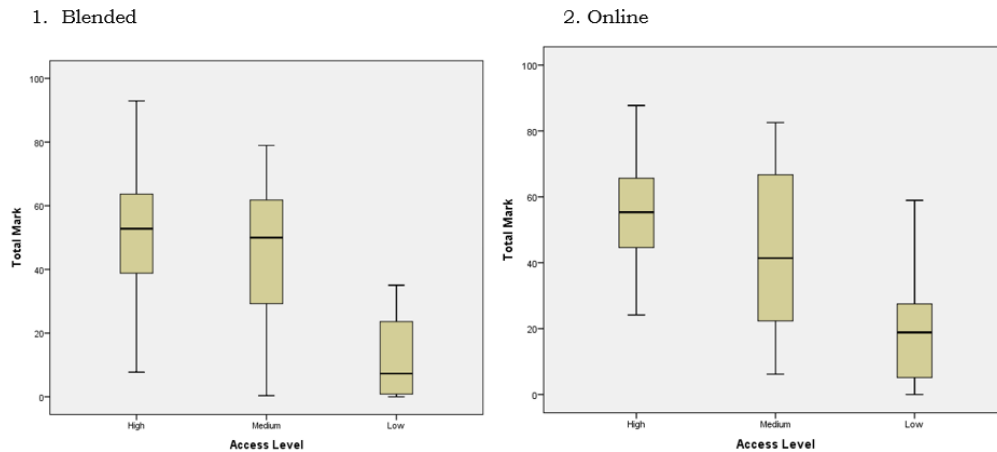


Figure 2. Marks obtained by students in the different access level groups

Compliance as a predictor of overall achievement

The next tests examined whether there was a difference in overall achievement due to compliance with the intended timescale and sequence in which learning resources and activities were accessed. These were performed separately for access to the materials in the expected week, and for completion of all discussion forum posts on time (in the expected week) and on task (about the relevant *exploring ideas* task). Figure 3 shows the percentage of students who had high, medium or low levels of compliance with timely access to materials and with the task requirements for the forums.

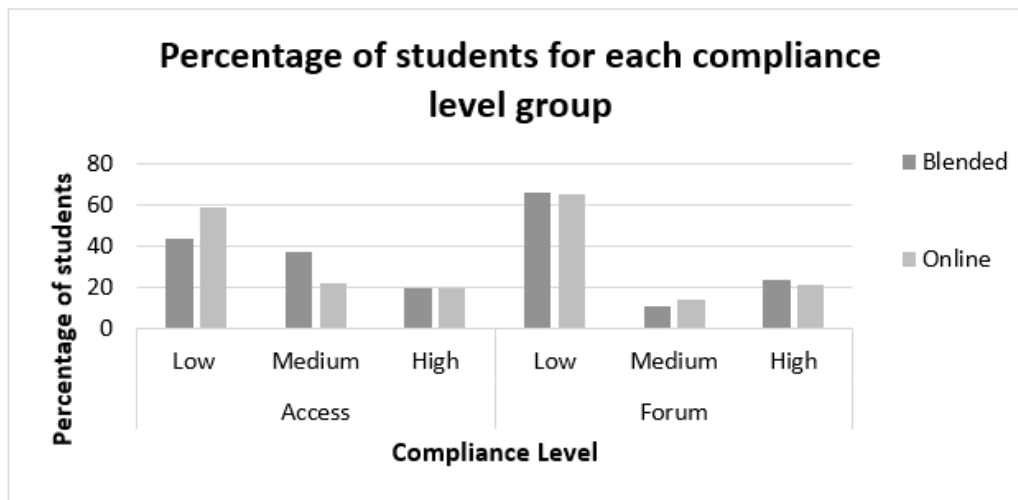


Figure 3. Students in each compliance level group

Kruskal-Wallis tests were conducted to determine if there were differences in total scores between groups that differed in their level of access to materials in the expected weeks, followed by pairwise comparisons using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons. Distributions of total scores were not similar for all groups, as assessed by visual inspection of a boxplot. For the blended students, total scores between the "low"(n=35), "medium"(n=30) and "high"(n=16) access compliance level groups were statistically significantly different, $H(2)=21.945$, $p<.0005$. The post hoc analysis revealed statistically significant differences in total scores between the low (27.31) and medium (48.78) ($p=.001$) and also between low and high (56.34) ($p<.0005$) access compliance level groups. For the online students, total scores between the "low"(n=45), "medium"(n=17) and "high"(n=15) access compliance level groups were also statistically significantly different, $H(2) = 20.432$, $p <.0005$. The post hoc analysis revealed statistically significant differences in total scores between the low (29.76) and medium (46.82) ($p=.022$) and between low and high (57.87) ($p<.0005$) access compliance level groups.

To examine the effect of forum compliance for the blended group a one-way Welch ANOVA was conducted. There were no outliers and the data was normally distributed for each group, as assessed by boxplot and Shapiro-Wilk test ($p>.05$), respectively. Homogeneity of variances was violated, as assessed by Levene's test of homogeneity of variance ($p=.004$). Total scores were statistically significantly different between different forum compliance level groups, Welch's $F(2, 26.128)=32.512$, $p<.0005$. The total scores presented as mean \pm standard deviation increased from the low (n=53, 32.7 ± 21.6), to medium (n=9, 58.5 ± 11.5), to high (n=9, 66.1 ± 13.1) compliance level. Games-Howell post hoc analysis revealed that the increase from low to medium (25.7, 95%CI, 13.45 to 38.0, $p<.0005$) and from low to high (33.4, 95%CI, 23.2 to 43.5, $p<.0005$) were statistically significant. For the online students, a one-way ANOVA was conducted. There were no outliers, as assessed by boxplot; data was normally distributed for each group, as assessed by Shapiro-Wilk test ($p>.05$); and there was homogeneity of variances, as assessed by Levene's test of homogeneity of variances ($p=.062$). Total score was statistically significantly different between different compliance level groups, $F(2, 74)=29.5$, $p<.0005$, $\omega^2=0.43$. Total scores presented as mean \pm standard deviation, increased from the low (n=50, 31.3 ± 19.7), to medium (n=11, $56.27 \pm$

16.6) to high (n=16, 68.0 ± 11.1) compliance level. Tukey post hoc analysis revealed that the increase from low to medium (25.0, 95%CI, 10.8 to 39.2, $p < .0005$) and low to high (36.7, 95%CI, 24.47 to 49.0, $p < .0005$) were statistically significant.

Figure 4 shows the distribution of total mark (total score) for students in each compliance level group for the two modes. Compliance is defined as 1) accessing materials and resources in their intended weeks (Access Compliance), and 2) completing the discussion forum tasks on time and on task (Forum Compliance). Both compliance traits had statistically significant effects on overall achievement in the course. There thus appears to be a benefit in maintaining the schedule of the course. Again, the greatest difference was seen between low and medium compliance, while there was no significant difference between medium and high compliance. In other words, students benefitted by accessing a reasonable amount of materials on time rather than very few, but once students were broadly compliant, it did not have such a great effect beyond that level. The implication again is that we need to get our students broadly in step with how the course works, help them get acquainted with expectations, and then they will be able to make their own decisions about what to prioritise. Students who struggle to conform to basic expectations and scheduling are more likely to do poorly.

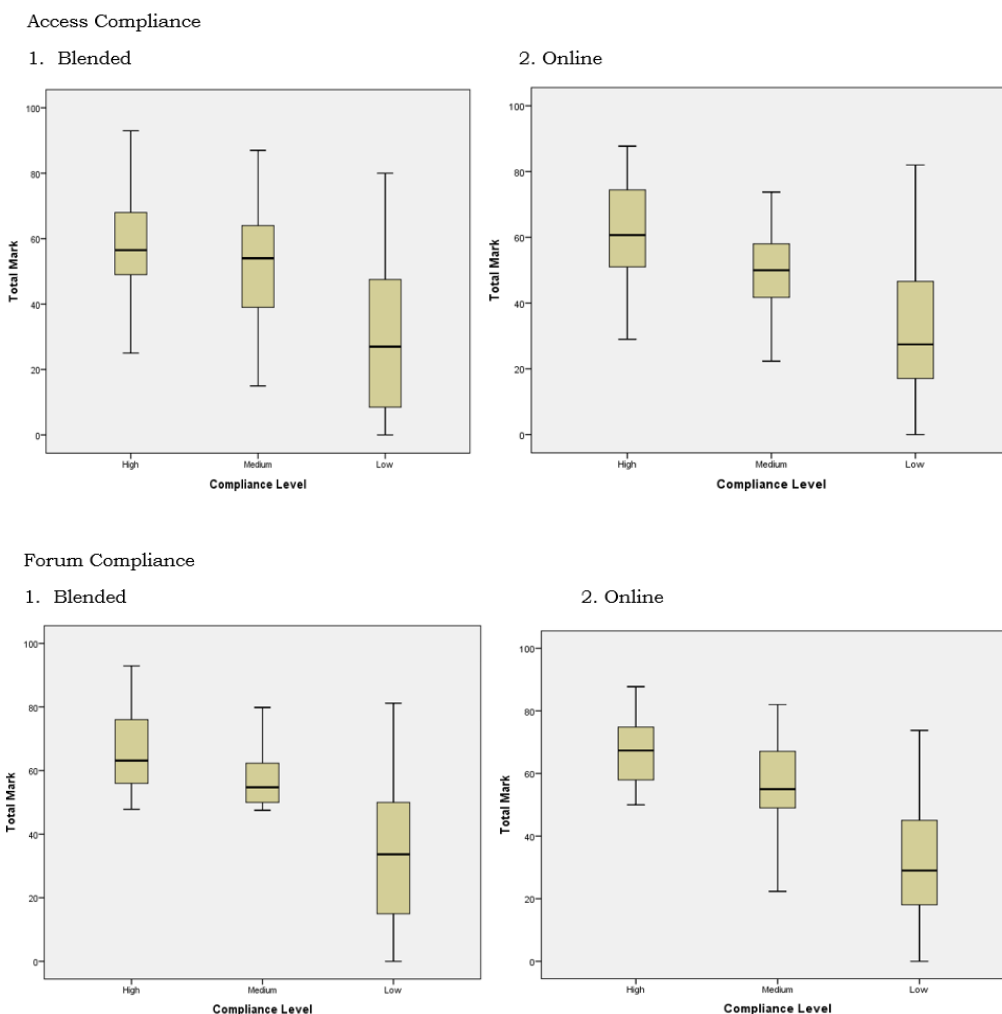
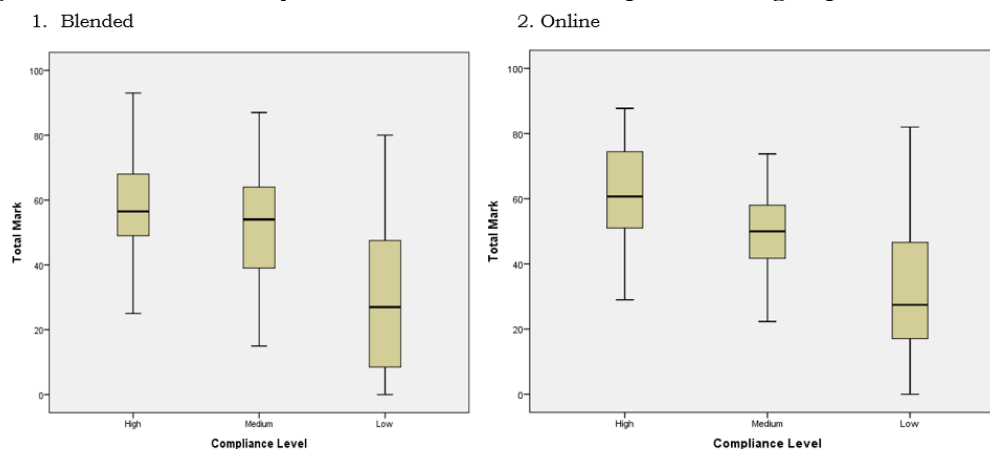


Figure 4. Marks obtained by students in the different compliance level groups

Access and compliance as predictors of achievement on the scaffolded writing task

A subset of the access and compliance data was analysed in order to examine whether students' engagement with the online materials, readings and tutorial activities during Weeks 4 to 7 could predict achievement on the written assignment that the materials from these weeks had been specifically designed to scaffold. For this analysis, Kruskal-Wallis tests were conducted, followed by pairwise comparisons using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons. Distributions of total scores were not similar for all groups, as assessed by visual inspection of a boxplot.

For the blended students, the written assignment scores were statistically significantly different between the "low"(n=8), "medium"(n=24) and "high"(n=49) access level groups, $\chi^2(2)=12.287$, $p=.002$. The post hoc analysis revealed statistically significant differences in assignment scores between the low (23.00) and high (47.85) ($p=.013$) and between medium (33.02) and high (47.85) ($p=.028$), access level group combination. For these students, written assignment scores were also statistically significantly different between the "low"(n=14), "medium"(n=37) and "high"(n=30) compliance level groups, $H(2)=19.702$, $p<.0005$. The post hoc analysis revealed statistically significant differences in assignment scores between the low (23.25) and high (54.32) ($p<.0005$) and between medium (36.92) and high ($p=.006$) access compliance level groups.

For the online students, the written assignment scores were also statistically significantly different between the "low"(n=11), "medium"(n=13), and "high"(n=53) access level groups, $\chi^2(2)=17.261$, $p<.0005$. However, unlike the blended group, the post hoc analysis revealed statistically significant differences in the online students' assignment scores between the low (13.68) and medium (39.88) ($p=.004$), and between low and high (44.04) ($p<.0005$) access level groups. Once again, assignment scores were statistically significantly different between the "low"(n=41), "medium"(n=18) and "high"(n=18) compliance level groups. This time, the post hoc analysis revealed statistically significant differences in assignment scores only between the low (30.01) and high (54.61) ($p<.0005$) combination but not for any combination with medium (43.86) compliance level groups.

Overall, we therefore see that greater and timelier access to the materials in Weeks 4 to 7 had a positive effect on the quality of submissions for the written assignment, but the two modes exhibit this effect differently. Amongst the blended students, high rather than medium access and compliance had a greater effect on the assignment marks than medium rather than low access. Amongst the online students, an improvement from low to medium access had a greater effect than improving from medium to high access, and incremental improvements in compliance did not have an effect. Given that the tutorial activities were crucial to helping students make use of the readings in writing their own assignment, it is likely that the different effects of access and compliance here relate to the different formats in which these tutorial activities were provided: face-to-face for the blended students, and via an online set of activities with answers for the online students. A comparison of the raw numbers of students grouped as “low access” in Weeks 4 to 7 and over the semester as a whole also indicates either that there was a decline in access amongst the online students from Week 7 onwards (a retention issue), or that the online students considered it more important to access the materials that directly supported the written assignment due in Week 7 than other materials throughout the semester.

Investment as a predictor of overall achievement

The final tests examined whether there was a difference in overall achievement between groups of different investment level, with investment defined as going beyond the minimum required by the tasks. These tests were performed separately for investment in the weekly discussion forum posts (beyond the minimum required to simply comply with the task) and investment in retaking the weekly quizzes multiple times in order to score more highly (despite gaining only a negligible increase in coursework credit as a result). Figure 5 shows the percentage of students who had high, medium, low or nil levels of investment, both for the forums and the quizzes.

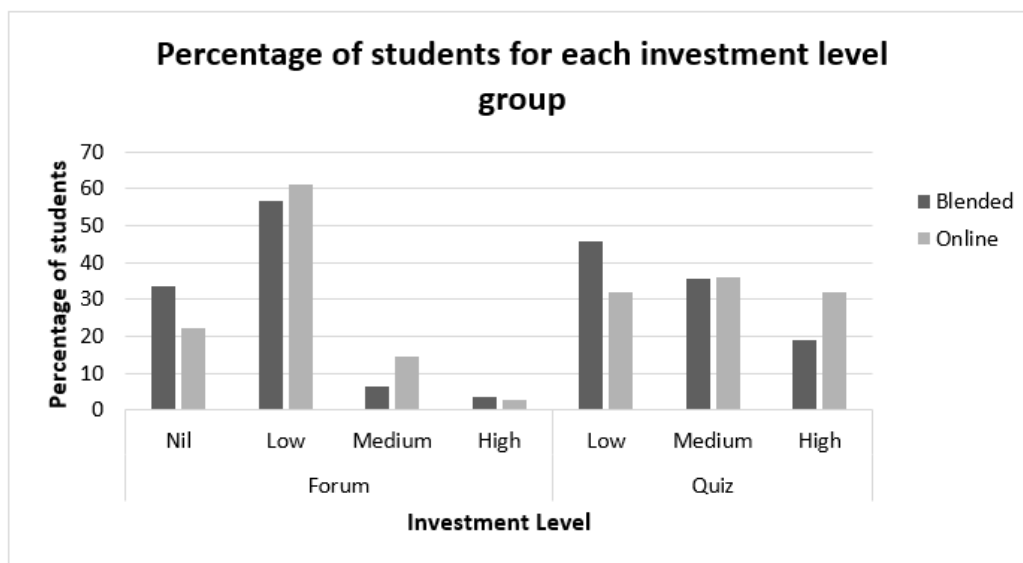


Figure 5. Students in each investment level group

Kruskal-Wallis tests were conducted to determine whether there were differences in total scores between groups that differed in their level of forum investment. Subsequently, pairwise

comparisons were performed using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons. The distributions of total scores were not similar for all groups, as assessed by visual inspection of a boxplot. Amongst the blended group, total scores were statistically significantly different between the "nil"(n=27), "low"(n=46), "medium"(n=5) and "high"(n=3) forum investment level groups, $\chi^2(3)=32.943$, $p < .0005$. The post hoc analysis revealed statistically significant differences in total scores between the nil (22.81) and low (46.23) ($p < .0005$), nil and medium (68.50) ($p < .0005$) and also between nil and high (78.67) ($p=.001$) forum investment level groups. Results were similar for the online mode, with statistically significant differences in achievement between the "nil"(n=17), "low"(n=47), "medium"(n=11) and "high"(n=2) forum investment level groups, $\chi^2(3)=25.441$, $p<.0005$. The post hoc analysis revealed statistically significant differences in total mark scores between the nil (20.24) and low (39.64) ($p =.013$), nil and medium (59.18) ($p < .0005$) and also between nil and high (72.50) ($p=.011$) forum investment level groups. It is clear from the raw figures that a very small proportion of students consistently invested beyond the bare minimum requirements of these tasks.

To determine whether students did better on the *effective communication* quizzes by retaking them multiple times, different tests were used for the two modes. For the blended group, a Kruskal-Wallis test was conducted, followed by pairwise comparisons using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons. The distributions of total scores were not similar for all groups, as assessed by a visual inspection of the boxplot. Quiz scores were found to be statistically significantly different between the "low"(n=36), "medium"(n=28) and "high"(n=15) quiz investment level groups, $\chi^2(2)=34.590$, $p<.0005$. The post hoc analysis revealed statistically significant differences in quiz scores between the low (26.78) and medium (51.71) ($p < .0005$) and between low and high (60.33) ($p < .0005$) investment level groups. For the online group, a one-way Welch ANOVA was conducted. There were no outliers and the data was normally distributed for each group, as assessed by boxplot and Shapiro-Wilk test ($p<.05$), respectively. Homogeneity of variances was violated, as assessed by Levene's Test of Homogeneity of Variance ($p<.0005$). Quiz score was statistically significantly different between low (n=24), medium (n=27) and high (n=24) levels of investment group, Welch's $F(2, 39.837)=14.821$, $p<.0005$. Quiz scores increased from the low (45.8 ± 26.1), to medium (82.4 ± 12.1) to high (92.3 ± 6.0) investment level groups. Games-Howell post hoc analysis revealed that the increase from low to medium 36.5 (95%CI, 22.3 to 50.8, $p<.0005$), low to high 46.5 (95%CI, 32.9 to 60.1 $p<.0005$) and medium to high 10.0 (95%CI, 3.6 to 16.4) ($p=.001$) were statistically significant.

Figure 6 highlights the distribution of total mark of students in each investment level group for the two modes. In summary, it appears that students who were more invested in completing tasks at a level beyond the bare minimum were those who did better in the course, although it is impossible to ascertain whether the greater effort put into completing these tasks had any causative effect.

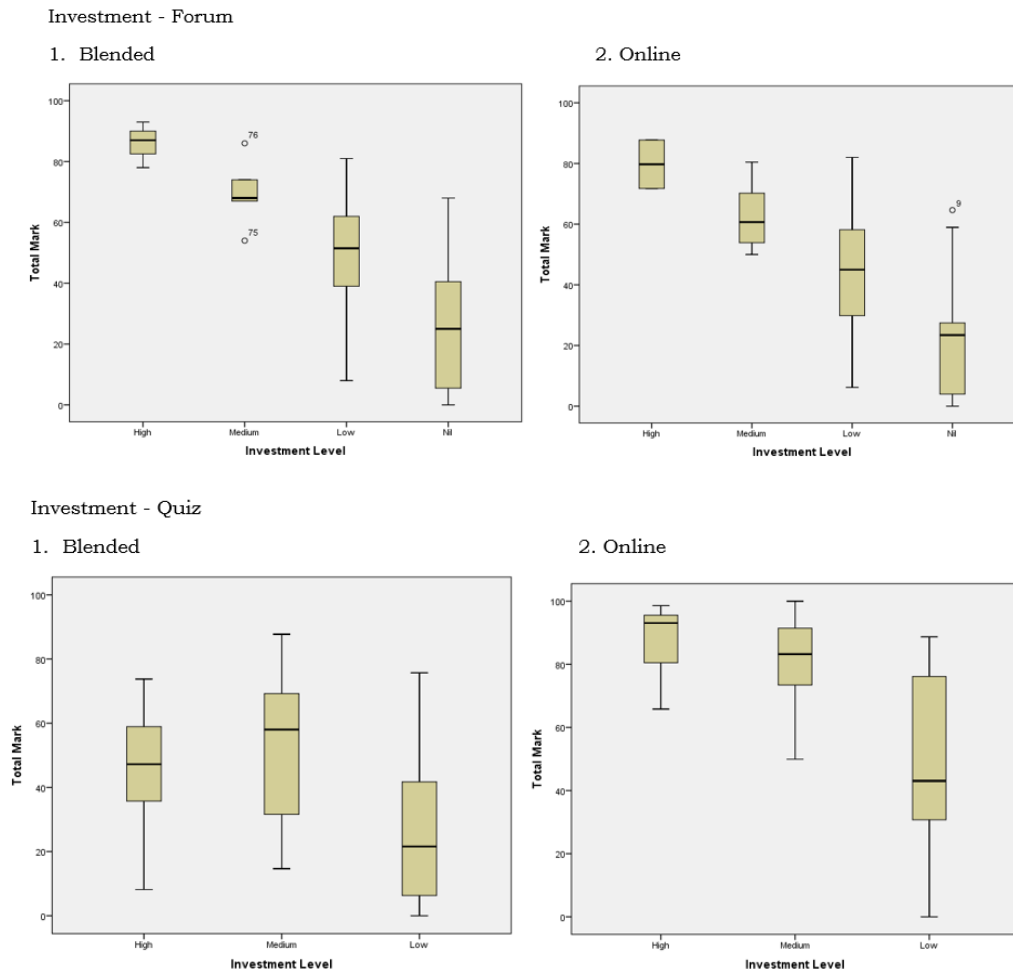


Figure 6. Marks obtained by students in the different investment level groups

Engagement as a composite of access, compliance and investment

A hierarchical multiple regression was run to determine if the addition of investment and then of compliance scores improved the prediction of total mark above access scores (Model 1), and this was found to be the case. For blended students, the addition of investment to the prediction of total mark (Model 2) led to a statistically significant increase in R^2 of .158, $F(1, 78)=26.325$, $p<.0005$. The addition of compliance to the prediction of total mark (Model 3) also led to a statistically significant increase in R^2 of .077, $F(1, 77)=15.136$, $p<.0005$. Model 3: total score= $3.991+(.143\times\text{access})+(.336\times\text{investment})+(.533\times\text{compliance})$ was statistically significant, $R^2=.609$, $F(3, 77)=39.983$, $p<.0005$; adjusted $R^2=.594$. Similarly, for online students, the addition of investment to the prediction of total mark (Model 2) led to a statistically significant increase in R^2 of .057, $F(1, 74)=8.229$, $p=.005$. The addition of compliance to the prediction of total mark

(Model 3) also led to a statistically significant increase in R^2 of .056, $F(1, 73)=9.050$, $p=.004$. Model 3: total score= $5.640+(.262\times\text{access})+(.142\times\text{investment})+(.388\times\text{compliance})$ was statistically significant, $R^2=.545$, $F(3, 73)=29.178$, $p<.0005$; adjusted $R^2=.527$.

Conclusion

A key finding from the study is that students who accessed more materials did better overall in the course. However, those who also invested more than the bare minimum in forums and quizzes did significantly better than those who simply accessed the same amount. Moreover, those who complied with the scheduling of the course did significantly better than those who simply accessed the same amount and were invested to the same degree. These results suggest that our course design can be an effective way to support the learning of content and academic literacy simultaneously, provided that all students have full opportunities to access all learning resources and activities, and provided that they can navigate the learning design effectively.

The rapid increase in online learning both encourages and obliges us to make the most of the affordances of VLEs such as Moodle. As lecturers and course designers, we can create much more innovative courses that support students as they grapple with the challenge of learning new disciplinary content. As researchers, we can make Moodle work harder for us in helping us understand how our students are making use of what we have designed. And, as academic literacy specialists, we can ensure that we use insights from such research productively, so that we constantly refine our approaches in line with the growing evidence.

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