Self-efficacy, performance and the role of blended learning

Warren, Liz; Reilly, D.; Herdan, A.; Lin, Y.

DOI:
10.1108/JARHE-08-2019-0210

Document Version
Peer reviewed version

Citation for published version (Harvard):
Warren, L, Reilly, D, Herdan, A & Lin, Y 2021, 'Self-efficacy, performance and the role of blended learning', *Journal of Applied Research in Higher Education*, vol. 13, no. 1, pp. 98-111. https://doi.org/10.1108/JARHE-08-2019-0210

Self-efficacy, performance and the role of blended learning

Liz Warren, Dawn Reilly, Agnieszka Herdan and Yong Lin
Business School, University of Greenwich, London, UK

Abstract

Purpose

This paper investigates the mathematics self-efficacy of students who are non-maths specialists. The project explores the student experience in the context of a maths module with a blended design, comprising both online content and face-to-face teaching. The aim was to reflect on the role of blended learning in this context.

Design/Methodology/Approach

Using a mixed method analysis, the study uses data gathered via student surveys and discussion forums, as well as module grades, to provide evidence regarding whether the online component of the module enables students to master the required maths skills. The data is examined under four themes that emerged as critical to improving the self-efficacy of students: flexibility, the interactivity of the online platform, the module's blended design and the functionality of the platform.

Findings

The findings are that the blended approach increases academic self-efficacy in the area of mathematics, also enhancing the student experience. These benefits arise from the combination of allowing the individual mastery of technical skills in the private and stress-free environment provided by the online platform, and access to social resources in the classroom setting.

Originality/ value

The paper details the influence of self-efficacy on academic performance and the effectiveness of a blended learning approach, in the area of mathematics. It provides insight into the importance of providing multiple opportunities for students to become autonomous as they develop academic self-confidence through the mastery of maths skills.

Keywords: blended**,** mastery experience, mathematics, online, self-efficacy

Introduction

Developments in learning technology have challenged Higher Education (HE) institutions to change how they design and deliver their programmes. By creating an environment in which students feel comfortable with the idea of technology-based learning, universities can facilitate the development of a skillset which will enable graduates to continue to develop throughout their careers (Chartered Institute of Personnel and Development (CIPD), 2017).

However, an important issue to consider here is clearly stated as follows:

> Students today would appear to be more digitally literate than previous generations because many have grown up immersed in technology-rich environments, but research has shown that this does not necessarily equate to confidence, especially in an educational context (Johnson *et al*., 2016: 24).

Dumford and Miller (2018) also highlight how the use of online assessments might adversely affect the opportunities provided for students to receive formative feedback. However, where online resources have an inbuilt feedback mechanism and students' online engagement is carefully monitored by the lecturer, potential disadvantages can be alleviated through a blended approach combining online and face-to-face elements. If done well, this has the potential to increase the self-efficacy of students because of the amount of information they can access online for themselves (Arkorful and Abaidoo, 2015). Therefore, this paper will examine if self-efficacy can be improved in the area of mathematics by using a blended approach within a learning environment that provides access to lecturers for face-to-face instruction, explanations and a supportive pastoral care system.

As well as understanding the general nature of blended learning in HE, it is vital to learn from studies in the subject area of mathematics using blended learning. Dumford and Miller (2018) stress that it is important for educators to aim to harness students' use of mobile devices, such as smartphones and tablets, to encourage their engagement with educational activities across a diverse student population with differing lifestyles and commitments outside their degree programmes. Their study analysed Year One students across a range of programmes, and discovered that online modules had a positive effect on engagement with quantitative reasoning activities, thereby supporting the use of online learning in the context of mathematics teaching. Borba *et al*. (2016) highlight the increasing trend in using mobile technologies in mathematics education, noting that mobile devices have the potential to improve performance by moving mathematics education outside the classroom to take advantage of certain benefits. For example, as students can work alone, and remotely, this enables them to avoid the distractions that can arise in a taught class. Students might also spend longer studying.

In the context of mathematics and engineering students studying calculus modules at a UK university, Inglis *et al*. (2011) extended the definition of blended learning to

include where students had access to a selection of learning resources so that each student had autonomy over how, or indeed whether, to combine them. Inglis *et al*. (2011) examined the correlation between students' attainment and their choice of learning resources in a context where they had access to traditional lectures, online lectures and a mathematics learning support centre. They found that those students who favoured traditional lectures tended to achieve higher scores in the end of module summative exam. The students who preferred the online material typically scored below average in the exam which contrasts with Borba *et al*.'s (2016) findings. Interestingly, Inglis *et al*. (2011) also observed increased student satisfaction in relation to online lectures, with students enjoying the associated flexibility. However, they note that students also need some structure to their learning activities and benefit from direction regarding how and when to use an online resource. Therefore, using technology alongside traditional face-to-face teaching could improve student engagement and performance when taking a blended approach to mathematics education.

Following on from previous research in this area, this paper explores the use of online assessment within a blended learning structure in a large Year One mathematics module called 'Quantitative Methods', which is taught at a UK university across three undergraduate programmes, all in the general subject area of accounting and finance. The university is proud of its widening participation strategy with 58% of the enrolled students identifying as Black, Asian or Minority Ethnic (BAME), 34% being aged over 21 and 59% of students being from Indices of Multiple Deprivation groups 1 or 2 (the lowest socio-economic groups), resulting in a very diverse student population. The module analysed in this study was designed to ensure the students have the requisite numeracy skills for their programmes (Opstad, 2018); however, they are non-maths specialists. The findings of this paper are not only relevant to accounting and finance-related programmes because large maths modules are the norm at most universities (Wiggins *et al*., 2017). This case study is important because as Bernard *et al*. (2014) suggest, online activity which fits around a student's lifestyle serves to motivate learning. This is especially relevant in the context of maths education for non-maths specialists as students might not be particularly interested in mathematical concepts, and therefore require assistance with motivation (Awodeyi *et al*., 2014).

Today's universities are under increasing pressure to improve students' academic performance and engagement and also to give students an enjoyable learning experience. Blended learning was established as good practice long before the current set of students entered HE; however, the requirements of each generation change (Rovai and Jordan, 2004). Therefore, this paper presents the views of Generation Z, to answer the following research questions (RQs):

RQ 1. How does blended learning improve academic self-efficacy?

RQ 2. What do students enjoy about using blended learning and what do they gain from this approach?

Self-efficacy

Bandura's social cognitive theory examines human development, adaptation, and change from an agentic perspective (Bandura, 2002). Bandura argues that personal efficacy is pivotal in mechanisms of human agency. Bandura's concept of self-efficacy has been referenced in multiple educational contexts to explain and illuminate students' beliefs about their self-efficacy and its relationship with performance, including within maths education (Honicke and Broadbent, 2016; Zientek *et al*., 2019). Honicke and Broadbent (2016) reviewed 59 self-efficacy studies in university settings and identified a moderate correlation between self-efficacy and academic performance whilst noting the effect of mediating and moderating factors. For example, Villavicencio and Bernardo (2013) found that high levels of negative emotions, such as anger or anxiety, had a moderating effect on the relationship between perceived self-efficacy and the trigonometry grades of Filipino students.

Bandura (1997) identifies four sources of self-efficacy: mastery experiences (the previous successful completion of a similar activity, particularly if perseverance was required to accomplish it); vicarious experiences (seeing one's peers complete an activity successfully); verbal persuasion (confirmation from others that one can succeed); and emotional state (the way one interprets and reacts to feelings of stress, for example). Bandura (1997) argues that mastery experiences are the most important component of self-efficacy; they provide evidence that one has what it takes to succeed because one has done it before. In the context of online learning which tends to take place alone, and not in the social setting of the classroom, mastery experiences are critical. They might be encountered through feedback and grades for online tasks, or be brought forward from experiences of online learning within secondary education. If a student has used online learning before and succeeded, he or she will be convinced that success is achievable this time and so be willing to persevere. This type of self-knowledge, which is built on past experience, constructs the perception of self-efficacy.

Method and design

This case study is set in the context of using online learning as part of a blended module within maths education. The team researched various online resources that were provided by different academic publishers and found that a suitable resource was the MyMathLab offered by Pearson. MyMathLab was introduced in 2007, and the aim was to address students' varied ability levels and encourage their engagement with the module on a regular basis. Introducing technology in this way required changes in how the module was delivered, and also the assessment structure, because the inbuilt online test component proved suitable as part of the module assessment. Therefore the module was designed with MyMathLab accounting for 20% of the summative assessment. The remaining 80% of the assessment was by an unseen paper exam at the end of the module. The face-to-face teaching comprised a weekly 2-hour lecture

and a 1-hour small group seminar, over a single semester of 12 weeks. This design blends online and face-to-face elements so that they work together to increase students' learning and enhance their experience. The online activities are set up as eight homework tasks and each task is released to students immediately after the related lectures on that topic. The online resource provides multiple practice exercises for students and by working on these exercises after the lecture, students can identify areas in which they need further help.

The case study was designed to explore whether the ability to work at their own pace and to receive instant feedback from MyMathLab (via answering practice questions correctly, and the grade received for a homework task) would improve their maths skills and therefore their confidence, i.e. their self-efficacy. The homework tasks are not time constrained because the Quantitative Methods module runs throughout the first semester of Year One. In a widening participation institution, students come from diverse backgrounds and a significant number have not sat formal exams for some time. Therefore, it is important to provide students with an opportunity to build their confidence early in their programme of study without additional time pressure, particularly as the Quantitative Methods time-constrained exam is the first major exam to be sat by these students.

Data was collected across the 2017-18 academic year, via two online surveys and two student discussion forums. Ethical approval was obtained from the university before commencing the project. Online surveys were used to identify students' expectations of online learning at the start of the academic year (Survey One) and also to compare and contrast the actual student experience in relation to MyMathLab later in the academic year (Survey Two). The aim of the project was to move away from selective student feedback to a more universal form (Herdan *et al*., 2019). Therefore all of the students studying the module were invited to complete the surveys and/or join a student forum. To enhance data reliability, a unified methodology was implemented for each survey, to ensure the data were sampled and collected in the same way.

Our approach to data analysis in this study was to use a mixed method, integrating both quantitative and qualitative analyses. A Two-Tailed Regression Test was used with the data in Tables 4 and 5 because this improved the precision of the test, regardless of whether the correlations between two variables are statistically significant. By convention two-tailed tests are used to determine significance at the 0.05 level; however, this research also shows some results are at the higher significance level of 0.01.

The qualitative data was thematically analysed, reflexively (Braun and Clarke, 2006), meaning the data was analysed to identify, and interpret, patterns of emerging themes. The process was an abductive approach because the authors interpreted the data with knowledge of the underlying theoretical concept, self-efficacy.

138 students (84.15% of the cohort of 164 students) completed Survey One which addressed students' overall perceptions and expectations of online learning. Of the

students who participated in Survey One, 42.34% were female and 57.66% were male, with 94.16% being between the ages of 18 and 20 years old, and the remainder between the ages of 20 and 29. 79.1% of the students had studied in the UK between the ages of 11 and 16 and 83.09% had completed their education in the UK between the ages of 16 and 18. 41.61% of the students reported having used online platforms in their previous education. Forums One were organised in the middle of the first semester. By that time students had engaged with activities in the lab, and completed some of the homework tasks. The aim of the forums was to explore experiences in relation to MyMathLab. 46 students agreed to participate and so three separate forums were run. Each was audio-recorded and transcribed for analysis.

Survey Two asked the students about their experience of using MyMathLab, having finished the module. 86 students (52.44%) completed Survey Two. In these types of studies it is normal for the participation rate to drop in the second study (Herdan *et al*., 2019). In order to investigate the effectiveness of the lab as a method of increasing students' maths skills, performance data on MyMathLab and in the end of module exam were accessed. In total 43 students completed both surveys and also had traceable grades giving a reasonable response rate of 26.22%. For the expectation questions in Survey One and the questions in Survey Two, a 5-point Likert scale was used to calculate the mean responses. During the second semester, Forums Two were organised to give students the opportunity to discuss their experiences of using the lab after completing the module.

Findings

This section presents the survey data and pertinent matters raised by the students in the forums. The data will then be analysed in the ensuing Discussion section along with the main themes from the student forums to compare and interpret the results as part of the mixed methods approach adopted (Cresswell, 2009). Table 1 shows the students' perceptions of mathematics self-efficacy at the start and end of the module. **[Table 1 near here]** Table 2 shows the students' expectations of online learning at the start of the module (Survey One), and Table 3 shows the students' assessment of their actual experiences at the end of the module (Survey Two). **[Tables 2 and 3 near here]**

The forums included several matters which students introduced into the conversation themselves and which provide the themes for the analysis: the flexibility of being able to study in their own time; the interactivity of the system; the blended design of the module which was based on the online learning and face-to-face content; and some additional functionality that they wished to see in the future.

Flexibility

A key theme which arose in the forums was that students found it to be particularly helpful that by using the online platform, they could learn in a more flexible learning environment with less time pressure,

> If we want to save it and go back to it later, we always have the opportunity to do that ...It's quite flexible as well, so you could do it in your own time when you want to do it, perhaps after work. (Student A)
>
> They've given us enough time to answer each question on each topic. Once we cover one topic, we have enough time to go and look over the next homework and the next, in that order. It's good. (Student B)
>
> I think the fact that they don't give us a time limit to answer the questions is also good because it doesn't put pressure on us. (Student C)

Interactivity

The structure and design of the online platforms helped students to build up their subject knowledge,

> I think it's good having easy questions at the beginning as well because not everyone knows the stuff, maybe they're doing it for the first time, so they need that to build up to the hard ones. (Student D)
>
> It's interactive, and also, when you go on the help section, you can do practice questions. It's a good resource for students who really want to benefit their own maths skills and push themselves more because there's a lot on there for us to use to help build our maths skills. (Student E)
>
> I like the fact that it gives you an example and it helps you to solve a problem which is really useful. If you get stuck on a question, with that you can help make your way through the question and you can potentially get it right from before. (Student C)

The students discussed the benefit of being able to attempt practice questions more than once,

> It gave us multiple chances[1], which gave us the chance to redo the question properly again, so it gave us a second chance when I realised mistakes. We do make silly mistakes. It was quite useful, to give us more chances. (Student F)
>
> ... once I'd worked it out two times and found out what my problems were, I was able to write the right answer which I found quite helpful. If I didn't get it at first and it wouldn't have told me, then I wouldn't have understood where I went wrong. (Student G)

[1] The multiple chances relate to the practice tests not the summative assessment.

Blended design

When using a bended learning approach, online platforms helped to motivate the learning of content covered in the face-to-face teaching activities,

> I think it's a good reason to get people to start working at home because it is more compulsory. It works towards your actual grade, so that people will actually have to do things and it gives you a bit of motivation to actually do something. ... it allows you to remember a lot about what you've learned in lectures instead of just having to go by what you remember from the lecture itself. It gives you something a bit extra to help you understand. (Student H)

> I feel like if we didn't have MyMathLab maybe we wouldn't be as pushed to practise the topics that we are learning in the lectures and the seminars**.** (Student I)

> That's really good for a refresher because it actually makes you go back and look through stuff that you might not have understood in the lecture. (Student J)

The students also raised the topic of the different expectations in the online component of the blended learning and the overall assessment for the module,

> I think the exam has longer questions with different parts …. but on MyMathLab it's just a single question with no other parts so we don't really practise for the exam. (Student K)

> You know with MyMathLab it's not exam style questions, it's just all normal questions. Obviously in the exam you'd need to practise the exam style questions … . There are past papers on [the virtual learning environment] but MyMathLab also needs to have some exam style questions. (Student L)

Functionality

Finally, students provided their own suggestions regarding how the functionality of the platform could be improved,

> If [you] have them on the go, on your commute to uni you could do a few or whenever you're just on your phone. You constantly got it, so I think that would be a lot more useful for students, especially because nowadays it's all about the technology you use and how is it integrated into learning. And if we're still having our laptops to do our work, I think that defeats the point a bit because it's supposed to be interactive and all that sort of stuff. It would be useful to have an app. … And then that would incorporate reminders. So they could send you, like, you've got one week to do so and so. I think that would

> be a lot better than having to go to the library if you don't have a laptop or go home to your computer. I think that's a lot better for students. (Student M)
>
> A suggestion I think, as well, that could be made is I feel like you should get an email or something to say that you've completed the test. I know it tells you you've completed but I always get worried that it isn't completed and the due date is gone and you've missed it. (Student N)

Following examination of the surveys and forums the relevant data from Survey One was then tested against the grades in the exam, MyMathLab and the final overall grade for the Quantitative Methods module. **[Table 4 near here]** The relevant data from Survey Two was also tested against the grades in the exam, MyMathLab and the final overall module grade. **[Table 5 near here].** The data was analysed via linear regression and correlations reported in Tables 4 and 5 (only significant correlation results are included).

Discussion

How does blended learning improve academic self-efficacy?

Interactivity

Survey Two asked whether the students agreed that MyMathLab helped them to understand the topics on the module; 80.46% of students strongly agreed or agreed that it did. There was a strong positive relationship between these students and students who had used MyMathLab to test themselves repeatedly on each topic until they understood it completely. In the forums, the students said that building up their knowledge gradually through regular practice and the ability to have multiple attempts at practice exercises, helps them to acquire new knowledge and skills. Learning from their mistakes supports students in improving their maths skills. This type of mastery experience builds sufficient confidence that they can learn maths without always relying on a lecturer to teach them.

The survey data suggests that because the students found MyMathLab useful, they were willing to work hard; 58.82% strongly agreed or agreed that this was the case. However, only 40.23% strongly agreed or agreed that they worked hard because they found MyMathLab interesting. The students were not required to complete the practice exercises on MyMathLab in order to access the homework tasks. The practice exercises are optional but a willingness to complete them had a strong positive impact on the final overall grades for the module. In the forums, the students commented that the forthcoming online assessments acted as motivators, so that the students engaged in mastery experiences by practising maths, and therefore were able to improve their ability. In Survey Two, 67.86% of students strongly agreed or agreed that MyMathLab had helped them to improve their grades in Quantitative Methods, which was also proven by the significant correlation between 'I see no point in using MyMathLab for practice if this will be not be part of the assessment (reverse)' and the final grade for

the module. Additionally, there was a strong positive relationship between these students and students who had used MyMathLab to test themselves on each topic until they understood it completely.

Blended design

In Tables 4 and 5, the significant correlations between 'My knowledge of basic maths' and 'My ability to apply maths to solve practical problems' and grades, demonstrate that perceived mathematics knowledge and ability to apply mathematics to solve practical problems has a strong impact on the final grades, including performance in both MyMathLab and the exam, which is to be expected. Moreover, it should be noted that at the end of the module, 92.93% of students were very confident or confident about their knowledge of basic maths, compared to 84.67% at the start. Similarly, the proportion of students who were confident in their ability to apply maths to solve practical problems increased to 88.99% from 78.10%. It is not possible to attribute these increases exclusively to MyMathLab as it is only one component of a module which employs a blended approach. However, these results suggest that the blended approach improves maths efficacy.

The survey data revealed interesting findings about students' perceptions of how the module uses a blend of online and face-to-face instruction. In the forums it was noted that the removal of time pressure eliminated one source of stress associated with academic assessment. Therefore, the use of the online lab optimised the student's emotional state, and provided a positive learning environment, in which he or she could perform effectively in the assessment.

There was a positive relationship between those students who used online activities to identify areas to ask their lecturers about in class and MyMathLab grades, showing that students understand the complementary relationship between these two elements. As discussed in the forums, the students considered the blended learning design with the integration of the online homework tasks scheduled to follow the face-to-face delivery of individual topics was appreciated by students and contributed positively to their maths skills and confidence. This confirms the view of Jones and Chen (2008) who pointed out that embedding an online learning element helps support students' learning by encouraging them to undertake a regular review of recently studied topics.

Table 5 shows that when used as part of a blended module, MyMathLab has a positive impact on engagement in face-to-face sessions. This is proven by the correlation between 'With the use of MyMathLab, I come to most classes with questions in mind that I want answering' and the final MyMathLab grades. Partway through the module, a good attitude toward using MyMathLab for practice also influences the exam component. It may be that students made better use of MyMathLab which led to better performance in the exam, reinforcing the strength of the blended approach. However, only 31.04% of students strongly agreed or agreed that MyMathLab was the best way to prepare for an exam, perhaps overlooking the synchronised content of lectures,

tutorials and online tasks, and instead focussing on the question style in their assessment of the lab.

For educators, the fact that the blended learning approach is enabling students to improve their self-efficacy is encouraging. Further, Pennington *et al*. (2018) suggest that increasing self-efficacy enhances student satisfaction. Within HE the student experience is a significant factor that academics must consider when designing modules and programmes.

What do students enjoy about using blended learning and what do they gain from this approach?

Flexibility

Survey One explored whether the students anticipated enjoying the online element of the blended learning design and 75.94% stated that they thought they would, with 66.16% answering that completing assessments online was something they would like. 83.45% welcomed the opportunity to complete some of the work around their own schedules. At the end of the module, flexibility was indicated as a positive feature of MyMathLab in Survey Two, where 79.31% of students confirmed that the lab had allowed for a flexible approach to learning. One of the biggest discussion points raised in the forums was how the online learning component of the module benefited students by providing them with an opportunity to learn in their own time and at their own pace, which supports the results reported by Inglis *et al.* (2011). This makes the curriculum more inclusive because it supports students who have commitments outside their programme of study such as part-time employment or caring responsibilities.

Interactivity

The module leader designed the online learning element of the module with two issues in mind. First, on entering university students have different prior experiences in terms of maths education at school or college, and of completing maths exams. Second, being a widening participation university, it is important to build confidence in Year One, because when students enter university without members of their family or friends currently attending or having previously attended university, there can be a lack of external verbal persuasion to promote achievement. These issues are especially important here as Quantitative Methods is the first module in the programme that will be assessed by exam. The use of online learning to build maths skills is also popular with students; in the forums, the students discussed how the system is interactive and provides lots of resources for students to use in their own time. Therefore they have the opportunity to delve into those subjects where they need the most help, providing a personalised study plan.

Blended design

Consistent with Osgerby's (2013) findings that students' principal focus is on the end of module exam, the students questioned the relationship between the short online questions used to practise key techniques and how to answer longer exam style questions. The teaching team use the MyMathLab platform in the module to build confidence through the mastery of maths skills; however, some students presume that it should prepare them more obviously for the style of questions in the final exam.

Functionality

Following the use of the online platform, 65.51% of students stated that they found the content interesting; however, a higher percentage of 78.16% recognised that the tool was useful in their studies. One of the interesting results revealed from the survey data related to whether they would prefer to study using a traditional textbook and only 27.91% of students answered that they would, which clearly indicates that students prefer the online method of learning. 89.54% of students found the platform easy to access from a personal computer and therefore 79.31% of them studied mainly at home for this element of the module. Only 26.44% of students found it easy to access the platform using their mobile phones, and this is assumed to be because it is a web-based product. The impact of the platform not being easy to access via a smartphone is that only 10.35% of students accessed the platform whilst travelling to the university. Dumford and Miller (2018) and Borba *et al.* (2016) suggested that the use of mobile phones has a positive effect on engagement with modules which include qualitative reasoning; therefore, easy access via smartphone is something that needs to be considered further in relation to the module studied in this case study.

To summarise, when a university is using an online resource as part of a blended approach, forum discussions suggest that to provide an optimal student experience, the integration and purpose of the various elements should be carefully explained to students. Although the students enjoyed the experience of using online learning, they identified some other areas that need to be considered if the online lab is to provide maximum benefit to students and a better experience. These include the desirability of having an app.

Conclusion and lessons learned

This paper reflects on the use of blended learning from the perspective of today's students, with their greater understanding, utilisation and expectation of information technology compared to students in the early days of this innovation in teaching practice. Evidence from the student forums suggests that the ability to work on practice examples and receive instant feedback is popular with students because it provides them with a flexible opportunity for multiple mastery experiences, and the interactivity of the platform facilitates the repetition of examples until such a point as the student is confident in a particular area of maths. Additionally, the removal of

time pressure from practice exercises and online assessments removes a potential source of stress for students. Bandura (1997) notes how adverse reactions to emotions such as stress can hinder the development of self-confidence. Therefore, using the online labs in the way outlined here can increase students' confidence in their maths skills. This is very valuable for non-maths specialists on 'numerate' degree programmes who might not have been among the top maths achievers at school but are required at university to demonstrate maths skills. The findings of this project show that a blended design can have a positive influence on maths self-efficacy, as well as on the student experience for accounting and finance students. Therefore it should continue to have a place in programme structures alongside recent developments in teaching and learning, such as the flipped classroom and team-based learning. However, the following recommendations arise from lessons learned during the project:

1. The online and face-to-face elements involved in blended learning should be aligned in order to improve their efficacy.
2. The role of the online element in a module with a blended design should be explained clearly to students at the outset. For example, where it is not the only form of assessment such as where there is also an exam, it should be made clear whether the online resource is designed to teach skills, to provide opportunities to practise exam-style questions or both.
3. Today's students have expectations about their online platforms and therefore careful attention must be paid to the functionality of any online resource, including its availability as an app-based product, not only as a web-based product. This would enable the convenient email confirmations, clarifying that assessments have been completed, as well as sending reminders to complete outstanding assessments.

The limitations of this project are that the case study is based on a single set of students, all studying on undergraduate accounting and finance-related programmes. It would be appropriate for other institutions using similar platforms in the area of maths education, and for non-maths specialists in particular, to complete similar studies to determine if the findings are replicable in institutions with different sets of students and also in institutions located in different cultural settings such as Transnational Education Partners.

References

Arkorful, V. and Abaidoo, N. (2015), "The role of e-learning, the advantages and disadvantages of its adoption in Higher Education", *International Journal of Instructional Technology and Distance Learning*, Vol. 12 No. 1, pp. 29-42

Awodeyi, A. Akpan, E., and Udo, I. (2014), "Enhancing teaching and learning of mathematics: Adoption of blended learning pedagogy in University of Uyo". *International Journal of Science and Research,* Vol. 3 No. 11, pp. 40-45

Bandura, A. (1997), *Self-Efficacy: The Exercise of Control,* W.H. Freeman and Company, New York, NY

Bandura, A. (2002), Social Cognitive Theory in Cultural Context. *Applied Psychology: An international review*. Vol 51, No. 2, pp 269-290.

Bernard, R., Borokhovski, E., Schmid, R., Tamim, R. and Abrami, P. (2014), "A meta-analysis of blended learning and technology use in higher education: from the general to the applied", *Journal of Computing in Higher Educatio*n, Vol. 26, pp. 87-122

Borba, MC., Askar, P., Engelbrecht, J., Gadanidis, G., Llinares, S and Aguilar, MS (2016), Blended learning, e-learning and mobile learning in mathematics education, *ZDM Mathematics Education* Vol, 48, pp 589-610.

Braun, V. and Clarke, V. (2006), "Using thematic analysis in psychology". *Qualitative Research in Psychology.* Vol. 3 No. 2. pp 77–101.

CIPD. (2017) *The future of technology and learning*. https://www.cipd.co.uk/Images/the-future-of-technology-and-learning_2017_tcm18-29348.pdf, accessed 31/12/19.

Creswell, J. (2009), *Research Design: Qualitative, Quantitative and Mixed Methods Approaches,* Thousand Oaks, California: SAGE Publications, Inc, (3rd edition)

Dumford, A. and Miller, A. (2018), "Online learning in higher education: exploring advantages and disadvantages for engagement", *Journal of Computing in Higher Education*, Vol. 30 No. 3, pp. 452-465

Herdan, A., Reilly, D. and Warren, L. (2019), "Getting the blend right: listening to the wide student voice to enhance the online learning experience", *The Journal of Educational Innovation, Partnership and Change*, Vol. 5 No.1, pp. 41-47

Honicke, T. and Broadbent, J. (2016), "The influence of academic self-efficacy on academic performance: A systematic review", *Educational Research Review*, Vol. 17, pp. 63-84

Inglis M, Palipana A, Trenholm S, Ward J. (2011) Individual differences in students' use of optional learning resources. *Journal of Computer-Aided Learning*. 27(6), pp 490-502

Johnson, L., Adams Becker, S., Cummins, M., Estrada, V., Freeman, A. and Hall, C. (2016), *NMC Horizon Report: 2016 Higher Education Edition*, Austin, Texas: The New Media Consortium. Retrieved from https://www.learntechlib.org/p/171478/.

Jones, K. and Chen, C. (2008), "Blended-learning in a graduate accounting course: Student satisfaction and course design ideas", *The Accounting Educators Journal*, Vol. 18, pp. 15-28

Opstad, L. (2018), "Success in business studies and mathematical background: the case of Norway", *Journal of Applied Research in Higher Education*, Vol. 10 No. 3, pp. 399-408

Osgerby, J. (2013), "Students' perceptions of the introduction of a blended learning environment: An exploratory case study", *Accounting Education*, Vol. 22 No. 1, pp. 85-99

Pennington, C., Bates, E., Kaye, L. and Bolam, L. (2018), "Transitioning in higher education: an exploration of psychological and contextual factors affecting student satisfaction", *Journal of Further and Higher Education*, Vol. 42 No. 5, pp. 596-607

Rovai, A. P. and Jordan, H. (2004), Blended Learning and Sense of Community: A Comparative Analysis with Traditional and Fully Online Graduate Courses. *The International Review of Research in Open and Distributed Learning*, *5*(2). https://doi.org/10.19173/irrodl.v5i2.192

Villavicencio, F. and Bernardo, A. (2013), "Negative emotions moderate the relationship between self-efficacy and achievement of Filipino students", *Psychological Studies*, Vol. 58, pp. 225-232

Wiggins, H., Harding, A. and Engelbrecht, J. (2017), "Student enrichment in mathematics: a case study with first year university students", *International Journal of Mathematical Education in Science and Technology*, Vol. 48 No. 1, pp. 16-29

Zientek, L., Dorsey, J., Stano, N. and Lane, C. (2019), "An investigation of self-efficacy of students enrolled in a mathematics pathway course", *Journal of Applied Research in Higher Education*, Vol. 11 No. 3, pp. 636-652

Table 1 - Self-perceptions of mathematics self-efficacy in Surveys One and Two

When thinking about the following areas indicate your levels of confidence for:

	Mean	**Standard deviation**	**Variance**	**C**	**N**	**U**
Survey 1 (n=140[2]):						
My knowledge of Basic maths	4.12	0.81	0.65	84.67%	11.68%	3.65%
My ability to apply maths to solve practical problems	3.96	0.78	0.61	78.10%	17.52%	4.38%
Survey 2 (n=99[3]):						
My knowledge of Basic maths	4.40	0.72	0.52	92.93%	5.05%	2.02%

[2] 138 students completed the remaining questions in Survey One.
[3] 86 students completed the remaining questions in Survey Two.

My ability to apply maths to solve practical problems	4.18	0.72	0.51	88.89%	9.09%	2.02%

Note: C = Very confident 5/Confident 4; N = Neither confident nor unconfident 3; U = Unconfident 2/Not confident at all 1

Table 2 - Expectations from online learning in Survey One

You will be using online learning systems to explore the subject, provide homework assignments, complete assessments and provide self-study. This is in addition to face-to-face teaching and other course assessment. When you think about the online learning systems, please answer how you feel about the following statements: I expect….

	Mean	Standard deviation	Variance	A	N	D
To enjoy studying and learning using online resources.	3.89	0.73	0.53	75.94%	21.05%	3.01%
To like completing assessments online.	3.76	0.83	0.68	66.16%	28.57%	5.26%
To like using online resources because I can complete work around my own schedule.	4.14	0.77	0.59	83.45%	14.29%	2.25%
To improve my ability to learn independently.	4.08	0.68	0.47	84.21%	15.04%	0.75%
The online system to help me improve my grades.	3.87	0.85	0.73	69.93%	25.56%	4.51%

Note: A = Strongly agree 5/Agree 4; N = Neither agree nor disagree 3; D = Disagree 2/Strongly disagree 1

Table 3 - Experience of online learning in Survey Two

	Mean	Standard deviation	Variance	A	N	D
The content of MyMathLab helps me understand the topics on the module.	3.92	0.70	0.51	80.46%	14.94%	4.60%
I use MyMathLab to test myself on each topic until I understand it completely.	3.37	1.00	0.99	51.73%	28.74%	19.54%
I am satisfied with the feedback I receive when I use MyMathLab.	3.47	1.04	1.08	59.77%	18.39%	21.84%
Studying with the support of MyMathLab is interesting.	3.66	0.92	0.85	65.51%	24.14%	10.35%

Studying with the support of MyMathLab is useful for my learning experience.	3.82	0.75	0.56	78.16%	14.94%	6.90%
I work hard at my studies because I find MyMathLab interesting.	3.30	0.94	0.88	40.23%	41.38%	18.39%
I work hard at my studies because I find MyMathLab useful.	3.59	0.86	0.74	58.82%	30.59%	10.59%
With the use of MyMathLab I come to most classes with questions in mind that I want answering.	3.15	1.03	1.07	37.94%	35.63%	26.44%
Using MyMathLab is the best way to prepare for the examination.	2.92	1.13	1.27	31.04%	34.48%	34.48%
I am satisfied with MyMathLab.	3.87	0.74	0.55	77.01%	20.69%	2.30%

With the use of MyMathLab I have been able to take part in the module actively.	3.66	0.86	0.73	62.07%	28.74%	9.20%
It is more convenient to use a textbook rather than MyMathLab.	2.92	1.12	1.26	27.91%	36.05%	36.05%
MyMathLab allows for flexible learning through its easy platform.	3.90	0.74	0.55	79.31%	16.09%	4.60%
With the help of my lecturer I understand how to use my MyMathLab effectively.	3.55	0.92	0.85	56.32%	29.89%	13.79%
I am not able to access MyMathLab easily.	2.06	0.86	0.74	6.90%	16.09%	77.01%
MyMathLab is easily accessed through my mobile phone.	2.91	1.06	1.12	26.44%	45.98%	27.58%
MyMathLab is easily accessed through a PC/Laptop.	4.31	0.77	0.59	89.54%	8.14%	2.32%

I generally use MyMathLab at home.	4.05	0.93	0.87	78.16%	13.79%	8.05%
I generally use MyMathLab on campus.	3.12	1.08	1.17	47.67%	19.77%	32.56%
I generally use MyMathLab when I am travelling between home/university/work.	2.14	1.00	0.99	10.35%	19.54%	70.12%
Because I can use MyMathLab to cover topics, I sometimes miss tutorials.	2.25	1.11	1.22	16.09%	21.84%	62.06%
The online system helped me to improve my grades.	3.76	0.95	0.90	67.86%	23.81%	8.33%
Using online resources helped me to build my confidence during my studies.	3.77	0.92	0.84	65.48%	27.38%	7.14%

Note: A = Strongly agree 5/Agree 4; N = Neither agree nor disagree 3; D = Disagree 2/Strongly disagree 1

Table 4 - Correlations for students who completed Surveys One and Two and with a module grade (n = 43)

	Final module grade		MyMathLab grade		Exam grade	
	Corre-lation	Sig.	Corre-lation	Sig.	Corre-lation	Sig.
Using online resources helped me to improve my grades.	.371	**				
Using online resources improved my ability to study independently.			-.351	*		
My knowledge of basic maths	.459	**	.318	*	.366	*
My ability to apply maths to solve practical problems	.454	**	.388	*	.409	**
I see no point in using MyMathLab for practice if this will be not be part of the assessment. (reverse)	-.340	*				

I am not able to access MyMathLab easily. (reverse)			**-.311**	*****		

***** Correlation is significant at the 0.05 level

****** Correlation is significant at the 0.01 level

Table 5 - Correlations for students who completed Survey Two and with a module grade (n = 60)

	Final module grade		**MyMathLab grade**		**Exam grade**	
	Corre-lation	**Sig.**	**Corre-lation**	**Sig.**	**Corre-lation**	**Sig.**
My knowledge of basic maths	**.407**	******			**.412**	******
My ability to apply maths to solve practical problems	**.408**	******	**.388**	*****	**.471**	******
With the use of MyMathLab, I come to most classes with questions in mind that I want answering.			**.295**	*****		

I see no point in using MyMathLab for practice if this will be not be part of the assessment. (reverse)	**-.309**	*****			**-.269**	*****
I am not able to access MyMathLab easily. (reverse)			**.258**	*****		
I generally use MyMathLab on my own.	**.258**	*****			**.353**	******

***** Correlation is significant at the 0.05 level

****** Correlation is significant at the 0.01 level