

Blended learning approaches enhance student academic performance

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Blended learning, or technology enhanced learning, is increasingly becoming an expectation for higher education students. Blended learning allows for the enhancement of face-to-face interaction between tutors and students, using internet or computer based tools. In this paper, a range of case studies are described which illustrate methods to engage students with technology enhanced learning and improve academic performance and student satisfaction. In the first case study, first year undergraduate students were provided with short video lectures and formative assessment opportunities in addition to face-to-face lectures, and the impact on examination performance was analysed. Results showed that students in multiple cohorts performed significantly better on multiple choice questions that were supported by online blended learning resources. Student usage of the resources was also analysed, and revealed that the majority of students engaged with the online resources after the live teaching event. In the second case study, students were provided with podcasts of lectures with mobile assessments (completed via SMS on mobile telephones) to assess the effect on examination performance and the results showed a significant improvement in academic performance. In the final case study, students have been issued with personal response system handsets to increase interactivity and feedback in teaching sessions. The results of these case studies provide evidence for the use of blended learning approaches to improve students' academic performance in higher education courses, as well as enhancing student satisfaction.

Keywords: Blended learning, podcasts, video resources

Introduction

Blended learning or technology enhanced learning is rapidly becoming an expectation for courses in higher education institutions across the world. This branch of e-learning describes the enhancement of face to face interaction between teachers and students with online learning opportunities, in the form of flexible, self-directed activities, which may utilise multimedia, interactive, internet based, mobile or collaborative tools (Bluic, Goodyear and Ellis, 2007; Garrison and Kanuka, 2004; Graham, 2005; Whitelock & Jelfs, 2003). Blended learning is perceived to have many advantages for the learner, including anytime, anywhere access, self paced learning, enquiry led learning and collaborative learning (Ruiz, Mintzer and Leipzig, 2006). The current generation of higher education students are so called "digital natives" (Prensky, 2001; Proserpio and Gioia, 2007) and many already use technology to enhance their social interaction, shop online and interact with online tools (Ito, 2008). However, this familiarity with technology does not necessarily translate into a desire or ability to learn using

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non-conventional methods (Bennett, Maton and Kervin, 2008; Li and Ranieri, 2010; Selwyn, 2009). Notwithstanding concerns about students' ICT abilities or learning styles, it is generally accepted that higher education students expect to make use of technology as part of their learning experience at university (Bradwell, 2009; Sharpe, Benfield and Francis, 2006). However, many institutions have approached the implementation of blended learning cautiously, due to the academic time investment needed, the perceived lack of pedagogic evidence of effectiveness (Bennett and Maniar, 2007; Conole, Dyke, Oliver and Seale, 2004; Tang & Austin, 2009), perceived negative impact on student attendance at face to face teaching sessions (Bell, Cockburn, McKenzie and Vargo 2001; Brotherton and Abowd 2004; O'Toole and Absalom, 2003; Sharpe et al. 2006) and lack of experience with the tools available or insufficient resources (Garrison & Kanuka, 2004). However, there is growing evidence that well designed and appropriately implemented institutional and departmental blended learning strategies can enrich the student experience and enhance academic performance (Bluic et al. 2007; Kerres and De Witt, 2003; Sharpe et al. 2006; Sharpe, Benfield, Roberts and Francis, 2006; Twigg, 2004).

In this paper, a number of blended learning approaches will be described along with quantitative evidence of their effectiveness in improving academic performance. These studies illustrate a variety of methods to enrich the student learning experience by supplementing face-to-face learning with online, mobile and interactive learning resources.

Use of video resources to enhance learning opportunities

In this study, blended learning was used to provide students with short videoed lectures with associated presentational materials, narration and self-assessment quizzes with instant feedback, in addition to the face-to-face teaching. In this regard, blended learning resources were provided as additional learning materials, and not as a replacement for face to face interaction. As digital video technology has evolved, students can now interact with and manipulate non-linear video presentations, in an anytime, anywhere fashion, and this makes video lectures a potentially attractive asset in a blended learning approach (Soong, Chan and Cheers, 2006). Furthermore, allowing students to revisit lectures that may have been missed, or not fully understood, allows for deeper understanding and a more flexible approach to learning (Brotherton and Abowd 2004; Hermann, Hürst and Welte 2006; Krüger and Nickolaus, 2005). Previous studies have showed that providing students with access to video lectures in addition to face to face learning can improve academic performance (Chiu, Lee and Yang 2006; Day and Foley 2006; Wieling & Hofman, 2010; Zupancic and Horz 2002), although other studies have shown no effect (Bell et al. 2001; Brotherton and Abowd 2004). In this research study, around half of the lectures on a first year undergraduate module were videoed and edited into short manageable topics. Narration was provided to accompany the video topics along with a series of formative assessment and links to further reading. Blended learning resources were hosted in the institutional virtual learning environment and usage statistics were collected. In the first year when usage statistics were collected, there were 162 students who completed the module, and of these 151 (93%) made use of the online learning resources. There were 1199 individual hits to the main menu of the resources and the average number of hits per student was 7.94 ± 0.45 (range 1 – 29 hits per student). In the following year, there were 212 students who completed the module, and 189 (89%) students accessed the online resources. There were 1041 hits to the menu page of the resources, and each student accessed the menu 5.5 ± 0.3 times (range 1 – 19 hits per student). Further analysis of the usage of individual topics showed that the majority of students accessed the resources after the associated live lecture had taken place. Usage statistics for each topic were analysed

in relation to the date of the live lecture, and only $3 \pm 0.3\%$ hits were recorded before the day of the live lecture. On the day of the live lecture, $5 \pm 0.7\%$ of the hits were recorded. The usage increased after the live lecture, with $13 \pm 1.8\%$ of the hits within 1 week and the remaining $81 \pm 1.6\%$ of the hits recorded in the months following this, up to the date of the end of module examination.

Analysis of student performance in the final module MCQ examination was conducted to ascertain if performance was increased when questions were supported by online learning resources. Students completed the final MCQ examination under University of Leeds examination conditions during the May/June examination period. The MCQ examination consisted of 50 multiple choice questions each with 5 statements, and one correct option. Responses were recorded on computer readable cards which were analysed automatically using a Speedwell OMR scanner (Speedwell, UK). Analysis of performance in final examinations was conducted using data collected on Speedwell multiquest reports, where the mean score on each question was reported. Results for individual MCQs were reported on a 0 - 1 decimal scale, indicating the proportion of students getting the question correct. All MCQs were checked against the online resources to ascertain if the knowledge tested in the question was featured in online resources. To analyse the effect of the online resources on student performance in the final examination, student performance on the sixteen questions in the final examination which had supporting online learning resources were compared to all of the rest of the questions in the examination ($n=34$), none of which had supporting online resources. Students performed significantly better in questions supported by online learning resources (0.61 ± 0.05 ; $n=16$), than those without online resources (0.44 ± 0.03 ; $n=34$; $P < 0.01$, two sample T-Test), indicating a 15% improvement in performance for MCQs supported by online resources.

Seventy-eight students completed a feedback questionnaire incorporated into the online learning resources. Overall, students found the resources very useful (see Table 1) and were particularly keen on having the lectures divided into small topics. Also, students were keen on having access to the lecture slides and notes as separate documents. Interestingly, when asked if the resources would have been as useful if audio clips were provided instead of video, students stated a clear preference for video resources.

Table 1: Student evaluation of online blended learning resources.

Results from evaluation questionnaire presented to students within the online resources. Students answered the questions on a Likert-scale and results are presented as average score, where 1= strongly disagree and 5=strongly disagree.

Question	Average score (n=78)
I would like to see similar resources to accompany other modules	4.7
The use of videos made the presentation more interesting and encouraged my use of the resource	4.0
I found being able to view the notes and slides at the same time as watching the video useful	4.2
Overall, after viewing the presentations and taking the assessments, I feel my understanding of the topics to have improved	4.3
It was useful to have the option of viewing and downloading the	4.5

It was useful to have the option of viewing and downloading the notes and the slides separately	4.5
It was useful to have the lecture divided into subject areas and topics	4.6
The formative assessment tested my understanding of the topic	4.1
The presentations aided my understanding of the topics further	4.2
I feel the resource would have been as useful and interesting if	2.5

This study analysed students performance on multiple choice questions in a formal examination and showed that students scored better on questions which were supported by extensive online learning resources provided throughout the students' enrolment on the course. As not all aspects of the course were supported by these extensive blended learning resources, it was possible to analyse academic performance in the formal examination in this way. The hypothesis was that students would perform better in examination questions which were supported by these enhanced learning resources, and this has been proven statistically. Furthermore, this study has provided some insight into how students use these study resources as part of their learning. The vast majority of students accessed the learning resources after the face-to-face learning event, and commented that they were a useful aid to understanding, reinforcing knowledge and revision. This study was designed so that the blended learning resources would supplement the face-to-face learning, and therefore this behaviour was expected. When designing the integration of blended learning into the curriculum, considerable thought should be given as to when students will be expected to engage with the resources, and what the expected learning outcomes are (Sharpe et al. 2006). As well as showing a significant improvement in examination performance by providing these enhanced learning resources, this study highlights students' appreciation of these resources to supplement their learning. Importantly, students felt that having video resources enhanced their learning more than audio clips would have done, although this has not been tested formally. Students also commented that providing additional online learning resources was useful for improving understanding, revision purposes, and for students with learning difficulties, such as dyslexia (Draffan and Rainger, 2006).

Use of podcasts and mobile assessment to enhance learning opportunities

Podcasting is rapidly gaining a foothold in UK HEIs (Harris & Park, 2008), and will soon be commonplace in bioscience courses. Podcasts of full lectures are used by many higher education institutions in the United States and UK and are available freely through podcatching software (Campbell, 2005). A number of studies have found that students value podcasts greatly as an additional resource to support their learning (Clarke *et al.*, 2007; Ralph *et al.*, 2010; Evans, 2008). Students supplement their lecture attendance with podcasts and previous research has suggested that podcasting lectures does not significantly reduce attendance (Brittain *et al.*, 2006; Lane, 2006; Malan, 2007). Students commonly perceive that podcasts have contributed to their exam marks (Brittain *et al.*, 2006), and whilst there is increasing literature on the methodology for producing educational podcasts, there is little pedagogic evidence that podcasts are useful for improving learning (Falzon *et al.*, 2005; Grabe & Christopherson 2008). However, a recent study has found that students given access to a podcast of a lecture, instead of the face-to-face lecture, performed better in an assessment (McKinney *et al.*, 2009). A recent study by Morris (2010) highlights one way that mobile assessment can be useful to improve the learning experience and educational outcome for students who make use of mobile blended learning resources. In this study, students were

provided with access to short podcasts from final year undergraduate lectures, supplemented with narrated multiple choice questions which students answered using the SMS function on their mobile telephone. As with other studies, it was found that the majority of students accessed podcasts from their personal computer, despite receiving instructions of how to subscribe to podcasts on their MP3 players (Lane, 2006, Lee & Chan, 2007; Malan, 2007; Ralph *et al.*, 2010; Sandars & Schroter, 2007). This is an interesting, but perhaps not surprising observation, which suggests that the current generation of students are still traditional learners, and have not yet resorted to learning “on the move”. From comments received it is clear that most students listened to the podcasts whilst reviewing the lecture slides or research articles on a PC, thus limiting mobile learning opportunities.

When presented with a mock examination during the module, the students who had access to the podcasts and mobile assessments performed significantly better (Morris, 2010). Student evaluation collected during the study found that the respondents were very satisfied with the enhanced learning resources provided to support the module. Students were comfortable with the use of their mobile telephone to send SMS to answer the formative questions (86% agreed that the technology was easy to use) and valued the feedback received. Seventy-six percent of students agreed that the MCQs accompanying the podcasts reinforced their understanding of the audio material. The majority of students (86%) agreed that having podcasts to accompany all lectures would enhance their learning opportunities. The results of this study may help to inform future curriculum design principles as they provide evidence that providing enhanced learning resources during a module can significantly improve students’ performance in examinations. Importantly, producing podcasts of lectures and accompanying mobile assessments is not technically challenging for the teacher, and could be incorporated into course design relatively easily.

Increasing interactivity in teaching sessions

The Faculty of Biological Sciences at the University of Leeds has issued 1200 first and second year undergraduate students with eVoting handsets, or student response systems, at enrolment. Handsets are linked to individual students and data are stored in the central student administration system. Voting handsets have been issued to students in an attempt to increase interactivity, student engagement and discussion in teaching sessions, but they are also used to monitor attendance. There is considerable evidence in the literature that supports the view that using student response systems in lectures improves interactivity, concentration and fosters deeper learning (Draper & Brown, 2004; Sharpe *et al.* 2006). Initially, staff used the technology in quite straightforward ways, for example asking a revision MCQ at regular intervals during a lecture, to gauge students' conceptual understanding. This kind of interaction with students in formal lectures improved attention and encouraged dialogue between students and teachers. In the Faculty of Biological Sciences, staff soon started to experiment with more adventurous uses for the voting handsets. A number of colleagues started asking students controversial or discussion-type questions in lecture theatres, in the hope that the results graph would appear showing an even split of answers, provoking group discussion. In other types of teaching sessions, colleagues also found innovative uses for the handsets. For example, at the beginning of practical classes, students are asked a series of health & safety questions to test understanding of the major risks associated with practicals. In tutorials, students are asked to provide feedback on student presentations using the handsets, giving instant feedback to speakers. Also, the handsets are used to collect instant module feedback and staff running the session are able to provide ‘feedback on the feedback’ as it appears on the screen. As for student feedback on our use of the handsets, this is still

being gathered formally, but students seem at ease, and engaged, with the handsets and appreciate being able to interact in teaching sessions. Typical comments received from students on end of module questionnaires include “I would like to see more interactive questions, as I get to see whether or not I understand the lecturer. That came in useful in several instances. And to get my brain to process rather than just try and absorb information for an hour.”

Conclusions

Blended learning has beneficial effects for students both in improvements to academic performance, diversity of learning opportunities and enhancements to the student experience. Higher education institutions should be encouraged to facilitate the development of a wider range of blended learning resources to support students' learning, particularly with the advent of increased, fast and reliable access to internet services for the majority of students. Furthermore, educators should continue to develop innovative and useful ways for students to access learning opportunities using mobile devices, which are rapidly becoming the predominant means for communication and interaction amongst learners.

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References

- Bell, T., Cockburn, A., McKenzie, B. and Vargo, J. (2001) Flexible Delivery Damaging to Learning? Lessons From the Canterbury Digital Lectures Project. In Montgomerie C. and Viteli, J. (eds.) Proceedings of ED-MEDIA 2001 World Conference on Educational Multimedia, Hypermedia & Telecommunication. Tampere, Finland. Norfolk, VA: Association for the Advancement of Computing in Education: 117-122
- Bennett, S., Maton, K. and Kervin, L. (2008) The 'digital natives' debate: a critical review of the evidence. *British Journal of Educational Technology*, 39, 775–786
- Bennett, E. and Maniar, N. (2007) Are videoed lectures an effective teaching tool? Available online at: <http://www.e-learningcentre.co.uk/eclipse/Resources/academic.htm> (Accessed 18 May 2010).
- Bliuc, A.M., Goodyear, P. and Ellis, R.A. (2007) Research focus and methodological choices in studies into students' experiences of blended learning in higher education. *The Internet and Higher Education*, 10, 231-244.
- Bradwell, P. (2009). The edgeless university: why higher education must embrace technology. Available online at: http://www.demos.co.uk/files/Edgeless_University_-_web.pdf (Accessed 7 June 2010).
- Brittain, S., Glowacki, P., Van Ittersum, J. & Johnson, L. (2006) Podcasting Lectures. *EDUCAUSE Quarterly*, 29, 24–31.
- Brotherton, J. A. and Abowd, G. D. (2004). Lessons learned from eClass: Assessing automated capture and access in the classroom. *ACM Transactions on Computer-Human Interaction (TOCHI)*, 11(2), 121-155.
- Chiu, C. F., Lee, G. C., and Yang, J. H. (2006). A comparative study of post-class lecture viewing. In Proceedings of the 5th IASTED international conference on Web-based education (pp. 126–130). Puerto Vallarta, Mexico.

- Clark, S., Westcott, M. & Taylor, L. (2007) Using short podcasts to reinforce lectures, Symposium presentation at National UniServe Conference, 2007, The University of Sydney, pp 22-27.
- Conole, G., Dyke, M., Oliver, M. and Seale, J. (2004) Mapping pedagogy and tools for effective learning. *Computers and Education*, 43, 17–33.
- Day, J. and Foley, J. (2006) Evaluating web lectures: a case study from HCI. Proceedings from Conference on Human Factors in Computing Systems. Pp195-200.
- Draffan, E. A. and Rainger, P. (2006) A model for the identification of challenges to blended learning. *ALT-J*, 14 (1), 55-67.
- Draper, S. W. and Brown, M. I. (2004), Increasing interactivity in lectures using an electronic voting system. *Journal of Computer Assisted Learning*, 20, 81–94.
- Evans, C. (2008) The effectiveness of m-learning in the form of podcast revision lectures in higher education. *Computers & Education*, 50, 491–498.
- Falzon, B. G. & Brown, C. J. (2005) Web-Assisted First-Year Undergraduate Teaching in Engineering. *Computer Applications in Engineering Education*, 13(2), 125-132
- Garrison, D. R. and Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. *The Internet and Higher Education*, 7(2), 95–105.
- Grabe, M. & Christopherson, K. (2008) Optional student use of online lecture resources: resource preferences, performance and lecture attendance. *Journal of Computer Assisted Learning*, 24 (1), 1-10.
- Graham, C. R. (2005). "Blended learning systems: Definition, current trends, and future directions." in Bonk, C. J.; Graham, C. R. *Handbook of blended learning: Global perspectives, local designs*. San Francisco, CA: Pfeiffer. pp. 3–21.
- Harris, H. & Park, S. (2008) Educational usages of podcasting. *British Journal of Educational Technology*, 39: 548-551
- Hermann, C., Hürst, W. and Welte, M. (2006). Informatics Education Europe-The E Lecture Portal: An Advanced Archive For Lecture Recordings. In *Informatics Education Europe*. Available online at: http://www.ics.heacademy.ac.uk/education_europe/Session_1/4_Christoph_Hermann.doc (Accessed 10 June 2010).
- Ito, M. (2008) Living and Learning with New Media: Summary of Findings from the Digital Youth Project. Available online from: <http://digitalyouth.ischool.berkeley.edu/files/report/digitalyouth-WhitePaper.pdf> (Accessed 13 May 2010)
- Kerres, M. and De Witt, C. (2003) A Didactical Framework for the Design of Blended Learning Arrangements. *Learning, Media and Technology*, 28(2), 101-113.
- Krüger, M. and Nickolaus, R. (2005) Self-directed and cooperative learning with lecture recording. Available online at: http://stadium.open.ac.uk/prolearn/summer05/documents/marc_krueger_abstrakt_of_disser_tation.pdf (Accessed 8 June 2010)
- Lane, C. (2006) UW Podcasting: Evaluation of Year One. *University of Washington*. Available at http://catalyst.washington.edu/research_development/papers/2006/podcasting_year1.pdf (Accessed 15 March 2009)
- Lee, M.J.W. & Chan, A. (2007). Pervasive, lifestyle-integrated mobile learning for distance learners: an analysis and unexpected results from a podcasting study. *Open Learning*, 22 (3), 201-218.
- Li, Y. and Ranieri, M. (2010) Are 'digital natives' really digitally competent?-A study on Chinese teenagers. *British Journal of Educational Technology*, 41, 1029–1042.

- Malan, D.J. (2007) Podcasting computer science E-1. In *Proceedings of the 38th SIGCSE Technical Symposium on Computer Science Education*, pp 389-393.
- McKinney, D., Dycka, J. L. & Lubera E. S. (2009) iTunes University and the classroom: Can podcasts replace Professors? *Computers & Education*, 52 (3), 617-623
- Morris, N.P. (2010) Podcasts and mobile assessment enhance student learning experience and academic performance. *Bioscience Education*, 16, 1-6.
- O'Toole, J. M. and Absalom, D. J. (2003) The impact of blended learning on student outcomes: Is there room on the horse for two? *Journal of Educational Media*, 28(2-3), 179-190.
- Prenkys, M. (2001). Digital natives, digital immigrants. *On the Horizon*, 9(5), 1–6.
- Proserpio, L., and Gioia, D. (2007). Teaching the virtual generation. *Academy of Management Learning and Education*, 6(1), 69–80.
- Ralph, J., Head, N. & Lightfoot, S. (2010) Pol-Casting: The Use of Podcasting in the Teaching and Learning of Politics and International Relations. *European Political Science*, 9, 13–24
- Ruiz, J.G., Mintzer, M.J. and Leipzig, R.M. (2006) The Impact of E-Learning in Medical Education. *Academic Medicine*, 81(3), 207-212
- Sanders, J. (2008) The Challenge of Mobile Learning in Work Based Practice. In Proceedings of ALT-C, 2008, Leeds Metropolitan University.
- Selwyn, N. (2009) The digital native – myth and reality. *Aslib Proceedings*, 61(4), 364-379.
- Sharpe, R., Benfield, G. and Francis, R. (2006) Implementing a university e-learning strategy: levers for change within academic schools. *ALT-J*. 14(2), 135-151
- Sharpe, R., Benfield, G., Roberts, G. and Francis, R. (2006) The undergraduate experience of blended e-learning: a review of UK literature and practice. Available online at: http://www.heacademy.ac.uk/assets/York/documents/ourwork/archive/blended_elearning_full_review.pdf (Accessed 15 May 2010).
- Soong, A.S.K., Chan, L.K. and Cheers, C. (2006) Impact of video recorded lectures among students. Proceedings of The 23rd Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education. <http://www.ascilite.org.au/conferences/sydney06/papers.html>
- Tang, T.L-P. and Austin, M.J. (2009) Students' perceptions of teaching technologies, application of technologies, and academic performance. *Computers and Education*, 53, 1241-1255.
- Twigg, C. (2004) Using asynchronous learning in redesign: reaching and retaining the at-risk student. *JALN*, 8(1), 7-16.
- Whitelock, D. and Jelfs, A. (2003) Editorial: Journal of Educational Media Special Issue on Blended Learning. *Journal of Educational Media*, 28(2-3), 99-100.
- Wieling, M.B. and Hofman, W.H.A. (2010) The impact of online video lecture recordings and automated feedback on student performance. *Computers and Education*, 54, 992-998.
- Zupancic, B. and Horz, H. (2002) Lecture recording and its use in a traditional university course. Annual Joint Conference Integrating Technology into Computer Science Education. Proceedings of the 7th annual conference on Innovation and technology in computer science education, pp24-28.

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