

# **An evaluation of the use of blended learning strategies to develop and enhance students' knowledge of primary science**

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## **Abstract**

This paper is an evaluation of the effectiveness of the use of on-line tasks (a blog and a wiki), as part of the trialling of a blended learning approach in the delivery of a conventionally taught primary science module, during students' Postgraduate Certificate in Education (P.G.C.E) year of training. Students' engagement with these modes of learning and their views on their usefulness in developing their knowledge of primary science was evaluated. The paper identifies some lessons learnt for the future design of the module and its delivery and has identified a set of principles for other tutors considering the introduction of on-line activities in their respective modules.

## **Introduction**

The Government's Implementation Plan requires students on the (P.G.C.E) course to spend more time in schools (ITT Criteria 2012). This move towards increased school based training will inevitably have an impact on the amount of time students spend at University, attending traditional face to face seminars and tutorials. As a result there is a need to explore different ways of delivering the content of the science module which comprises pedagogical, curriculum, and subject content knowledge.

The intention of this paper is to report on a small-scale exploratory study which aimed to review the effectiveness of several blended learning approaches that combined face to face teaching with electronically completed activities. The latter was introduced into a P.G.C.E primary science module during the course of their one years' training. More specifically, the research sought to ascertain whether primary P.G.C.E students engaged with the delivery of

on-line tasks, a blog and a wiki, set up during the course of the module. It also set out to identify students' preferred modes of learning the primary science curriculum.

### **Research context**

The use of blended learning is regularly debated in the literature. Donnelly (2006) refers to blended learning as the term used to describe learning events or activities where e-learning in its various forms is combined with more traditional forms of teaching such as classroom based seminars. As stated by Yapici and Akbayin (2012), the purpose of blended learning is to establish a balance between on-line learning and face to face learning, but they note that there is no simple formula for establishing a well-blended learning environment. The aim instead is to find a synthesis of the most effective and sufficient methods appropriate to the content and to the individual learning objectives of the module. Salmon (2005: 211-214) offers an example of a four quadrant model as a framework for an e-learning strategy, with the aim of advancing what was possible in the classroom and combining traditional approaches with e-learning, to meet new objectives.

Blended learning solutions have been useful in some instances to help with a shortfall in teachers not provided by other traditional means. Kirwin, Swan and Breakwell (2009) describe the establishment and delivery of a Blended Learning Higher Diploma in Education for primary school teachers in Ireland which now produces more qualified primary school teachers than any other program in the country. They conclude that a blended learning educational system that includes on-line education was a highly appropriate mode of training school teachers.

There are also examples from research overseas which have used blended learning successfully to train teachers. Yan's (2009) study into teacher training in China for example, found that e-learning was an effective way for teacher education to meet the challenges of massive and routine training. Dettori, Giannetti and Perisco (2006) described the enhancement of certain competencies by on-line components of courses in Italy. These included flexibility in the management of time, the ability to personalise the learning environment according to personal learning style and need, as well as the possibility of reflecting on problem solving and assessing learning progress and contacting and receiving help from tutors and discussing issues with peers.

Using a blended learning approach in the training of teachers has been successful in certain instances, but there needs to be a consideration of factors that will facilitate a customised

Virtual Learning Environment (VLE) to achieve this. Williams, Tanner and Jessop (2007) as part of a blended learning approach (used on a part-time postgraduate route to Qualified Teacher Status) promoted the balance between face to face and e-learning, the nature and structure of e-learning tasks, the professional learning in the workplace, the motivation of students and independent and student led interaction.

Certain issues have however been identified with the use of e-learning and blended learning approaches. Salmon (2005) makes the point that e-learning is complex and involves considerable individual and institutional change and that most Higher Education Institutions are struggling to engage a significant percentage of students and staff in e-learning. E-learning and blended learning are viewed as technical solutions rather than as pedagogic innovation. Cousins and Bissar's (2012) findings on adapting to digital change at London Metropolitan University, was that a top down vision rarely worked and instead it is the community who realise the vision and set the agenda. Deepwell and Malik's (2008) study on how 250 undergraduate students engaged actively with learning technology in their self-directed study time stressed that more academic guidance was needed on how to use the technology effectively for independent learning, even when ICT skills were high. They found that notional time for self-directed learning was under threat, there were issues regarding supporting the learners in making sense of the technologies and the expectations for support by tutors needed to be clarified. Findings showed that students were in favour of using learning technologies to support their studies but most of its use was however administrative. They welcomed on-line materials as enhancement, but also indicated their preference for face to face learning. Williams et al.'s (2007) findings were that the VLE appeared to be a medium for sharing information, for mutual support and for some discussion but the latter was limited due to the length of time it took to conduct a discussion through an asynchronous forum. Other studies have also considered the role of the tutor in blended learning delivery of modules and highlighted certain problems. Deepwell and Malik (2008) for instance, found in their study that there was a strong reliance on the tutors for information and guidance on learning at all levels of study, there was a high expectation of almost instant tutor feedback and declared dependence on the supplied reading and the fact that on-line feedback did not have as high a value as face to face feedback.

We can learn as much from failures as from successes. This study will show the important lessons learnt from the level of engagement by trainees with new modes of on-line learning as part of a blended learning approach and how this will influence the design and delivery of such a module in the future.

## **Research design**

### **Sample**

Three groups of P.G.C.E. students were asked if they wished to participate in this exploratory research at the start of the academic year. The groups chosen were those being taught twice weekly throughout the year via face to face contact, but who also had ease of access via electronic means. Two thirds of the students were primary students (following a 5-11 year pathway) and one third were early years students (following the 3-7 year pathway). Eighty out of ninety possible students agreed to be part of the research. As is typical of any P.G.C.E. cohort these students consisted of both males (28%) and females (72%), and were of different ages (86% were under 30 years) with different types and classification of degree. These ranged from Early Childhood Studies (14%) and Academic Studies in Education (8) to Psychology (7%) and various other disciplines such as Criminology and Law. The research was intended to be a small scale study comprising one cohort of P.G.C.E. students based at the University of Worcester using a practitioner based approach.

### **Methods**

A compulsory and assessed on-line task was set for students, midway through the autumn term. The task was designed to consolidate the content of a seminar on helping students to enhance children's experimental and investigative skills. The approach included reflection and task based activities. Students were then asked to complete a questionnaire survey to assess how useful they found the on-line task in developing their knowledge and understanding of science skills and how easy they found the on-line task to access and complete. Semi-structured face to face group interviews were also held with students to receive informal feedback.

At the end of the autumn term a Wiki was set up with one group of thirty students. The Wiki comprised of scientific terminology linked to the topic of Materials taught in the spring term. Students were asked to contribute to the Wiki and define the list of scientific terms displayed and improve on each other's definitions. This pedagogical approach was intended to support a constructivist view of learning modelled to the students during the face to face taught sessions. Minimum input was provided on how to complete the Wiki to ascertain whether students would use their initiative. The task bridged the Christmas break to allow plenty of time for students to reflect on the vocabulary displayed. A face to face seminar on the topic

of Materials took place at the start of the spring term. It was intended that students would have previously accessed the Wiki, which would help them think about the content before the session and would improve the learning in the face to face session. Semi-structured interviews took place with two students who accessed the Wiki.

Midway through the spring term, a blog was introduced to students before they went out to schools for a four week placement. The aim of the blog was to help students in supporting each other in the teaching of primary science whilst in school. The University works in partnership with schools in a large geographical area comprising five counties, where students undergo school based training as part of their P.G.C.E. year. Due to the nature of the partnership being spread over a wide area and consisting of schools of different sizes, many of our students are placed on their own in school and as a consequence often feel isolated and do not benefit from peer support provided by other students in the school. The intention was, as Module Lecturer, to initially act as facilitator when students posted their messages and questions, and then withdraw to allow them to support each other. Students were reminded of the blog via e-mail after the placement had started. One group of thirty students was chosen due to there being a strong sense of identity within the group and because they were very enthusiastic and keen to participate in discussions during face to face seminars. The group completed a questionnaire comprising of open and closed questions at the end of the placement to ascertain their views and use of the blog.

At the end of the year a final questionnaire was given to all eighty students who had agreed to be part of the research to find out what on-line facilities on the VLE, Blackboard they had used linked to the P.G.C.E. course and what was their preferred mode of learning about primary science. The aim was to ascertain students' general use of the VLE in other modules and note any similarities or differences with the science module.

### Findings: On-line Task

The questionnaire regarding the usefulness and ease of access of the on-line task revealed very positive results as can be seen in Table 1:

Table 1 – Perception of Usefulness of On-line Tasks

	Yes	%	Some-times	%	No	%
Did the on-line task help you to develop your knowledge and understanding of SC1 science skills?	78	98	0	0	2	2

Do you think the activities you completed will help you when teaching SC1 science skills?	80	100	0	0	0	0
Was the task self-explanatory?	51	64	8	10	21	26
Would you have been able to complete the task without tutor input?	46	58	0	0	34	42
Were you able to access the task on Blackboard easily?	78	98	2	2	0	0
Once the answers were posted did you mark your task?	51	64	0	0	29	36
Would you find the setting of more tasks useful?	65	81	9	11	6	8

Nearly all 98% (n=78) of the students thought that the on-line task had helped to develop their knowledge and understanding of SC1 science skills and 100% thought the task would help them when they were teaching the skills of science to primary children. Just over one quarter (26%, n=21) of students thought that the task was not self-explanatory. 42% (n=34) thought that they would not have been able to complete the task without tutor support. This dependency was more marked with early years students where 68% stated that they would not have been able to complete the task without tutor input. Almost all, 98% (n=78) had stated that there were no problems accessing the VLE Blackboard and 81% (n=65) would find the setting of more tasks useful. An interesting result is that 36% (n=29) of students had not marked their test once the answers were posted on Blackboard so had not consequently obtained feedback on their performance.

Semi-structured interviews with groups of students revealed that they had learnt from the on-line activity. The task had given them the opportunity of combining the theory that they had learnt in the session with a practical activity presented on-line. They had found it a useful way of revising their subject knowledge on the skills of science, or catching up on work they had missed. One student stated that it had been 'Good to work independently and revise what we know'. Students however commented on how they still wanted tutor input whilst learning primary science because they valued the pedagogical as well as subject content knowledge provided by the tutor. One student commented: 'In science we need the practical element'. Suggestions by students to improve the setting of on-line tasks included asking them to work in pairs, completing the task and then posting it as a journal and making the expectations of students marking the task on-line very clear. They also wanted the task to be checked by the tutor.

### **Findings: The Wiki**

Analysis of results for engagement with the Wiki revealed the disappointing result that only 5 students (16%) had engaged with it and only one student had added or modified the definitions posted by another student. Semi-structured interviews were carried out with two of the participants in a face to face setting. One was a mature student, whilst the other was a young student who had recently completed her undergraduate course. The mature student stated that she preferred practical activities and a hands-on approach for teaching science on the P.G.C.E. course: 'I enjoyed the carousel of practical science activities during the science seminars'. She thought it encouraged students to be more motivated and helped them develop their subject content knowledge of science as well as their pedagogical and curriculum knowledge. She felt the face to face seminars generated excitement and interest and was of the opinion that if more on-line work was provided, students would learn the subject content knowledge of science rather than the pedagogy: 'The face to face seminars provide us with ideas of how to teach aspects of the topic to children which is really useful when we are out on school placement'. Despite not having had input on using the Wiki, she used her knowledge of Wikipedia and found the information on the screen easy to follow. She thought that the Wiki had made her think about the scientific vocabulary before the session and she felt better prepared in the face to face seminar. She suggested restricting the time the Wiki was available to encourage students to use it, rather than leaving it open. She also felt that monitoring its use, or making it compulsory to use would result in students engaging with it: 'You need to be self-motivated to engage with those on-line activities which are voluntary'. She felt that a reduction in practical face to face seminars would have a negative effect on the learning and training taking place on the course.

The younger participant stated that she had used the Wiki because she found the activity useful. She thought the instructions were clear. It allowed her to think of the definitions and she had benefitted from seeing somebody else's definitions which helped her with her own thought processes. The Wiki had helped her with the elicitation task to determine prior knowledge done in the seminar by all students, where they were asked to define the same key scientific terms: 'I felt more prepared when I was asked to define these terms in the face to face seminar'. Her view was that the Wiki had provided her with the opportunity to reflect and could see its value in developing her competence as a primary teacher of science. She too thought the Wiki should be made compulsory and students would then engage with it. She mentioned there being a time issue on the course because it was so intensive which made it difficult to engage with on-line medium. She also preferred face to face seminars and thought reduced social contact would be a threat to her own professional development as she found her peers stimulated her noting: 'During the seminars we learn by discussing

and solving problems together'. She thought that if the content of the course comprised of more on-line work it would result in more subject content knowledge rather than pedagogical and curriculum knowledge which is essential for a teacher to possess.

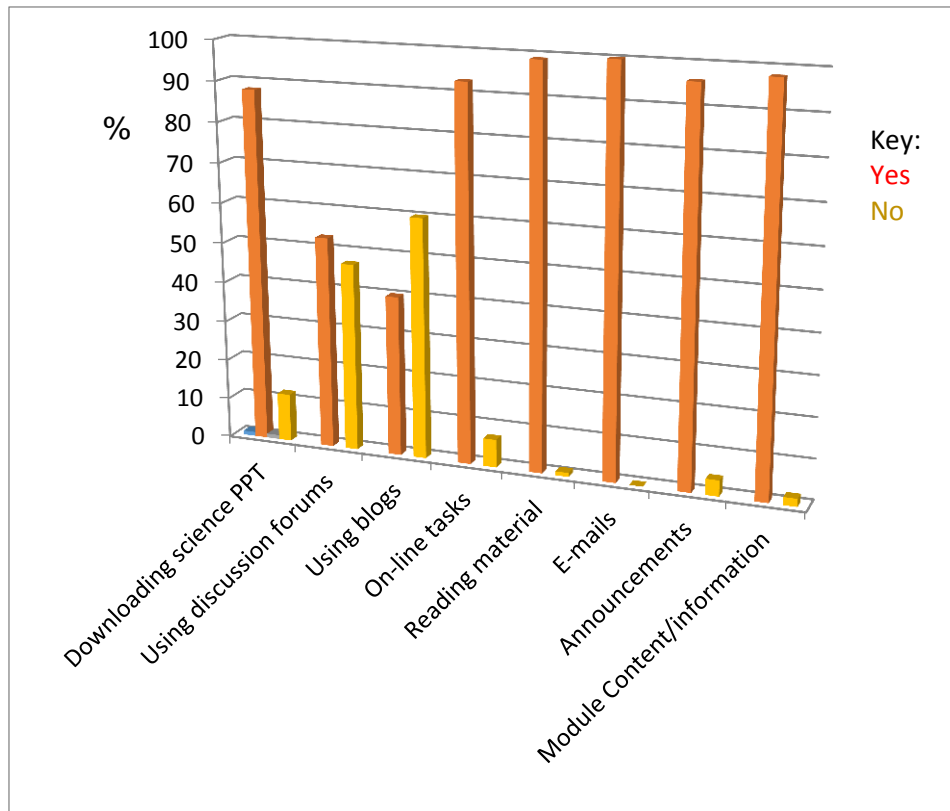
### **Findings: The Blog**

The use of the blog also revealed some very disappointing results. 100% of the 30 students in the sample had thought that the blog would be a good idea to have during the school experience. Only 25% of them had used a blog before. During the second week of the placement they were reminded of the existence of the blog but despite this, only 13% of students had used it. Unfortunately 42% of students had not had the opportunity to teach science but only 4 students of the 58% that had the opportunity to teach science used the blog. Comments by students in the questionnaire revealed a variety of reasons for not using the blog despite being overwhelmingly positive about it at the outset. Some obviously stated that because they had not taught science they had not had the need to use the blog. An overwhelming majority stated that they found the placement very intensive and they had to carry out a great deal of planning, marking as well as completing school based tasks on a variety of topics, so did not have time to engage with the blog. One student said: 'I felt that I had to focus on my own work rather than responding to the needs of others'. Two stated that if they had struggled they would have used it for guidance but felt confident in their teaching of science. One interestingly said that: 'I wanted an immediate response to my query and the blog could not provide that.'

Students' use of the VLE Blackboard for the P.G.C.E. course was investigated through an end of course questionnaire to establish whether it was being used in other modules and how it was being used. This consisted of a mixture of open and closed questions. The graph below shows how its facilities were used.



**Figure 1 - Trainees Use Of The VLE Blackboard**



The VLE was mainly being used for administrative tasks such as accessing on-line tasks, reading, e-mails, announcements and accessing module content information rather than engaging with discussion forums or using the blogs. Only 40% of students had engaged in the use of blogs and only 53% had used the discussion forums provided in other modules. This echoed the disappointing use of the blog and the wiki in the science module discussed previously. By contrast trainees' use of Social Media was high with 85% using Facebook and 37% using Twitter. Other Social Media being used was Instagram, 7%, and 7% used Snapchat, Pinterest and LinkedIn. 51% had had previous experience of on-line courses. 12% had used Blackboard before in their undergraduate degree, 5% had used Moodle and 2% had completed a part-time course with the Open University. Nonetheless, the VLE was being used as an information repository rather than for active learning.

Students were asked via the end of course questionnaire to rate their preferred way to learn about primary science on a scale of 1 to 5 where 5 was the most preferred way of learning and 1 the least preferred. The five approaches were presented as alternatives, rather than as a blended range of approaches to learning and the list of approaches used is by no means exhaustive, so these limitations needs to be taken into account when interpreting the data collected. Nonetheless the table below shows some interesting results.

**Table 2 – Preferred Way To Learn Primary Science**

	1 = least %	2 %	3 %	4 %	5 = Most %
Independent reading	28	16	30	16	10
On-line tasks including video clips	8	13	35	29	15
Face to face seminars	11	3	4	10	72
On-line seminars with tutors	6	25	38	27	4
On-line podcast	25	37	26	6	6

The preferred way of learning about primary science was through face to face seminars with an overwhelming 72% rating it as their preferred mode of learning. This was followed by the use of on-line tasks including video clips. Independent reading was the least popular followed by on-line podcasts. Students were non-committal about on-line seminars with tutors.

Feedback from semi-structured interviews with individuals as well as questionnaires with the eighty students revealed that despite students using the University's VLE Blackboard to access information and students being confident users of Information Technology (23% and 73% had rated themselves as very confident and confident respectively) and 100% having Internet access at home, they were less likely to engage with on-line modes of learning unless it was a course stipulation and a requirement for assessment purposes.

## **Discussion**

These findings have highlighted a number of issues which have implications for the future design and delivery of this primary science module, but could also be applied to modules in other University courses. A set of principles for tutors considering the introduction of on-line activities in their courses can now be outlined.

The content of a science module on a P.G.C.E. course or other University course using a blended learning approach needs to first of all provide opportunities for students to engage with each other and their tutor and go beyond simply information transmission. As stated by Salmon (2005: 202), it needs to be more than 'a substitutional approach.' This requirement needs to be stipulated in the module outcomes and expectations and instructions made clear to the students. Blended learning thus needs to be inherent in course structure not as an

add-on which was the case in this study which was intended to be exploratory in the first instance.

The design of any module needs to consider the best modes for delivering subject knowledge whether pedagogical, curriculum or subject content knowledge, or a combination of these as well as considering the balance of delivery. This may entail a combination of face to face traditional and on-line learning. Students' preference of how they wish to learn in that particular subject or area also needs to be considered when designing the structure and content of the module. Face to face seminars were the preferred modes of learning in this study and students interviewed commented on the value of these seminars to develop their pedagogical and curriculum subject knowledge. Donnelly (2006) argues that problem-based learning and e-learning are pedagogical approaches that do support a constructivist view of learning because this approach requires reflection and task based activities where learning is by doing. The constructivist view of learning is one very much promoted on the science module. Sands (2002) makes the valid point that while information transfer may be more effective on-line, simply uploading materials will not guarantee students will engage with the material and learn from it. Thus using classroom time that connects with the on-line task needs to take place in order to assist in the construction of knowledge. It is also essential that students are asked to engage with each other as well as with the materials. A set of goals or tasks which requires them to return to on-line work may be a useful strategy. The nature of any module content delivered through the VLE thus needs careful consideration.

This exploratory study highlights that a move to the use of more blended learning in a P.G.C.E. course requires a uniform and united approach across all modules on the P.G.C.E course not just one solitary module. It is then more likely that students will engage with the different modes of on-line learning if it is a course requirement and this will apply to other University courses. This study did reveal that students' engagement with on-line modes of learning on other modules on the P.G.C.E. course was also very low. As noted by Salmon (2005), e-learning does involve shifts in understanding and behaviour but often academic staff are reluctant to change their methods of teaching and learning. Cousins and Bissar (2012) discuss the necessity to build on positive staff attitudes. A full induction for both staff and trainees on the use of the VLE Blackboard and its different facilities on any courses considering the introduction of blended learning strategies would address some of these issues.

The role of the tutor needs to be clearly defined and their facilitator skills developed so that discussions and learning can be managed on-line. More importantly however, students'

responsibility for their own learning needs to be reiterated both in accessing information, receiving feedback and acknowledging and being pro-active in identifying the next steps in their learning and not over-relying on the tutor. Students thus need to be autonomous and self-directed. Dettiori et al. (2006) discuss the need to include the practice of self-regulated learning in programmes and making it an explicit aim of pre-service teacher training. This point is particularly pertinent in this study where students cited the reason for not using the blog as lack of time. Deepwell and Malik (2008) also conclude that there is a need for more guidance on what and how to use technology for learning more independently. Tutors then need to be able to motivate participation and encourage students to co-construct knowledge. Williams et al. (2007) comment on the need to establish learning communities to enhance communication between the various parties.

Monitoring the use of the on-line modes of learning needs may increase engagement by students but may diminish their very important attribute of offering flexibility to those that engage with it. Students in this study cited that they wanted monitoring of their on-line tasks and suggested monitoring the use of the Wiki and Blog to increase its use by students. A more productive way forward may however be as stated by Salmon (2005: 203) for 'well supported and focused learning intervention'.

### **Conclusion**

This small exploratory case study has investigated the introduction of new educational technology to a module previously taught through traditional face to face contact. It has led to an improved understanding of some important issues encountered by a practitioner and challenged assumptions made at the start of the study. It has enabled the critical reflection of working practice and provision and will have implications for the future design of the module. Its findings will be of interest to other University courses as well as to other P.G.C.E. courses in different Institutions also facing the same reduction in hours and face to face contact. The results have shown that when on-line modes of learning are used, it can indeed enhance and extend the learning in primary science. A blended learning approach can provide flexibility of time and place and self-paced learning can be possible. It can also empower students to learn in a manner that suits them. Careful planning and execution is however required when adopting a blended learning approach if it is to be successful. It will then combine the best of traditional educational means with new media and enhance the learning experience for students.

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### **Biography**

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