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Large Scale Delivery of Cisco Networking Academy Program by Blended Distance Learning

Nicky Moss

Faculty of Mathematics Computing and Technology
The Open University
Milton Keynes, United Kingdom
n.g.moss@open.ac.uk

Andrew Smith

Faculty of Mathematics Computing and Technology
The Open University
Milton Keynes, United Kingdom
a.smith@open.ac.uk

Abstract—This paper reports upon the success that The Open University of the United Kingdom (UKOU) has had in delivering the Cisco Exploration Curriculum, as an undergraduate course (T216), using a Blended Distance Learning Model (BDL). It discusses the importance of Supported Open Learning as a method of supporting students, and the key role of simulators, remote access tools and day schools. It is argued that a constructivist learning approach was taken when designing T216, which is demonstrated by this BDL model. BDL has proven to be an excellent way of delivering Cisco courses to adult learners, as supported by student feedback and attainment. BDL offers the Cisco Networking Academy program an opportunity to extend reach in both existing and new markets.

Keywords-Cisco Networking Academy; Blended Distance Learning (BDL); Supported Open Learning; NETLAB; Constructivism; CCNA.

I. INTRODUCTION

The Open University of the United Kingdom (UKOU) has been providing higher education at a distance since 1969. At the time of writing it had 180,000 [1] students studying undergraduate and postgraduate courses, mainly in the UK, but also considerable numbers in Continental Europe and some other Countries. The faculty of Mathematics Computing and Technology also has a history of providing courses relevant to employer needs. In comparison, the Cisco Networking Academy currently has 470,000 [2] registered students in 160 Countries. Just in terms of outreach, both organizations have been successful in bringing education opportunities to very large numbers of people, and often to groups that do not have access to other types of education. Both have been successful in developing the courses and information systems to support their learners, and both provide courses that are valued by employers.

The UKOU became a Cisco Networking Academy in 2003, and delivered its first CCNA (Cisco Certified Network Associate) course in 2005. Since then it has recruited more than 2500 students to study the CCNA, and is currently enrolling about 600 per year to study CCNA Exploration. The UKOU also started to deliver the CCNP (Cisco Certified Network Professional) curricula in 2009, and has already recruited 80 students to study the first CCNP module, Building Scalable Cisco Internetwork. All UKOU students study the CCNA and CCNP using blended distance learning (BDL), or more precisely, a variation on what the University calls 'supported open learning'.

The UKOU has been a very successful University that has enjoyed growth, year on year, since it opened its virtual doors to students forty years ago. Much of the success can be attributed to the ability to offer learning opportunities to students who find it difficult to access traditional classroom based educators. For example, students in full time employment, those in the military and those with disabilities. It is these same groups of students who have enrolled in the Cisco courses at the UKOU, and this has brought about 5% extra students to the CCNA program in the UK, at a time when the overall program appeared to have reached saturation.

This paper will expand upon the model of supported open learning (BDL) that the UKOU is using, arguing that the CCNA program is ideally suited for this form of delivery, and that BDL offers opportunities to extend the reach of the Cisco Academy Program to students in existing and new markets.

II. SUPPORTED OPEN LEARNING

The style of distance learning used by the UKOU is often described as supported open learning. The key features and pedagogical aspects of this style are described below, followed by the specifics of how this style has been adapted in the case of students' studying the Cisco Networking Academy program using BDL.

A. The UKOU Model

In the UKOU model students study at a distance, normally at home in their own time, using material provided by the

University. Course related support is provided centrally by the University and by the student's own tutor. The materials the students' use for their studies can be broadly divided between teaching and assessment. Teaching materials make up the bulk, can be either electronic or print, and are often a mixture of both. Most of this material is produced in house by the University, although some third party material, such as books, journal articles, video or software is used. Teaching texts, books and DVDs are sent to the student's home, and on-line materials are accessed via the student's home page, using the usual password access controls. Broadly three types of assessment are used, tutor marked assessment (TMA), computer marked assessment (CMA) and examinations. These need a little more explanation.

The TMA is piece of written work that is completed by all students on the course. The work is submitted by the student to the University using an electronic handling system, and is marked by their tutor, and returned via the same system. Marked work is returned to the student with personal written feedback provided by their tutor. Marks are collected centrally for assessment purposes.

The CMA takes the form of multiple-choice questions that are completed by the student on-line. Marks and feedback are provided to the student after the cut-off date.

The final examination can take one of two forms, an extended piece of course work which is managed as the TMA, or a formal written exam held in an examination centre local to the student's home.

Guidance on studying course material is provided using an electronic calendar that provides all key dates, especially the cut-off dates for the various forms of assessment. The calendar is however only a guide to student study patterns, as flexibility about how and when students study is essential for those in work or with demanding home lives. Students are provided with general study support via their university and course specific home pages, additional course specific support is provided via on-line forum, moderated by professional teachers (tutors). Students can also call upon their tutor for support using e-mail or phone, and tutors can use their own home page to monitor their student progress and take action pro-actively.

The University also has a long history of providing stand-alone week residential schools (called summer schools) for many of its courses, especially those that are science or technology based. These are now less common, as modern on-line tools and simulations have provided good alternatives for these summer schools, even in subjects such as engineering [3].

B. Blended Delivery of CCNA

There are some obvious parallels between the way the CCNA curriculum is delivered through the Cisco Networking Academies and the UKOU's supported open learning model. Looking within the Cisco CCNA program, for example, these include student home, an on-line curriculum, the use of simulation tools such as Packet Tracer, and on-line assessment, both formative and summative. The one obvious difference is that the CCNA is primarily intended for delivery in the classroom.

Teaching the practical skills using real equipment is an essential learning outcome for the CCNA curriculum. The integrity of the final examinations is important for maintaining the credentials of the program. Maintaining both of these features is therefore critical, even if blended teaching is used. Both of these provided a challenge for the UKOU, where normal practice is for students to take much of their formative assessment at home unsupervised, and when the use of residential schools was diminishing as a result of advances in on-line labs. On the other hand, the ordered structure of the curriculum and the end of chapter tests, both fitted naturally with the flexible timetabled teaching used on other courses.

The final solution, that enabled the UKOU to make full use of its experience in supported open learning and meet Cisco's requirements for hands-on practical and proctored final exams were achieved with the use of dedicated day-schools and NETLAB+ [4]. The opportunity for students to develop and practice their skills with configuring networks has also been enhanced by the rapid developments of Packet Tracer. How the UKOU has used each of these elements to deliver the CCNA Exploration curriculum is explained below.

1) Day Schools

Students who wish to study the CCNA Exploration courses with the UKOU can only do so as part of an undergraduate degree program. Currently all four CCNA Exploration courses are offered as a single undergraduate course titled Cisco networking, given the designated university code T216. Because this course is part of a degree program students are expected to have some prior knowledge of networking computers, their use in the workplace and basic study skills; what is termed experienced learners in the Cisco Academy.

On the understanding that our students were experienced learners, together with recognition that T216 would also include NETLAB+, it was agreed with the UK Cisco Networking Academy managers that there would be four days dedicated to practical skills development. As UKOU

students live all over the country, it is not practical to get them to all attend one centre, especially when it would be better to align one day with each CCNA Exploration course.

Partnerships have been established with seven Cisco Networking Academies in the UK and one in the Republic of Ireland to deliver the four schools. This co-operation has brought benefits to both students and academies. Students can now attend day schools closer to their homes, they are taught by experienced Cisco qualified instructors, and in some of the best equipped UK academy labs. The academies have gained extra business on a Saturday, which is not a normal teaching day in the UK, allowing them to use facilities that would normally be dormant, leveraging extra benefit from the investment in networking equipment needed for teaching their normal academy students.

Students are able to book each of their day schools, from a selection of venues and dates, using an on-line booking system developed from the normal UKOU residential management system to allow for four separate days. This system also feeds an attendance mark, necessary to check the student meets the course requirement for compulsory day schools, to each student's assessment record. A written handbook is produced for each day school setting out the learning outcomes and activities to be carried out. This is supplied to all students and day school centres, and aims to ensure that all students gain a similar learning experience.

2) NETLAB+

The NETLAB+ Academy Edition provides remote access to Cisco networking equipment such as routers and switches. It has been specifically designed by NDG to host Cisco training equipment on the Internet for student and instructor use, and is particularly well suited for blended distance learning [5]. It is important to remember that NETLAB+ is not a simulator, and allows students to access the console port of real networking equipment, such as routers and switches.

All UKOU academy students are given access to NETLAB+ for the full duration of their study, normally 9 months. Student's accounts on NETLAB+ are organized in tutor groups to enable tutors to monitor students use and lead sessions as necessary. Some will have accounts on the UKOU's own NETLAB+, others will use systems belonging to our partner academies, who lease access to the UKOU. Student access is provided 24/7 using the self booking facility provided by the system.

Students can access NETLAB+ at any time to undertake labs as specified in the curriculum, or just to practice and develop their configuration skills. All students are required to use NETLAB+ and not to rely entirely upon Packet Tracer. Activities specific to NETLAB+ are included in the

UKOU's assessment to ensure that students complete practical work that can be assessed by their tutor.

3) Assessment

Students study the Cisco Exploration curriculum in the recommended order, starting with Network Fundamentals and finishing with Wide Area Networks. Students take all the chapter exams, normally at their own pace, although working within certain limits set by the study calendar. Their practical work is assessed at the day schools and through specific additional activities using NETLAB+ and Packet Tracer. Each day school is scheduled to take place when all students have completed each course. For example, the first day school is at the end of the study period allocated to Network Fundamentals. Students also take their Cisco final examinations at the day school. Students who successfully graduate from each Cisco course gain the appropriate certificate and/or letter from the Cisco Academy.

The UKOU awards credit towards a BSc Hons degree to all students who complete the four Cisco Exploration courses and pass the additional assessment set by the university. This assessment consists of five assignments (TMA) taken during the course, and the final written examination. Students must also gain a satisfactory attendance for each of the four, day schools.

Each TMA is completed by all students and submitted to the same deadline. All students complete the same tasks in the TMA, which is then marked by their tutor. A range of question types are used, for example, written explanations, sub-netting calculations, NETLAB+ activities and network design and implementation activities using Packet Tracer.

The final written examination lasts for 3 hours and draws upon the entire CCNA Exploration curriculum. Again a full range of questions are set that aim to test the students understanding, by asking them to explain, calculate and problem solve under closed book examination conditions.

The combination of Cisco Academy exams and the OU assessment provides a well-designed assessment strategy for the students. Assessment has long been seen as an essential part of teaching and learning [6], especially when it plays a vital part in getting the students to engage with the study material and keep them motivated. All students are encouraged to take the CCNA certification exams and full use is made of the preparation exams in the gradebook. Anecdotal data suggest that those that do well in the course go on and gain the certification exam.

4) Supported Learning

In many respects the CCNA curriculum is ideal for students to study on their own at a distance. For example, all of the teaching material is on-line, so easily available at home or work, it has embedded simulations and activities that engage the students, it can be studied linearly without teacher direction, also Packet Tracer can be used to develop practical skills and there is assessment with feedback which allows students to assess their own progress.

Unfortunately, providing students with easy on-line access to good study materials, with optional access to tools and assessment does not often lead to successful study. Technology alone is not sufficient [7], and students benefit immensely from a learning environment that offers support and fosters ambition to learn.

A central feature of the UKOU's supported open learning model is the role of the tutor (associate lecturer). Each student is assigned to a tutor group, nominally with 19 other students. Tutor groups are based on the student's geographical location, and this allows for face-to-face meetings, although these are not central to the teaching model. Tutors will make early contact with their students using e-mail or telephone. Students will also receive their login information via the academy, login detail to their OU home page and a welcome letter from the Chair of T216. Together these contacts should give the student a sense of belonging, in some ways similar to their first day at a conventional college. Students will also have contact details for their tutor on their home page, and are free to contact her if they have any queries.

During the first two weeks of the course students are allowed time to explore the UKOU learning resources and familiarize themselves with the academy site and materials. Additional study materials have been produced to assist the students in getting to grips with the basics of the academy gradebook and NETLAB+. A local face-to-face session is also arranged where each tutor can meet their students and go through all of the on-line learning materials and tools. Very few students have any difficulty in getting on with studying the course once they have reached this point.

Additional study support is provided through a national on-line forum. This is open to all students studying the course, and is primarily intended as self-help, where students are encouraged to exchange ideas, ask each other questions, and generally build up a sense of belonging to the UKOU and the Cisco Networking Academy. The forum is moderated by tutors, who provided an input to discussions when necessary, perhaps to correct a thread started by a student that is re-enforcing misinterpretation, or just giving wrong information. They also ensure, through a light touch, that students behave appropriately in their exchanges with other members of this on-line community.

All tutors are also trained academy instructors, and each one has an academy class with the same membership as their tutor group. This means that each tutor can see the progress of their students by checking their chapter exams in the academy gradebook. The tutor's own home page on the UKOU site also has the progression and assessment particular to the university study path. This information allows tutors to be pro-active in supporting their students if they are falling behind with their studies, or having other difficulties with their studies. Tools on their homepage also allow tutors to send e-mails to all or some of their students as they choose. This provides a very easy means of contacting groups of students, for example, a sub-group that all had difficulty with a particular set of questions in an end test.

Students have to submit a TMA about every six weeks. This process establishes a dialogue between each student and their tutor that is particular to that student at that time. The student's performance in the TMA will give the tutor a clear idea of how he is progressing. This will allow the tutor to tailor the feedback to the needs of that student. Some examples of feedback include explanation of sub-netting, or the suggestion to try a lab again, or perhaps just reassuring the student that they are coping with the course, or explaining what might happen at a day school if they express some anxiety.

There is good synergy between the Cisco Networking Academy and the UKOU as all tutors are also qualified Academy Instructors, and many of these also teach at day schools. As a result of this partnership the UKOU now employs more than 30 academy instructors on a part time basis, and role that most see as an enhancement to their CVs.

5) Packet Tracer

Packet Tracer provides students and teachers with a vast range of learning opportunities, from helping students to learn the basics of configuring routers, through to the design, implementation and fault finding of complex internetworks. The UKOU has used Packet Tracer extensively, both by actively encouraging students to attempt all of the labs, and by including scenarios as part of the TMA assessment.

III.   STUDENT LEARNING

It is interesting to consider briefly, how this blended delivery of the CCNA can be understood in terms of learning theory. In particular, how do students view the learning experience, and how well are they learning?

A. Learning Theory

There are many components to the CCNA curriculum, and the UKOU has added others with BDL. In summary these can be grouped into on-line study materials, assessment, practical activities (labs), day schools and supported learning. An important current debate in education is the difference between deep and surface learning. In the former the student's understanding is typified by rote learning, in the latter a deeper understanding that can be applied to novel situations, for example.

Constructivism is a theory that can be traced back to Piaget [8], although there has been significant development in thinking about this topic since, including the application of the theory to distance learning. Constructivism proposes that learning is achieved through the forming and modification of internal mental representations. These allow learners to accommodate their new learning into the context of their existing view of the subject, or even more broadly into their general view of the world, which is particularly pertinent if their new acquired learning is to be applied in the workplace. A central tenet of constructivism is to get students to take responsibility for their learning, what is termed active learning. This requires a shift in the role of the teacher towards facilitation.

It has been argued [9] that a teaching approach based upon constructivism alone may not be the most effective, that the transmission of knowledge is still a key overall part of learning. The authors' believe that the components of this BDL model provide this balance. For example, the on-line curriculum sets out the basic knowledge for student to build upon, and creative assessment, with feedback, informs students whether they are gaining a deep or shallow understanding. The taking of labs, using packet tracer or NETLAB+, challenge students and build their confidence. On-line forum allow students to exchange ideal and support each other, and day school activities are organized around groups. These two provide opportunities for the social aspect of learning. Tutors and conference moderators take on the moderator role in guiding students when they are going wrong, and challenge scenarios in TMAs push students to consolidate their learning in the context of real network design problems. Overall, this combination of components ensures that independent learners become successful in achieving the learning outcomes of the course.

Students who study with the UKOU are adults (over 18 years), and more than 75% on T216 are over 25 years. Most are studying to further their careers. These factors give this group a high level of motivation, and they may do better with this type of learning than other groups.

B. Student Achievement and Feedback

Students were surveyed during the 2008 presentation of T216, and 71 students responded. The statements in table I compare student satisfaction with the normal for UKOU level 2 ICT courses.

TABLE I.

Student Satisfaction Question	T216	ICT
Overall, I am satisfied with the quality of the course.	94.4%	88.8%
The course met its stated learning outcomes.	97.1%	88.5%
I enjoyed studying this course.	91.6%	81.2%

As can be seen in table I, students both enjoyed the course and were more satisfied than average with the quality.

Table II show student's ratings for statements generated by other students.

TABLE II.

TMAs and continual assessments were essential to keep studies on track.	Mostly agree.
Packet Tracer was excellent.	Definitely agree.
The combination of Cisco Academy material with OU's support material and assessments worked very well for me.	Definitely agree.

Overall, students are successful with their study of UKOU course T216, with most completing all four Exploration modules and passing the final exam. These students generally also go on to take the UKOU examination and gain credit towards their University study. Based upon anecdotal evidence from the student forum, a significant number go on to take the CCNA certification. Some claimed to have passed with a mark of 100%.

IV. CONCLUSION

The decision taken by the UKOU to offer the CCNA curriculum as a blended distance course has been rewarded with high student numbers and good student feedback. This success has shown that this model of delivery is well suited for adult learners, and may well be suited to all learners. It must however be recognized that BDL involves much more that just enrolling students and offering them access to the Cisco curriculum. It is vital to support learners in a way that facilitates learning, and to make maximum use of Packet Tracer and NETLAB+ to develop student's practical skills. Day schools are also essential as they give students the chance to get their hands on real equipment. Overall, it is the management of the students and resources, in a way that facilitates active learning, that lead to successful students. On-line forum, good information systems and tutor support all play an important role in this management. A well planned and

managed BDL form of the Cisco Academy Program offers an opportunity for educators to reach new students in established and developing markets.

The UKOU looks forward to building upon the success of the CCNA as they move forward with a Masters qualification built around the blended delivery of CCNP.

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