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Online Delivery of a Mathematics Course in a Distributed Environment: The Case of the University of West Indies Distance Education Centre

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Abstract

This article is a descriptive case study. The authors reflect on the experience of the University of West Indies Distance Education Centre (UWIDEC) in its pilot delivery of a mathematics course. In so doing, the authors discuss the background to the delivery of the course, describe the structure of the course and review the experiences and possibilities of offering the mathematics course online. The purpose of the study is to highlight issues which can suggest potential areas of research rather than to make causal connections. The methodology is largely qualitative, based on the reflections of the course administrators, with supporting information from data obtained from student evaluations of the course. Conclusions are drawn from the reflections as well as the student evaluations.

Abstrak

Artikel ini ialah kajian kes deskriptif. Dalam melakukannya, pengarang membincangkan latar belakang penyampaian kursus, menjelaskan struktur kursus dan memberi ulasan pengalaman dan kemungkinan menawarkan kursus matematik secara atas talian. Tujuan kajian ini adalah untuk mengetengahkan isu yang boleh menjadi bidang potensi kajian dan bukannya untuk membuat sebarang hubungan kasual. Kaedah kajian adalah berbentuk kualitatif berasaskan refleksi pentadbir kursus, dengan keterangan sokongan daripada data yang diperoleh melalui penilaian pelajar kursus tersebut. Rumusan diperoleh daripada refleksi-refleksi ini dan juga penilaian pelajar.

Blended Learning at the UWIDEC

Blended learning can be referred as to a combination of educational tools and resources which includes elements of interaction with persons either face-to-face or electronically. The combination of tools used in blended learning may include technology-based materials as well as traditional print materials. Blended learning can involve group and individual study as well as structured, paced study or flexible, unpaced study.

While there has been much debate about the effectiveness of technology-based learning versus face-to-face delivery (Ramage, 2005; IDECC, 2005), the final impetus for the University of West Indies Distance Education Centre (UWIDEC) to move away from synchronous delivery however, was influenced by practical considerations. With increasing student numbers over a wider geographical spread, and greater demands being placed on the audio-conferencing network, it was decided to move toward more asynchronous delivery (Marshall, 2004).

This incorporation of more asynchronous delivery using computer-based technologies into the mix is considered a move toward "blended learning". More specifically, while UWIDEC students continue to be provided with a range of learning resources, the emphasis is now placed on asynchronous modes of delivery, with the ultimate aim of not having any physical tutorial/lecture attendance at all. This is in keeping with what has been described as the standard model of online education by Roberts et al. (2000) who stated "advantages of the standard model include better access to resources for students, and opportunities for greater interaction; disadvantages include the amount of staff time needed to facilitate both on-campus and off-campus delivery effectively."

To initiate this move to blended learning, the UWIDEC established a blended learning project, headed by the Curriculum Specialist/Campus Coordinator, St. Augustine. The project was intended to prepare a set of pilot courses during the 2005/2006 academic year to incorporate more asynchronous, computer-based technologies in time for delivery in the 2006/2007 academic year. Mathematics for Social Sciences was one of the courses selected to be part of the pilot project.

This paper is organised into four sections. The next section takes a critical look at the pedagogical underpinnings of the traditional versus blended approach in distance education. This is followed by a description of the structure of the online/blended course Mathematics for Social Sciences and a section that records the UWIDEC's experiences in the delivery of the Mathematics for Social Sciences course. The paper concludes with some insights from the literature in creating a more inclusive, empowering environment for the course and some brief concluding remarks.

Pedagogical Underpinnings of the Blended Approach

While the model of programme delivery adopted by the UWIDEC prior to 2004 followed the industrial model, the blended learning approach requires a more flexible approach to programme delivery. The blended learning approach is based on constructivist thinking and focuses on student centred learning in an open, flexible environment (Taylor et al., 2000). For this method to be successful however, particularly for quantitative courses such as mathematics, specific attention must be paid by implementers to a number of challenges posed by the very nature of this method.

O'Neill et al. (2004) point out pedagogical and other challenges for students and lecturers. Where these students are concerned, these challenges include getting them to adapt to a change in learning processes, dealing with the issue of isolation or lack of face-to-face interaction and providing prior experience in using information technology. With regard to lecturers, O'Neill et al. (2004) pointed out the following challenges:

- Ensuring quality in the teaching and learning with a shift in teaching methods.
- The need to change traditional teaching styles to approaches where learners can control their own learning.
- Accommodating changes in the workload.

Moving from an industrial, traditional model of distance education to a blended approach has an obvious impact on the structure of courses and programmes. The nature of teaching and learning as well as the operations supporting these must adjust in order for there to be success. Many writers tend to focus on the structural requirements and on the differences

between modalities, i.e., the "no significant difference" phenomena. Thus far, little attention has been paid in the literature to curriculum review and redesign as a necessary activity in the move from traditional to blended learning.

It is apparent then that a change in the mode of delivery requires a fundamental change in the philosophy guiding the structure and delivery of programmes, particularly quantitative subjects such as mathematics. It is suggested that a change in curriculum orientation – to one which focuses on creating more inclusive, empowering environments – will be necessary for us to truly benefit from the possibilities of online learning courses in mathematics at the UWI.

Structure of the Mathematics Course for Social Sciences

Mathematics for Social Sciences had an enrolment of 862 students at the start of the academic year 2006/2007. The course comprised elements such as a print package comprising a self-instructional course manual and an activities and assignment booklet. The course manual contained the course materials for the units that comprised the course and four audio-conferences conducted by the course coordinator/lecturer which were also made available in a downloadable format on the web after the live broadcasts.

Moodle was used as the open access learning management system which was monitored by the course coordinator and members of the UWIDEC blended learning team. Students were divided into e-groups of 25 each. Each group was facilitated by an e-tutor with responsibility for monitoring discussions, providing feedback to students and making mini power point presentations in the online environment, under the guidance of the course coordinator.

Experience in the Delivery of the Mathematics for Social Sciences Course

Some challenges for the implementers

Challenges posed by the online component of the course to students are discussed in the literature. Behncke and McNaught (2001) not only observed that many students do not understand the role of online learning

in education and the benefits for them as learners but also identified the impact on students of the uncertainty which arises from moving from the "known", i.e., classroom based learning to the "unknown", i.e., the online learning environment. Collis and Moonen (2001) drew reference to the demand on students for independent learning. Reeves (2002) identified the associated issue of an increase in student workload which must be managed to maintain student motivation.

Alexander and MacKenzie (1998) drew attention to the issue of integration of the current learning environment with students' previous experiences of learning. Palloff and Pratt (2003) stressed skills such as time management and reflective and creative thinking; the belief that "high quality learning can happen anywhere and anytime" and qualities such as openness, flexibility, taking responsibility for community formation and willingness to work collaboratively.

In moving to blended learning in the delivery of the Mathematics for Social Sciences course, the UWIDEC experienced all the challenges enunciated by O'Neill et al. (2004).

Being the first delivery of this course in the online blended mode, there was a lack of confidence, and in some cases competencies, at the start among the e-tutors, site support staff and more so, students.

The UWIDEC blended learning team developed and executed a pre-course module for incoming students during the period of July–August 2006. Unfortunately, a significant number of students did not attend the course. Students therefore came to the course with widely varying degrees of computer literacy and these were manifested in their reluctance to come online and their inability to complete activities such as navigating the Internet, uploading a Word file, and locating a mathematical symbol in Word. A frequent complaint among the e-tutors for the duration of the course was the relatively low level of participation among the students.

Finding an adequate complement of trained e-tutors to facilitate 34 e-groups posed a challenge to the UWIDEC blended learning team. The reality was that the course started with an inadequate number of trained e-tutors. Furthermore, while the students had their learning curve with respect to participating in the online environment, the e-tutors had an even

steeper learning curve given that students expected them to be proficient from their first online interaction.

The UWIDEC St. Augustine Campus insisted that Trinidad and Tobago students entering the course with less than a Grade 2 at the Caribbean Examinations Council (CXC) General Proficiency or who have been away from CXC General Mathematics for three years or more must complete a remedial course during the period of June–August prior to the start of the online blended course. This requirement is not yet a standard across all 31 sites in the UWIDEC. Students therefore came into the online blended environment with proficiency gaps in the pre-requisites and expected the e-tutors and the course coordinator to close those gaps while delivering the course over the available 12 weeks of the semester.

Over email, the students complained about the following:

- They were unaware of the online blended delivery mode when they registered for the course.
- Their approach to learning mathematics was incompatible with the online blended delivery mode.
- They felt isolated (and in some cases, lost) without the face-to-face interaction.
- They were unable to navigate the course web home page and perform transactions such as uploading a solution to a worked assignment.
- E-tutors took too long to respond to their posting in the discussion forum. Further investigation revealed that students expected real time response.

Students made several requests for face-to-face tutorials to be re-introduced at the sites. Some sites took an informal decision to implement these tutorials prior to the coursework examination and the final examination.

Figure 1 shows the levels of participation at five key stages of the course, namely, registration, the coursework examination, the graded quizzes and the final examination. The overall dropout rate was 18.3%. The comparative dropout rate for the 2004/2005 academic year was 4.7%.

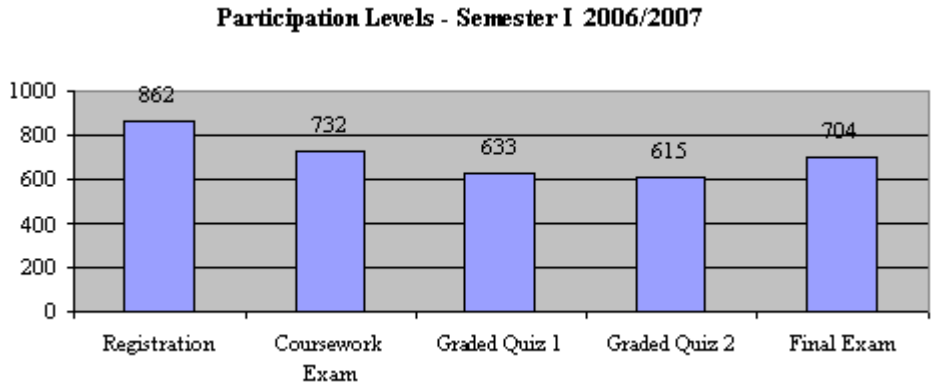

Figure 1 The participation level

Feedback from students

An evaluation questionnaire, adapted from Harvey (2000), was administered online to students during the last week of the course by the online blended learning team. The questionnaire was designed to obtain feedback from students in nine (9) areas, namely:

- Satisfaction with the use of tools in the course.
- Satisfaction with aspects of the online learning experience.
- Confidence in performing tasks during the course.
- Informal interaction within e-groups.
- Knowledge and assessment of e-tutors.
- Connectivity and site support issues.
- Perception of what did not go well in the course.
- Perception of what went well with the course.
- Comparison of the online learning experience with the overall learning experience of the semester.

A total of 177 questionnaires was received. The Likert scale of 1 to 5 was used to treat the responses for the first two areas with "1" assigned to "Definitely Not Satisfied" and "5" assigned to "Very Satisfied" for the first two areas. Similar scales were assigned to the responses from the next four areas in the above list.

With respect to the first area, Table 1 shows that the respondents were (a) satisfied with the course coordinator's announcements and, (b) fairly

satisfied with the e-tutor presentations, tutor-student exchange, students' questions on the units, unit discussion forum, getting-to-know-one-another forum, and chatting in that order. Observe that whereas the announcements required a mere "read only" response, the other tools required students to be the initiators.

Table 1 Satisfaction with the use of tools in the course

Tool used in the course	Very Satisfied	Satisfied	Fairly Satisfied	Not Satisfied	Definitely Not Satisfied	Overall Rating	Rank
Course Coordinator's Announcements	45	54	37	10	5	3.82	1
Getting-to-Know-One Another Forum	11	24	40	35	19	2.79	6
Tutor-Student Exchange	17	39	53	23	9	3.23	3
Chatting	9	12	49	33	13	2.75	7
e-Tutor Presentations	31	44	35	19	18	3.35	2
Unit Discussion Forum	14	30	49	38	14	2.94	5
Students' Questions on the Units	16	32	43	36	11	3.04	4

Table 2 Satisfaction with aspects of the online learning experience

Aspect of the Online Learning Experience	Very Satisfied	Satisfied	Fairly Satisfied	Not Satisfied	Definitely Not Satisfied	Overall Rating	Rank
Timeliness of response to general queries and concerns	16	40	39	21	14	3.18	5
Helpfulness of responses to general queries and concerns	17	34	46	19	7	3.28	3
Assistance in doing exercises and activities that students did on their own	15	27	47	22	15	3.04	6
Feedback on exercises and activities that students did on their own	14	29	38	24	4	3.23	4
Explanation of difficult areas of the course	18	21	38	35	17	2.91	8
Quality of discussions based on topics and issues from the course	15	24	36	40	18	2.83	9
Amount of self-assessment exercises	29	46	42	18	6	3.52	1
The coursework examination	26	45	48	13	6	3.52	1
The graded quizzes	13	23	29	9	20	3.00	7

With respect to the second area, Table 2 shows that respondents were (a) satisfied with both the number of self-assessment exercises and the coursework examination and (b) fairly satisfied with the other aspects of the online experience. Satisfaction was lowest for "Explanation of difficult areas of the course" and "Quality of discussions based on topics and issues from the course"; these aspects reflect the learning curve for the e-tutors.

With respect to performing tasks during the course, the respondents were confident in "Uploading an assignment", "Locating a posting in the course website", and "Posting a message or other information"; respondents were fairly confident with respect to all other tasks highlighted in Table 3 with the least confidence being assigned to "Starting a discussion on a course-

related topic or issue" and "Composing your working of a mathematics problem using a word processor" in that order.

Table 3 Confidence in performing tasks during the course

Task	Very Confident	Confident	Fairly Confident	Not Confident	Definitely Not Confident	Overall Rating	Rank
Posting a message or other information	33	47	29	20	7	3.58	3
Locating a posting in the course web site	48	42	34	15	4	3.80	2
Deciding on the most appropriate area of the course website to make a posting	30	31	43	24	4	3.45	4
Contributing to the discussion on a course-related topic or issue	22	25	35	34	11	3.10	7
Starting a discussion on a course-related topic or issue	22	27	32	34	14	3.07	8
Asking an e-tutor to explain something you did not understand	20	37	22	27	16	3.15	6
Uploading an assignment	46	35	26	5	3	4.01	1
Composing your working of a mathematics problem using a word processor	16	18	22	29	14	2.93	9
Using a link to search other websites	35	30	34	18	13	3.43	5

Respondents agreed to a certain extent that they knew the names and home countries of the members in my e-group. However, as Table 4 shows, they did not get involved in informal interaction within their e-groups.

Table 4 Informal interaction within e-groups

Statement	Completely Agree	Agree	Agree to a certain extent	Do Not Agree	Definitely Not Agree	Overall Rating	Rank
I knew the names and home-countries of the members in my e-group	24	28	43	24	20	3.09	1
I made friends with other members of my e-group	6	6	33	52	38	2.19	4
I engaged in light personal exchanges with other members of my e-group	4	9	35	49	32	2.26	2
I discussed matters of general interest with other members of my e-group	7	9	26	53	34	2.24	3

In their evaluation of e-tutors, respondents agreed without qualification that (a) e-tutors were knowledgeable about the course, (b) they had no difficulty finding out who their e-tutor was, (c) their e-tutor's postings were clear and well focused, and (d) e-tutors made useful postings regularly throughout the semester in that order. Respondents agreed to some extent with statements that (i) e-tutors did what was expected of them, (ii) e-tutors' performance was of a high standard throughout the semester, and (iii) e-tutors' performance improved as the semester progressed in that order. Here again, the feedback reflects the learning curve experienced by the e-tutors. Overall, respondents did not feel that they knew their e-tutors. See Table 5.

Table 5 Knowledge and assessment of e-tutors

Statement	Completely Agree	Agree	Agree to a Certain Extent	Do Not Agree	Definitely Not Agree	Overall Rating	Rank
I had no difficulty finding out who was my e-tutor	48	43	24	12	12	3.74	2
I felt as though I knew my e-tutor	12	17	27	42	37	2.44	8
I found my e-tutor to be knowledgeable about the course	34	52	29	5	5	3.84	1
I found my e-tutor's postings to be clear and well focused	31	49	41	11	10	3.56	3
My e-tutor made useful postings regularly throughout the semester	35	35	45	9	11	3.55	4
My e-tutor has done what he/she was expected to do	31	33	46	12	12	3.44	5
My e-tutor's performance was of a high standard throughout the semester	25	34	43	14	12	3.36	6
My e-tutor's performance improved as the semester progressed	20	34	33	22	12	3.23	7

A total of 67% of the respondents indicated without qualification that they had easy access to a computer with internet connectivity. 60% did not use the computers at their UWIEDC site to a significant degree during the semester. Overall, there was agreement among respondents, as shown in Table 6, that the staff at the UWIDEC sites provided good support to students on the course. In retrospect, these staff assisted the students in managing the increased workload as identified by Reeves (2002).

Table 6 Connectivity and site support issues

Statement	Completely Agree	Agree	Agree to a certain extent	Do Not Agree	Definitely Not Agree	Overall Rating
I had easy access to a computer with internet connectivity	59	35	25	13	9	3.87
I used a computer at my UWIDEC site most of the time	10	12	26	36	36	2.37
I found that the staff at my UWIDEC site provided good support	37	39	39	12	9	3.61

Student performance

Overall, the pass rate for the coursework examination was 89.3%. The distribution of the marks is shown in Figure 2. The comparative pass rate for the 2004/2005 academic year was 55%.

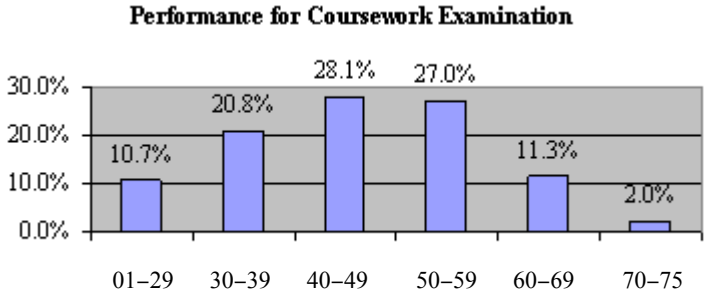

Figure 2 The performance for the coursework examination

Pass rates for the graded quizzes were 84.5% and 61.2% respectively. The distributions of the marks are shown in Figure 3.

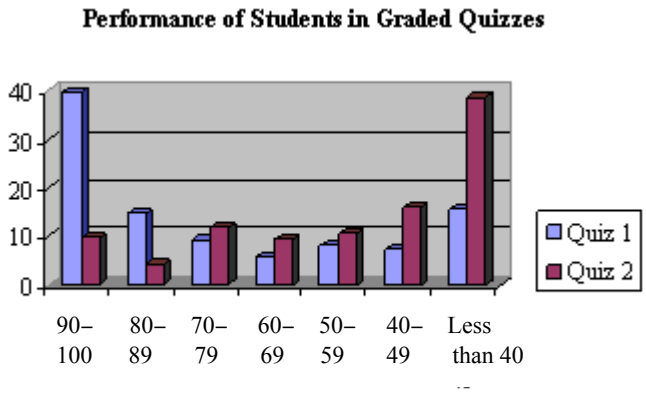

Figure 3 The performance of students

For the final examination, the pass rate was 75%. This compared favourably with 76% in the 2004/2005 academic year when the course was delivered in the synchronous mode.

Creating a more inclusive, empowering environment

In the context of pursuing a more inclusive empowering environment for the course, the findings of the feedback survey suggested that the course managed to do the following:

- Enhance the students' satisfaction with the tools in the course.
- Enhance the satisfaction of students and tutors with aspects of the online learning.
- Experience.
- Build confidence in students and tutors in performing tasks during the course.
- Get the students involved in informal interaction within their e-groups.

In pursuing these enhancements, we should not lose sight of the fact that:

- Students (and staff) engaged in online learning and teaching environments are required to master a complex range of skills to achieve their learning goals.
- In addition, effective distance education can be best measured in terms of the achievement of learning, the attitudes of students and teachers, and by the returns on investment [(Moore & Thompson, 1997) quoted in Ramage (2002)].

Joannsen et al. (1995) suggest that a cognitive-based, constructivist approach to course design can optimise the learning environment. This view regards learning as the active engagement of learners in the construction of their own knowledge and understanding of facts, processes and concepts. According to Joannsen et al. (1999), the constructivist learning theory supports the belief that learners should be engaged in "active, constructive, intentional, authentic and cooperative learning". For Joannsen et al. (1995), constructivist instruction is not the process of carefully arranged prescription strategies, but of "coming to understand how people make meaning, and then to create learning environments that promote this construction" (p. 13).

Communication must be seen as a critical component given the importance of social negotiation in the learning process. Collaboration occurs when learners communicate their understanding, listen to the view of others, explore alternative perspectives, are challenged in their beliefs and challenge others. This form of communication requires reflection and introspection for learners to make sense of their experiences.

Internet technology enables the development of a "community of learners" (Joannsen et al., 1995). Focus must be given to examining how we can best utilise the unique capabilities afforded us by internet technology – asynchronous learning, interactive simulations, direct lines to resources, individualised coursework – to improve learning outcomes (Twigg, 2001). Taylor (2001) suggested that computer conferencing must be recognised as not just another technology; rather, its capacity to rehumanise distance education represents a qualitative shift which has the potential to reshape learning at a distance.

Computer Mediated Communication (CMC), on the other hand, provides a rich source of thoughtful interactions, which can be structured, tagged and stored in databases and subsequently exploited for tuition purposes on a recurring basis through the application of automated response systems. This makes the effective use of CMC fundamental to online pedagogy in terms of ensuring effective interactivity (Taylor, 2001).

In pursuing a more inclusive empowering environment for the course, it would also be appropriate to look to fifth generation distance education (DE) models, incorporating the use of automated response systems and

intelligent object databases in the context of internet-based delivery since these have the potential to provide students with a valuable, personalised pedagogical experience at noticeably lower cost than traditional approaches to DE (Taylor, 2001). According to Gibbs (1992), the course characteristics necessary for fostering the desired learning include the motivational context, learner activity, interaction with others and a well-structured knowledge base.

One way to achieve the motivational context is to present students with problems and let them learn what they need in order to solve them. The actual problems to be solved in this situation become less important to the learning that occurs through the process of solving the problems. Learner activity must be planned, reflected on, processed and related to abstract concepts. Small groups in the class and outside the class are important ways to engage students with each other. Coursework marks must be allocated to participation in student-tutor forums and other student forums in the course. New knowledge must be built on existing concepts and experience and taught in integrated wholes rather than in bits and pieces. Students must be given the time needed to reflect on new knowledge so that they can integrate it with their existing understanding and connect it to what they already know.

Improving students' problem-solving skills is critical to the fostering of the desired learning. Rogers (2000) suggested that students be provided with some of what they expect, that is, a high degree of structure and clear instructions but they need to be challenged to consider different viewpoints and think for themselves. Active learning and student interaction are seen as important components of Kolb's experiential learning model (Kolb, 1984). This suggests that every effort must be made to ensure that each phase in Kolb's experiential model is included in the learning experience provided in the course.

With respect to the lack of preparation, students must be taught the skills they need – not necessarily in remedial courses but rather within the course and through an approach that promotes a deep, process-oriented approach to learning rather than rote memorisation (Rogers, 2000). With respect to students having little time to study, faculty members need to help students choose different priorities by making it hard for them to ignore the demands of the course (Rogers, 2000).

Other interventions that are worthy of consideration based on the experience of the course coordinator and the blended learning project team during the 2006/2007 delivery of the course are:

- Recruit and train e-tutors ahead of the start of the semester. E-tutors must be perceived to be knowledgeable in the technology from the first posting of their students as suggested by Gerbic (2004).
- Enhance the pre-course module and make its completion mandatory consistent with the induction approach recommended by Harper et al. (2000).
- Identify and implement a strategy to close the gap in the mathematics pre-requisites.
- Use CAMTASIA to bring some audio-video elements and a "human face" to the course materials.
- Upload solution approaches to past examination papers.
- Define service standards for responses by e-tutors to student postings.
- Introduce graded activities from Unit 1 to ensure early online participation as well as reward consistent participation consistent with the view of Alexander and MacKenzie (1998).
- Amend coursework/final examination ration from that of 20/80 to 40/60. Allocate coursework marks to online interaction with e-tutors and other students in their e-group.
- Give students clear and explicit rationales for each online activity so that they can understand its benefits.

Conclusion

In the global environment, blended learning and e-learning are "buzz" words representing, in most cases, a movement away from traditional forms of teaching and learning and the adoption of the latest technologies. Experiences with the online delivery of the course Mathematics for Social Sciences emphasise, however, that online learning possesses the potential to enhance the teaching/learning experience or make it all the more challenging. In order to overcome the potential challenges and make the experience worthwhile, it is necessary to adopt a cognitive-based, constructivist approach. The learners must be actively engaged through constant communication and activities. Online tutors must be well

prepared and able to motivate and encourage students to participate in their learning.

From the perspective of the course developers and the students however, the online course requires greater engagement with the knowledge base and the need to be clearer and more precise in general communication. Overall, the experience has led to greater attention to detail in course planning and the identification of administrative and pedagogical issues which need to be in place in order to ensure the delivery of better quality courses in the future. Online learning, while it forces us to be more student-centred, also requires us to focus more on the age-old skill of teaching, as we increasingly recognise that the technology merely provides the tools.

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