e-Mathematics 101 for Engineers: Teaching and Learning with a Techno-Logical Advantage

Suryakumari Rajah
Dept. of Mathematics
6/19/2009
2. Which current international and/or local trends are a trigger for your investigation?

We have seen in recent years a major pedagogical shift from teacher centred to student centred learning environments. This has been strongly motivated by research into learning theories such as constructivism, authentic learning, action research etc. In South Africa this shift became evident in “Outcomes Based Education” and the concept of a teacher as a “facilitator” of learning was introduced. The challenges that face the implementation of this methodology have at its root the difficulty of managing the time available for the process of self-learning and continual assessment. This is evidenced by the need to re-introduce traditional methods where the system has failed; as for example in the use of the old system “phonics” to teach reading, rather than theme based learning which is a much slower process.

Having recognised the key challenges, we are able to envisage overcoming these hurdles with the use of the internet and online classrooms. The power of web-assisted learning is it’s magnitude, availability and use of “intelligent”, fast and efficient computer aids for managing teaching and learning. We are in a phase where the access to the internet is limited to a very small sector of the population. However, the growing body of research that suggests blended learning to be more efficient pedagogically, supports the impetus to broaden access to the world wide web for all of the learning environment.

Here at higher institutions we are seeing more computer literate students who are familiar with advanced technology. This further motivates me to incorporate the computer and the internet as a teaching aid.

3. Which challenges and/or opportunities exist in your own teaching environment which you could possibly address through web-based learning?

1. Accommodating different learning styles.

Mathematics is historically a difficult subject to grasp. I am of the opinion that this is because we have only used the traditional approach of teacher centred learning with”chalk and talk”. A web-based course can incorporate visual learning styles, experiential learning by way of simple self assessments and interactive group learning through discussions.

2. Vast Content

We have to cover increasingly larger syllabus content as the technology advances in our world. This decreases the time for discovery and interactive learning in the classroom. The web-based course can easily allow students to access further web-linked readings at their own convenience. This is even available after the course has been completed as references. Greater time exposure to the content and repetition of tasks will lead to increased understanding.

3. Need for more self-assessment

It is my experience that the application of theory to problem solving increases the understanding of abstract concepts. This is especially so in Mathematics. Again, the time constraints of the class lectures do not allow for this. Furthermore, students cannot be monitored easily to check that they are doing their
"home-work" or attaining desired outcomes. By creating online tutorials with self-assessment exercises that may be viewed by the teacher, this problem is addressed efficiently.

4. Group learning activities

A web-based course allows for group discussions on projects without the difficulty of finding the convenient time for all students at once. Discussions online may be at different times.

5. Technology-friendly students

We can use the computer literacy of many students to our advantage. These youth are more interested in the new technologies and can navigate more easily than older counterparts since they have had early exposure to electronic technologies. A challenge that is addressed is that of making the learning environment stimulating to a student who is accustomed to a powerful audiovisual environment.

6. Lack of e-facilities/resources

A serious impediment is the current situation at the Durban University of Technology with regards to access to the internet. For e-Learning to be utilized, wireless access to the net throughout the campus should be possible. The university would need to budget for the necessary technology to allow for this. Also students need to purchase computers for blended learning to become viable. These are however challenges which are not insurmountable in the near future, since we are already seeing the introduction of cheaper computer notebooks which are designed for internet specifically – so called “net-books”.

4. Which educational theories seem most relevant to your investigation? Briefly describe each theory’s key characteristics.

Learning is a process which incorporates cognitive, emotional, environmental and inherent factors. How these come together to induce learning is described by learning theories. Classical theories include Behaviourism, Cognitivism and Constructivism. For behaviourists, learning is effected when desired outward behavioural changes are obtained. The main criticism against this is the inability to integrate the learning content with other knowledge and to sustain the behaviour. Cognitive theories focus on the brains process of thinking and acquiring knowledge. While behaviourists manipulate the environment to induce learning, cognitivists focus on the learner’s personal ability and learning style. Constructive learning views the learner as the main focus of the learning process and the teacher as the facilitator. Learning is effected through the learner’s active interaction with the subject matter, often in a real life context. The acquisition of knowledge is a personal growth brought about by the integration of experience, knowledge and reflection.

In modern theories, a distillation and blend of the classical theories have been described in Learning Styles (verbal/linguistic, logical/mathematical, visual/special, bodily/kinaesthetic or musical/rhythmic), Authentic Learning, Active Research and recently Blended Learning. In the traditional classroom we present the course in a manner which tends to favour verbal and logical learning styles. The web-based
course has the advantage of being able to provide strong visual learning material (videos and animations etc). This has the potential to improve learning. Also with a wider content access as well as convenient access from home, I see the potential to use self-discovery and exploratory methods to teach difficult and abstract mathematical content. Students may be guided by simple investigative type of research. These are key activities that promote authentic learning. In this scenario, the face to face contact during lectures will be aimed at clarifying misconceptions or difficult content to students who have already had good exposure to the study material. I will not be in the situation of having to push through vast syllabi, “hoping for the best”. This approach to teaching and learning leads to active research. The stages of planning, observing and reflection would ideally result in the proper “digestion” of the study material. These are key constituents of blended learning. The use of the formal classroom as well as other multimedia, group projects and self learning go towards addressing the unique process of learning that each student must undergo according to individual capacity, environment and inclination.

5. What is action research and how have you used the methodology’s structure for your investigation?

Action, the practical component and research, the intellectual pursuit of knowledge are two sides of the same coin. Four stages of action research are planning, acting, observing and reflecting. During planning, there is problem analysis. Action refers to the implementation of a strategic plan; observation refers to the evaluation of the action by appropriate instruments and finally reflection involves the evaluation of the whole process, identifying strengths and weakness, with the aim to improve further implementation.

In this investigation, I have considered firstly the evidence of pass rates in Mathematics, the type of learner, the current changes in the school syllabi, the availability of resources and the competency of the lecturing staff. The design of learning material, the structure of the course and the preparedness of students are some of the important factors which must be considered when designing a web-based course. I view, however, the web as an integral part of the teaching and learning system within the current practise of traditional classroom teaching. The personal contact with the lecturer remains as the primary teaching environment. The online course may even be brought to the classroom when the resources are available.

In order to evaluate the use of a web-based course, I assisted Mr R Harripersad of the Physics dept. who has been designing a web-ct course in Mathematics as part of his MSc. project. For a few weeks, students from my Math 1 class were taken to the computer labs and exposed to the online material. This pilot study provided some insight into a future learning environment, and I had the opportunity to reflect on the strengths and weaknesses.
6. Design

6.1 What is your vision for your online classroom in the long term?

I envisage that a blended learning environment will become the norm. The online classroom will be a key component in managing teaching and learning. Our technology-friendly students will appreciate the powerful multimedia which can be brought to aid the learning process. More time will be spent doing fun and interesting activities which promote learning. Students will always be accountable since the time spent doing the work can be monitored.

In general, an online classroom will evolve a new breed of both learner and teacher. I look forward to the new ideas that it will stimulate in my own pedagogical paradigm.

6.2 How will the online course encourage interaction/collaboration/engagement/participation/active Learning?

The ease of communication via online discussions, e-mail etc. between facilitator and student as well as amongst students may be used to initiate group activities. Assessments which require group work will encourage participation. By providing web-links and other media such as local content, students can be given tasks which encourage active research. The novelty in the early stages of this type of course is also a motivating factor for students to do their work.

6.3 How will you use this mode of teaching and/or the Learning Management System’s capabilities to make your life easier?

There are multiple areas of our work which will be made easier.

1. Assessment: Some time and thought has to go into designing questions and tutorials which promote understanding of the subject matter. These are then made available online and may be given with the solutions. The computer becomes the examiner, invigilator as well as the assessor, also providing the solutions!

2. Notes and articles: These may be given at time released intervals as the course progresses. Lectures will not need to be focused on “dishing out” notes. More interesting activities may be brought to the class. E-texts will be a compulsory part of the learning class. Students will not have the excuse of not affording texts and so a lecturer can simply refer to texts and exercises. The web has a vast storehouse of excellent notes and tutorials. These may be used without my having to physically print and hand-out the material. The reinforcement of concepts is essential to learning. Quick self-assessments can be given regularly.
6.4. How will “the blend” work? Consider how you would keep the best of both worlds, combining paper with electronic resources, and face to face interaction with online activities.

I envisage the online class as a super, ultramodern “teaching aid”. It is not a lecturer replacement! The continual guidance and assessment by the lecturer is essential to learning. Timeous interventions have to be given in order to ensure that goals are achieved. Furthermore, I see the facilitator/lecturer as the glue holding students to the course itself. The face to face contact, personal feedback and availability to help with difficult material is a key motivator for students to get involved and enjoy the experience of learning.

7. Implementation

7.1. Describe the pilot activity you have tried out with one or two users.

A web-ct course for Math1 was designed by Mr R Harripersad from the Physics Dept -DUT. Last year, he needed to test it with students and this was an ideal opportunity for me to engage in “active research”. Students were given passwords and during tutorial periods for two weeks we conducted the online course. During the double period, students were asked to do simple tasks such as get to relevant pages for reading and to navigate through the course material.

The course was available for their use after the sessions if they had access to the web at home. Students were asked to talk about their experience at the following lecture.

7.2. What is the relevance between this activity and the challenges and opportunities you have identified?

This pilot study provided some insight into the practical situation and also some of the challenges which we may face. I found to my surprise that there were some students who were not at all familiar with computers. However, all the students were very eager and enthusiastic to learn how to use the software (even with its challenges). I noted that the students did not have access to the web outside of the university.

The resources at the lab was not up to date and so required an upgrade. This brought attention to the need for technical assistance in such an environment.

7.3. What feedback did you receive from users?

They enjoyed the sessions. It was a novel experience having exposure to computers, but since we did not spend much time, they did not get to actually learn Maths!
8. Reflection

8.1. Which assumptions did you make and what did you learn from your assumptions after implementing the activity?

I assumed that all students will be familiar with the basics of computer usage. This is not the case and therefore, some time is required to prepare students on the basics before actually beginning the course. We did not have a technician to assist with problems of getting in with the password etc. This required us to phone for assistance and clarify some points about simple things like using uppercase and just surnames to log in. Technical support during the implementation is essential. We expected the computers to be fully upgraded with the latest software. This was not so. Certain Java scripts could not be viewed.

8.2. In the light of the feedback received and the lessons you have learnt, how will you adjust/adapt/change your activity and/or your classroom during the next action research cycle?

Assess the students prior knowledge of computers beforehand and provide the necessary information to get started. They would also have to be informed about the wide possibilities that a web based course offers to teaching and learning. The resources would have to be thoroughly checked to ensure smooth running of the system. It wastes a lot of valuable time trouble-shooting poor software or hardware.

8.3. What impact do you envisage this intervention could make, or has made on either or all of the following: you, our learners, the curriculum and the institution?

Teaching and learning will become an innovative and creative process. In a relaxed environment where we are not rushed to complete notes in class, we can bring fun activities to our class. Personal challenges and experiences about the work done offline can lead to good discussions. Students will move into the technological age comfortably familiar with the idea of the internet being a powerful information highway on which they may travel at whatever speed they are comfortable with.

The implementation of learner centred classes is feasible, practical and efficient. This is crucial to practicing modern learning theory. Also, it will lead to the development of new curricula and also new activities. It is envisaged that this will improve pass rates and promote the culture of excellence at DUT.

The inclusion of an online course will extend the learning environment from the confines of the institution to the home and the real world. This truly is world class teaching and learning.

8.4. What lessons have you learnt overall during the year in which you have become an online facilitator?

I think that the first lesson was just knowing that such systems as “My Blackboard” were already in place at DUT and that we did not need to create the software. I had many ideas of computer based learning earlier but given our time constraints, implementing computer aided learning was a major challenge since we needed time to develop software to put the course content into.
The system is actually not very difficult to learn how to use. This makes it available as a methodology to all lecturers.

Distance learning does not compromise the learning process without a lecturer for off campus students. The course can be covered at home if one has internet access (which is becoming essential to academic staff).

I have learnt about modern trends in blended learning and this has given motivation to rethink how I approach the challenges of teaching Mathematics, improving pass rates etc.

The online course has shown that the “ideal” of constructive learning with self-discovery, exploration etc. may actually be attainable in our institution despite large student numbers and vast syllabi.

Overall, the course has widened my vista and I am sure that the lessons for me as a teacher will also continue even after Pioneer’s Online.

**Bibliography**

1. en.wikipedia.org (learning theory)