Periodic Functions - A unit for Year 11 Mathematics B students

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Abstract: Ask any teacher of mathematics in the secondary scene as to the enthusiasm of students in their learning of mathematics and their response will be predictable. It will indicate that student attitude is very hard to surmount and that students would prefer not to study mathematics. We are dealing with students who have large holding of MP3 music, surf the Internet for pleasure and for chat, use a computer as a game machine and integrate the computer and mobile phones. It is in this light that we, as teachers, must utilise the current technology to appeal to our learners. We must help them to construct a viable model of mathematics, which will also increase their appreciation for mathematics and their attitude to the learning of its principles. It is here that teachers must utilise current presentation technology so students can interact and appreciate the beauties of mathematics. Mathematics lessons are designated as traditional types of lessons with the teacher at the front and students receiving data. Technology is being increasing used but is it enough and is it appealing? It will not be a static presentation that will help students in their construct of mathematical principles. Rather, it will be the dynamic use of such technology. This paper and demonstration aims to show some applications of dynamic presentations and the integration of various software packages to achieve this.

Teachers of mathematics will tell anybody who inquires that they are constantly being challenged by students' attitudes towards mathematics. We are dealing with students who know Napster, surf the Internet regularly, use a computer as a chat machine and integrate the computer and mobile phones. Yet do we as teachers utilise the same media for a learning environment?. We must help them to construct a viable model of mathematics, which will also increase their appreciation for mathematics and their attitude to the learning of its principles. Teachers must utilise current presentation technology so students can interact and appreciate the beauties of mathematics.

Mathematics lessons are usually thought of as traditional types of lessons with the teacher at the front and students receiving data. Slowly, technology is being increasing used but is it enough and is it appealing? How do you move a teacher that has fears, … might lack expertise, … needs to be convinced that different methods will work. The teacher will not move from one end of the spectrum to the other. What is needed is a gradual path.

The initial movement into the world of the tools of multimedia and technology will be one that has elements of the teacher-centred approach but one that allows students to have the tools that give them some control in their construct of knowledge. This will be through presentation technology which will let the teacher think that he is still the control figure. The presentation however should be such that it allows for the student to see and build on what he knows and infer new constructs of knowledge. It will be the dynamic use of such technology that will allow for this. This paper and demonstration aims to show some applications of dynamic presentations and the integration of various software packages to achieve this.

Since the technology novice teacher has usually heard that computer labs are a waste of time and would be loathe to venture to them, this resource module allows the teacher to stay in his room for the initial presentation and then move to individual computers for follow-up and evaluation and extensions. It could of course also be loaded to a web site for full internet access. In the classroom, the unit is designed for a whole class audience with the teacher and hopefully the students utilising the outputs. The use of a datashow could be employed but I tend to think that these are expensive and not needed. Instead I would utilise the use of laptop computers which have a video out or a S-video port. These could then be connected directly to television monitors. In my school, I have ensured that all mathematics classes have a 68 centimetre set with AV points. The size is such that it can be easily seen in all parts of the room. The relative cost is that for under $4000 each class can have a laptop computer

and television set compared to a datashow which costs about $5000 for a cheap model. This former option is much more cost effective.
The principal software multimedia tool that I have used is Microsoft's Powerpoint. This is fairly universal these days and can be used by teachers and students. The design of this central tool enables the presentation to be given as a class presentation or as an individual tutorial for a student. Within the presentation, there are graphical movies which give the students a great visual perception of the concepts involved. It is here that constructivist learning principals could be employed. These movies were developed in *Graphing Calculator* by Ron Avitzur. This application is provided free with all Macintosh computers. It has a Window's equivalent by the name of Nu-Calc. There are other mathematics applications that could be used such as Mathematica as suggested by Leigh-Lancaster (1996). The provision of an opportunity to view dynamically the effects of a changing parameter saves students lots of curve sketching either on a software package, a graphing calculator or even by hand.

McKenzie (2001) suggests throughout his book that technology implementation into schools and its connection to curriculum have not always been linked. Often schools take on technology and with it the infrastructure without seeing if logistics fit the curriculum. He further argues, amongst other major concerns, that professional development of teachers has been seriously missed or poorly attempted. When software developers make it difficult for users with poorly designed software, (or is it software with special features?), it makes it less appealing for teachers to develop modules for the teaching of mathematics in particular. In this case, we have one of those special features because of Microsoftness. Although both platform versions of Powerpoint (97 and 98) are interchangeable and both will run Quicktime, you need to perform a trick to see the movie in either version. If the presentation is made in the Macintosh platform, you need to open it in the Windows platform, find the movie inserts, delete them and then reinsert them!! It is the reverse if you did it the other way. So to make this presentation platform independent for schools, I have a Windows and a Macintosh version. The Windows version requires the .mov files as separate files and does not run as smoothly as the Macintosh version.

I have included some practice for students within the presentation. These practice questions do not have solutions as I considered that the interaction within the class and with the teacher would have been more valuable. I have broken 'best practice' with the presentation in allowing music tracks with the movie in the Macintosh version. The music was to provide a reflective and constructing time for students to grasps the concepts involved without the 'interruption' of the teacher. Further I have found that students have used the music as memory tags which helped them to recall the concept involved.
Since it is important to assess if students have grasped the concepts, I have developed two little tests for their use. These have generated in a freeware program called *Hot Potatoes*, from http://halfbakedsoftware.com. This was originally devised for language teachers but is easily adapted for other areas. It has a number of components which allow for multiple choice questions, short answers, matching, crosswords, jumble words and filling in the blanks. It is dual platformed and allows you to save as HTML files. The latest version also provides a facility for the student to email results to the teacher. These are great for a quick check of understanding or revision. These do have the inability to handle mathematics symbols but that is a minor problem. These have a greater use in science where there are many more applications for this type of testing.

Finally, three extension activities are included. Again, the pathway for the traditional teacher has been eased. Instead of giving a site, these three .pdf files have been downloaded already.

This removes any problem that could arise from a slow ISP pipeline or access to a computer even. These files are such that they could be printed and given to students to do as an assignment. The files all concern the applications of periodic functions in real life and use a graphics calculator for finding the specific function to fit data that is obtained from the Web. If the teacher has moved on his path, I would hope that he would in fact structure his lessons to allow students to gather the data themselves. The files come with solutions as well as instructions to program the calculator. If graphic calculators are not favoured, then the data collected could easily be added to an Excel document and the curves generated in that application. One of the files has a review section that further ensures that concepts are understood. All references to the producers of the files are contained in the files.

References

Leigh-Lancaster, D. (1996). Mathematica at the secondary-tertiary interface. *Australian Senior Mathematics journal, 10(1), p 21-34*. Adelaide: Australian Association of Mathematics Teachers.
McKenzie, J. (2001). *Planning good change with technology and literacy* Bellingham, WA. FNO Press http://fnopres

Resource Module: Periodic Functions

Brief Summary: This module is aimed at having students understand Periodic Trigonometry Functions and the role of the parameters within the equations. The presentation consists of a dynamic Powerpoint file that is shown to the whole class. There is reflection time in the presentation to help the students come to their own conclusions and yet the teacher can still steer students to understanding concepts correctly. It can also be used as a personal tutorial. This is backed by a two small assessment tasks and three applications to the real world which could be used as assignments.

Objectives

Mathematics as Problem Solving

Students will analyze data to model real-world statistics and make conclusions based on comparisons.

Mathematics as Communications

Students will interactively discuss translations of curves and follow up with a written activities.

Mathematics as Reasoning

Students will make conjectures based on presentations and Internet data generated graphs from the data.

Mathematical Connections

Science - Students will see that temperature data can be modeled by a trigonometric function.

Geography - Students will find cities on an Internet map and make generalizations concerning location and its effect on temperature patterns.

Trigonometry - Students will analyze graphs to write an equation of a sine curve in the form $y = A \sin B(x + C)$. Students will relate the parameters A, B, and C to the Amplitude, Period, and Phase Shift of the sine graph and will adjust the values of these parameters to obtain the best fit to the data.

Resources: Laptop computer with S- video / RGB output, Large screen monitor, Microsoft Office – Excel, Word, Powerpoint, Internet Access, Graphics Calculators/ Excel

Activity

1) Presentation (With the laptop and monitor) Use the Powerpoint file to introduce concepts;

2) Quick Quizzes (With Web Browsers) Have students independently attempt the following quick quizzes:
Multiple Choice, Matching terms

3) Extensions and enrichments (Set as assignments–need Web browser and graphics Calculator/Excel)
Climate Waves
Climate with exercises
Heart Rates

Time

The presentation and tests should be done in two hours
The assignments would take an additional four hours.