

THE EVOLVING USE OF INFORMATION TECHNOLOGY IN A LARGE CANADIAN HIGH SCHOOL – WHAT’S WORKING AND WHAT’S NOT

V. L. Pasek, B. Clintberg, R. J. Kennedy, and P. W. Wright

ABSTRACT

This presentation provides an update on the evolving use of information technology (IT) in the classrooms of a large Canadian high school. The discussion concentrates on IT developments in the mathematics and science departments. The presentation program Microsoft PowerPoint is used extensively in the teaching of mathematics. The integration and benefits of using this approach will be discussed. In the science department, various forms of IT (videoconferencing, online teaching, simulation programs, etc.) have been implemented for many years. An account of the successes and failures of these different presentation methods will be presented.

KEYWORDS

Instructional technology, videoconferencing, web-based learning, videoanalysis, PowerPoint, physics, mathematics, high school

INTRODUCTION

Since the early nineteen-eighties, when desktop computers became relatively inexpensive, the use of IT (information technology) became feasible in the schools. During the last twenty years some programs have evolved, others have been eliminated. This presentation will provide an update on several IT initiatives in the physics and mathematics classrooms of a large Canadian high school.

USE OF INSTRUCTIONAL TECHNOLOGY IN PHYSICS

This section will provide an update on the current use of four distinct initiatives in the physics classroom, notably, videoconferencing, video analysis, the use of simulations in the teaching of physics, and online learning. The use of videoconferencing and video analysis has been discussed in detail in previous papers [1, 2].

Videoconferencing

Clintberg, Moore, Pasek and Wright described three different uses of videoconferencing [1]. The first practical use was for students to go on virtual field trips. This was accomplished by connecting to a remote Science Center and having the presenters explain different physics concepts with the help of models and simulations. The second practical use was for students to talk to experts in various fields and have those experts explain how they came to their careers in science. This was accomplished during career day at school. The third practical use was for collaborative work with physics students in different parts of the world. Students and their virtual peers would in some instances discuss scientific demonstrations and in others, challenge each other to solve problems of mutual interest.

The overhead involved with planning, establishing, and maintaining effective videoconferencing links was found to be very high yet little if any preparation time was available for these activities. In view of

this, virtually nothing has been done with videoconferencing since September 2001. The prospect exists that videoconferencing activity may be resumed for one school term (at least) but on a very limited scale and with only two classes of honours students. What may make videoconferencing viable is the fact that, for honours students, less time is required for formal teaching thereby making more time available for planning and implementing the conferences. It has been the experience at our school that, within existing constraints, the use of videoconferencing for regular classrooms is essentially impractical.

Videoanalysis

The use of video analysis in the physics classroom has been described previously by Pasek & Wright [2]. An account of one particular experiment can be found on the school website (<http://www.ualberta.ca/~vpasek/indexp.html>). The program used for the video analysis is called Video Point [4]. In the experiment, students first videotape a motion segment that displays projectile motion (throwing of a ball) and then analyze the digital record of the event frame by frame using Video Point. The program is then used to represent the motion through the production of various graphs such as distance versus time, speed versus time, acceleration versus time, and many others. Corresponding data tables for the various graphs are also produced. Students then integrate information from their Video Point analysis into a report that is submitted for evaluation.

Video analysis is used constantly in Physics 20, especially for projectile motion. Today, the use of digital video cameras in conjunction with Apple's iMovie program provides a simple and convenient method of producing video clips for use with Video Point. The use of such videoanalysis techniques appears to be gaining in popularity.

Simulations

Simulations are effective for showing different physics concepts especially if the student can manipulate the variables and see the outcome of his or her interventions. For the past six years, the *Interactive Physics Player Workbook* by Cindy Schwarz [3] has been successfully used by the Physics 20 students at the school. A computer disk that contains numerous simulation activities as well as questions to be answered accompanies this relatively inexpensive resource. One workbook is provided for every computer workstation in the lab and the simulations are used to reinforce concepts covered in class.

Figure 1 shows an example of one of the simulations in which a car is seen to run at a certain velocity and acceleration while at the same time, velocity versus time and displacement versus time graphs are being drawn. The student can change the velocity and the acceleration by moving a slider. An interesting part is that as one changes the variable its vector changes in length and direction accordingly. The student can stop the simulation at anytime and reset with new data. Another good feature of the simulation is that the reference frame can be changed - one can observe the motion as if he or she were in the car or outside the car.

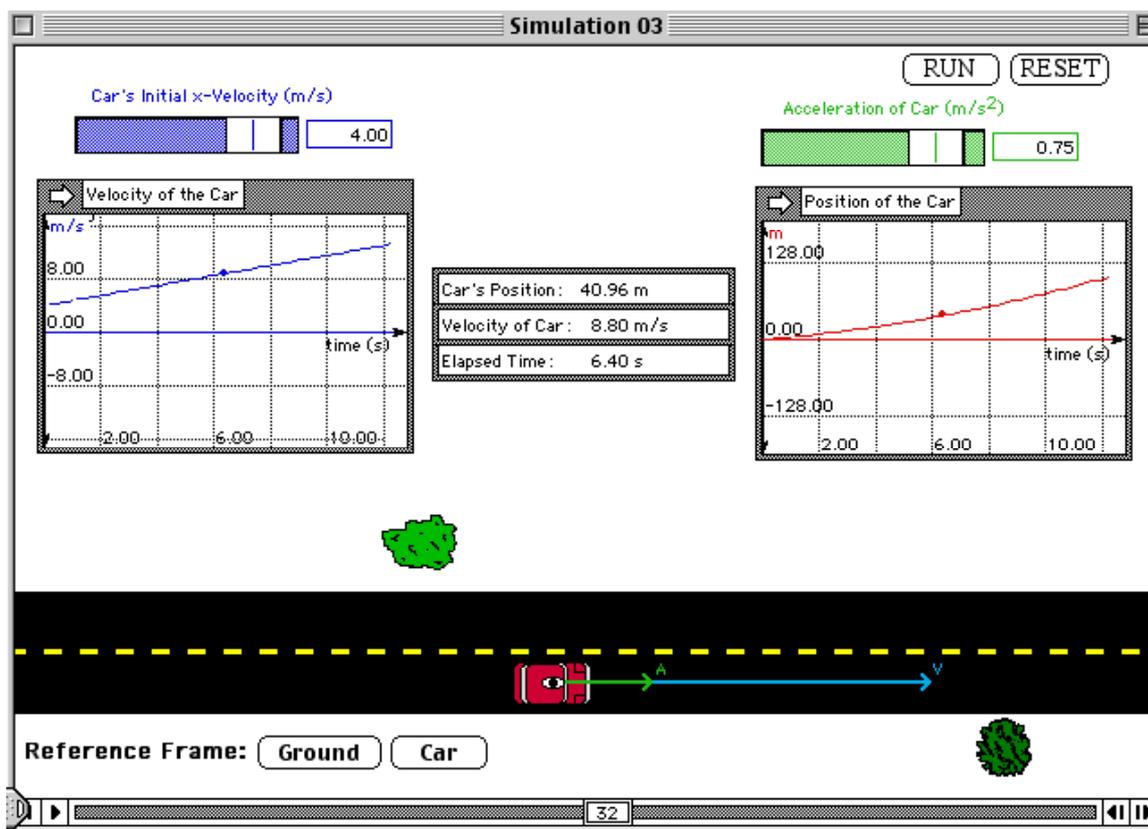


Figure 1. Simulation in Kinematics

At one time, it was thought that the teacher could make these simulations with the program Interactive Physics but due to the large amounts of time necessary to produce such simulations, it is easier to use the workbooks. Now, many publishers are using simulations in their products.

Online Learning

The use of online resources and teaching has grown considerably in recent months. Based on information collected from students, it would appear that some of this growth has been spurred by a marked increase in the number of households upgrading to a broadband connection and the adoption of computers by the students as their primary source for research and information.

A Website of Physics Resources

One of the teachers at the school established a physics resources website called “*Mr. Clintberg’s Studyphysics*” (<http://studyphysics.iwarp.com>). In the past year, this website has seen an enormous jump in traffic. In the period from September 1996 (when the website first came online) to June 2001, ten thousand hits were logged on the site. The next ten thousand visitors to the site took only fifteen months (June 2001 to September 2002). At the current rate, it is anticipated that thirty thousand visits to the site will have occurred by sometime in August 2003. The increase in visits to the website appears to correlate to more favourable positions in some of the major search engines (such as Google and Yahoo). The majority of hits on the website are shifting away from local students in class, to individuals outside of the school. Using an improved tracking system for the past several years, hits on the website have been recorded from over fifty-five different countries around the world. By far the most visited pages on the website are the “Note-A-Rific” pages which supply a complete set of class notes for the Physics 20 and 30 programs offered in Alberta. Many students have remarked that they are using these notes as a supplemental resource to their textbooks and class notes. In several cases, teachers from outside of Alberta have requested to have their students access the website as a secondary resource for their classes. These requests are granted, with the understanding that the resources remain the property of teacher who created them, that they will be accessed directly through the original website, and that no

one profits in any way from the use of the materials.

An Online Course

Approximately three years ago, Edmonton Catholic Schools established an online learning presence called *Revelation Online* (<http://www.revelation.ab.ca>). This initiative got off to a slow start but recently; there has been a slight increase in interest. In the first year of operation there were only three students enrolled in Physics classes. This past semester there were a total of ten students enrolled in Physics classes. Of these ten students, seven achieved the acceptable standard (a final grade of 50% or higher), with one of these students only 2% away from achieving the standard of excellence (80% or higher). There continues to be some difficulty with encouraging students to participate in group projects or to engage in online discussions. Many of the students focus on the completion of assignments, quizzes, and exams with support and contact only from the teacher. Several initiatives have been implemented to try to foster a sense of school community among the online students, the most successful of which has been a general chat area on the website. Students are allowed to discuss any subject of their choosing (within reason) with fellow students, just as they would in their breaks in a traditional school setting.

USE OF INSTRUCTIONAL TECHNOLOGY IN MATHEMATICS

Approximately every ten years In Alberta there is a curriculum change in all subjects. Alberta Learning (formerly Alberta Education) analyses the program of studies for every grade level and makes appropriate changes according to new materials and new methods of delivering the material. The changes start at grade one and follow sequentially up to grade twelve for each consecutive year. In this section of the presentation, a new method of delivering (teaching) mathematics from grade ten to grade twelve will be discussed.

In 1997 Archbishop O’Leary Catholic High School piloted the new mathematics program. The math teachers at school decided that the time was ripe to experiment with new methods of delivering the math content. They decided to team teach and to use the program PowerPoint for presenting and explaining the material. Team teaching occurs when two or more teachers teach the same group of students. In this case, there were two math teachers with a maximum of seventy students. This required a large room and a large screen for the projection of the PowerPoint presentation (see Figure 2). Due to the experimental nature of the initiative, parental permission (in writing) was initially required before students were allowed to participate.

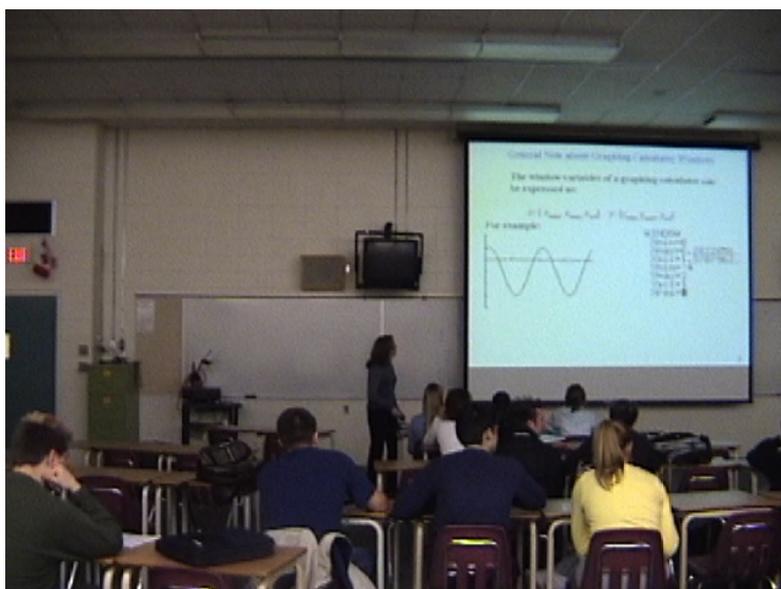


Figure 2. Team Teaching Environment

During the scheduled instructional time, one teacher delivers the presentation while the other performs other tasks such as marking quizzes or exams or preparing for the next presentation. The math teachers decided to produce a PowerPoint presentation of the whole course. They felt that this would captivate the students in a large classroom especially if it is on a large screen with animations and with the Internet available for accessing additional resources. The students receive a set of sheets that follow the PowerPoint presentation (see Figure 3). Typically, while one teacher is presenting (see Figure 4), the students follow along and complete missing sections on their sheets with the information that is on the screen. Meanwhile, the other teacher is circulating among the students to provide assistance wherever it is needed. After the presentation the students do the homework on the sheets and complete other work that is assigned to them from the textbook.

Chapter 2 Exponents and Logarithms

2.6

Laws of Logarithms

MATHPOWER™ 12, WESTERN EDITION 2.6.1

The Product and Quotient Laws

Product Law: $\log_b(mn) = \log_b m + \log_b n$

Quotient Law: $\log_b\left(\frac{m}{n}\right) = \log_b m - \log_b n$

Express $\log_3\left(\frac{AB}{C}\right)$ as a sum and difference of logarithms

$$\log_3\left(\frac{AB}{C}\right) = \log_3 A + \log_3 B - \log_3 C$$

$$\log_3\left(\frac{A}{BC}\right) = \log_3 A - \log_3 B - \log_3 C$$

$$\log_3\left(\frac{AB}{CD}\right) = \log_3 A + \log_3 B - \log_3 C - \log_3 D$$

2.6.2

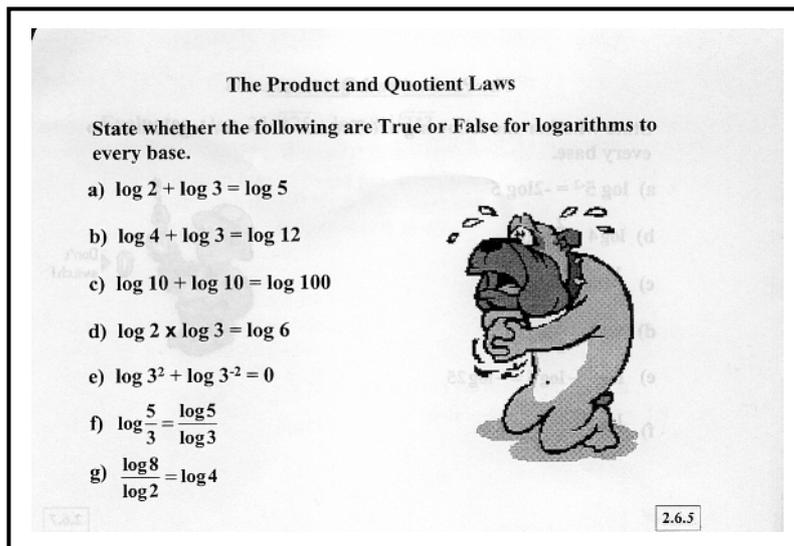


Figure 3. Power Point Generated Sheets

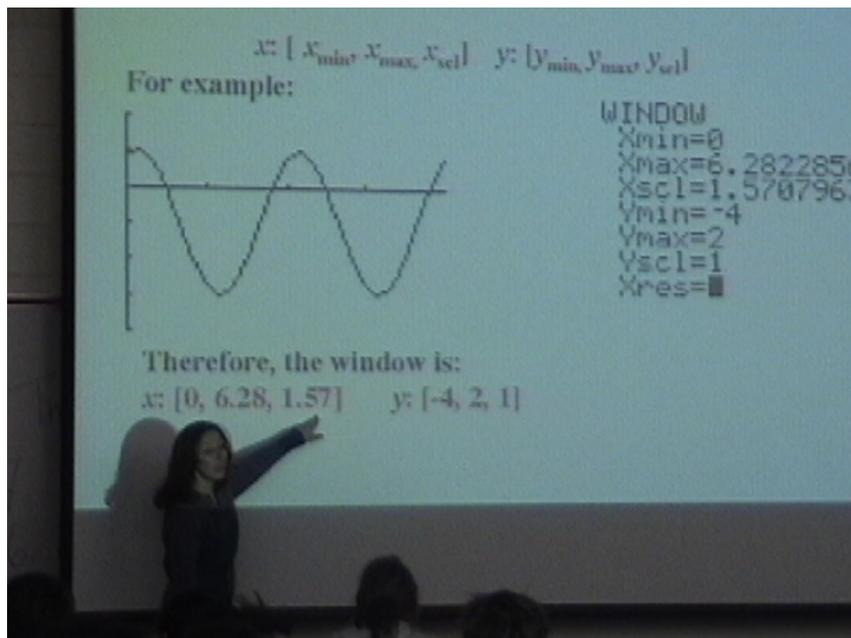


Figure 4. Teacher Using the PowerPoint Teaching Resource

Teachers at the school cite the following as advantages of the PowerPoint-based approach to teaching mathematics.

- Animation - the use of animation to explain a concept. This saves time since otherwise, the teacher would have had to draw on the board.
- Internet – recent statistics can be obtained on the Internet. As well, many Internet sites have explanations covering the concepts that are taught.
- Interaction – immediate feedback for “what if” questions can be obtained because variables can be manipulated “on the fly” thereby instantly displaying the effects of the changes. This is particularly advantageous when using graphs.

- Humor – when dealing with difficult concepts it is important at times to interject some humor by showing a cartoon or video of a funny situation.
- Movies – can be readily incorporated in PowerPoint. This often allows the teacher to demonstrate practical situations where the mathematical concepts apply.
- Flexibility – the program can be used any time anywhere. When a student misses classes, s/he can obtain the course CD and review the material.
- Updating – the program can easily be updated with new material or edited to reflect changes in the program of studies.
- Organization – PowerPoint facilitates the organization of material.

The most significant disadvantage of the approach is the very large amount of time required to develop course for the first-time offering.

COMMENTS

The PowerPoint approach to teaching mathematics is considered to be one of the school's success stories. Over the years since the conception of this method, it was observed that the students are interested in learning mathematics in this manner, especially the visual learners. For the most part, the students always seem to be on task and therefore the classroom management is relatively easy. The method is efficient because the course is well organized. The material covered is the same in every class for the same course. Since its inception, more teachers in the school have become involved in the same method of teaching. The use of videoanalysis has become ingrained in the physics classroom and has continued to be a worthwhile application of IT. The resource website and online learning continue to be valuable, particularly the former. While online learning has experienced only a very modest increase in use and its acceptance has been limited, it continues to be of interest. Online learning is a complex endeavour and thus an activity that needs more time to evolve - it is probably too early to for the school to pass serious judgment on it. Videoconferencing has achieved only limited success. The overhead involved in pursuing this activity seems to be out of proportion with the benefits. If preparation time was made available it could prove to be worthwhile but it is not likely that this will occur, at least in the foreseeable future. It is likely that Videoconferencing will only be used sporadically in the future and, in all probability, for events of widespread interest to the school.

REFERENCES

Clintberg, B.R., Moore, D. T., Pasek, V. L., & Wright, P. W. (2001) Integrating information technology into the teaching and learning of High School Science. Proceedings of the International Conference on Computer Based Learning in Science, A2. Pedagogical Faculty of University of Ostrava, Czech Republic, 2001.

Pasek, V. L. & Wright, P. W. (1999). Use of Video Analysis in the Study of Kinematics in the High School Physics Classroom. Proceedings of the International Conference on Computer Based Learning in Science, D4. University of South Bohemia: Ceske Budejovice, Czech Republic.

Schwarz, C. Interactive Physics Workbook. Prentice Hall, Upper Saddle River, NJ 07458, 1996.

Luetzelschwab, M. L., and Laws, P. Videopoint. Lenox Softworks, Lenox, MA 01240. Web site: www.lsw.com/videopoint.

Vladimir L. Pasek
Department Head, Science
Archbishop O'Leary High School
8760 - 132 Ave
Edmonton, Alberta
T5E 0X8, Canada
Email: vpasek@ualberta.ca

Bryan R. Clintberg
Archbishop O'Leary High School
8760 - 132 Ave
Edmonton, Alberta
T5E 0X8, Canada
Email: bclintbe@hotmail.com

Ron J. Kennedy
Archbishop O'Leary High School
Edmonton, Alberta
T5E 0X8, Canada
Email: Kennedy-ron@shaw.ca

Peter W. Wright, Ph.D.
Professor
8760 - 132 Ave Department of Educational
Psychology
Faculty of Education
University of Alberta
Edmonton, Alberta
T6G 2G5, Canada
Email: peter.wright@ualberta.ca