Teaching Mathematics via Computer.
'The case of Trigonometry'.

Koumis Constantinos MA

Learner thinks, teacher guides, technology supports. (Abtar, 2000).

I am currently employed as a teacher of Mathematics at the Paralimni Technical High School by the Cyprus government (Ministry of Education and Culture). The school is located in Paralimni village and our region is the rural community of Kokkinochoria "Red soiled villages". We have about 120 students and 20 staff. The mathematics faculty has only one staff, me.

The reasons which have dictated this research were the need to study the effectiveness of the computer as a teaching instrument, as well as the lack of researches in Cyprus as far as the subject of Trigonometry in Technical Schools is concerned.

The project has given me the knowledge of research design. I have learned and become more capable of working on research projects and gained valuable knowledge out of it. Through the whole procedure, I feel that I have become a more complete instructor.I have improved my academic knowledge in teaching Mathematics and my efficiency in classroom management. I have gained knowledge that can be used both in my work environment and the daily routines too. It has also helped me to reflect on my students, attitude and thus understand my students better.

Aims and Objectives of my project

The research aims to investigate the effectiveness of using the computer as a teaching aid in Trigonometry in the first year students of the Paralimni Technical High school.

The objectives are to identify the following:

1. Whether the performance of the students that have been taught trigonometry via the computer is higher than the performance of students who have been taught in the traditional way.
2. Identify whether boys' and girls' scores on academic tests were the same.
3. Identify the connection between the teaching method and the students' gender.
4. Identify the impact of the use of a computer on students' attitudes towards mathematics.

Deskwork is spent on literature research and data analysis.

Fieldwork involves an experiment that took place in the computer laboratory of the school.

In the experiment group there was a combination of teaching media such as the computer, the video projector and the board. The teaching of the control group was effected mainly through the whiteboard while as an approach I used the group work. Experimental designs are especially useful in addressing evaluation questions about the effectiveness and the impact of programmes. Experimental designs increase

researchers' confidence, that observed outcomes are the result of a given programme or innovation instead of a function of extraneous variables or events.

Data collection techniques

Documents:

- They provided me with the first group of data which occurred from studying the literature.
- Through the documentary study, I gathered information and used it in order to identify the learning of mathematics via computer.

A pre - test which included exercises on basic mathematic knowledge was conducted. This test was given at the beginning of the school year in order to determine the norms of the incoming students in Technical schools in Cyprus. A post – test was performed as well, which assessed the trigonometry concepts that the two groups had been taught.

A questionnaire of attitudes. The questionnaire included 35 statements and was taken by a blending of statements from the questionnaires of attitudes of the:

a) Assessment of Performance Unit (A. P. U)
b) Research on the Geometry students' attitudes (Karagiorgos, 2002).
c) Research on the students' attitudes (Filippou and Christou 2003).

Research sample

Experimental group		Control group	
Boys	Girls	Boys	Girls
14	12	13	11

Inside Researcher

My role as a Mathematics instructor in conjunction to the fact that I am producing material to be used for the lessons I teach, played a significant role in the way I conducted the research and the way I wrote the outcome of my work. I, as an instructor, am adequately familiar with the curriculum and this helped me set the aims and the objectives of my study. Through the research, specific methods were followed in order to fulfil these aims and objectives.

Data analysis

For the data analysis the SPSS was used. SPSS enabled me to input raw data, to modify and reorganise them once they had been inputted and to carry a wide range of statistical and multivariate analyses.

Project Findings

Pre- test analysis showed the equivalence of the two groups (experimental and control group) in respect of the students' performance in the general Mathematical knowledge. There was no connection between the gender and the groups.

Pre-test and post-test analysis

A pre and post-test comparison have shown that the experiment, as well as the control group, has displayed a progress. The experiment group had better results than the control group. Since the experiment group had better results than the control group, there is a possibility that the use of the computer as an instructive means in Mathematics will help the improvement in students' proficiency. Probably by using the computer students applied their ICT skills to increase their knowledge and understanding of Trigonometry.

The software might also provide them the opportunity to acquire and practise geometrical skills. Opportunities occur when student create, analyse and interpret dynamic spatial images; make and test conjectures about geometrical relationships that they can manipulate, record and present the results of their investigations.

It is possible that this improvement was due to the fact that students have been "worn out to be instructed in the traditional way "(Simeou et all, 2004) and this way the use of the computer, as a new instructive means roused interest. The fact that the use of the computer was combined with traditional teaching is possible that it contributed in succeeding the above, as Edwards claims (1974).

Girls' progress was greater than boys'. Probably girls had more confidence and sense of independence in mathematics and stopped viewing math as a male domain as Fennema (1985) argues. Tiedemann (2000) believed that boys could increase their success through additional effort, and that girls used more of their functional capacity for mathematics than boys do. Boys' failure might be attributed to lack of effort.

Questionnaire analysis

The experiment group students' attitude, regarding their satisfaction towards Mathematics, was increased in relation to the control group, which remained the same. The experiment group students' attitude regarding the usefulness of Mathematics was increased in relation to the control group, which remained the same.

Recommendation

I strongly recommend to the Ministry of Education in Cyprus (my employer) to use the outcome of this project as an instructive model that is intended to permeate teaching and learning Mathematics. In particular, I wish to see the potential of ICT realised in supporting the teaching and learning of geometry. There is already software available, such as for dynamic geometry, Calculus, Statistic, Computer Assisted Instruction (CAI), but its use is not widespread. Many schools do not have licences for the software. There is also a need for the development of additional software, such as to support work in 3-dimensions. I would like to see the funding to schools for ICT being used more effectively to support the Mathematics curriculum.

The most significant contribution to improvements in Mathematics teaching will be made by the development of good models of pedagogy, supported by carefully designed activities and resources, which are disseminated effectively and coherently to and by teachers. I also recommend to my colleagues, the Mathematics Instructors,

to go beyond these interrelated mathematical processes and select instructional strategies appropriate for their students:

1. Positive attitude
2. Connections
3. Problem solving
4. Reasoning
5. Visualisation
6. Relationships
7. Shape
8. Technology

Reference

Anthoulias, T. (1989). Computers and Education. Athens:Gutenberg.

Barba,R., & Cardinale, L. (1991). Are Females Invisible Students? An Investgation of Teacher-Student Questioning Interactions School. Science And Mathematics, 91,7, 306-310.

Becker, R. B. & Jacobs, J. (1983). Sex: Is it an issue in Mathematics? Educational Horizons, 61, 60-64.

Bell, J. (1999). Doing your research project. (3rd ed.). Milton Keynes: Open University Press.

Bendow, C., Stanley, J. (1980). Sex differences in Mathematical ability. Fact or anti fact. Sciece, 1262-1264.

Blaxter, L.,Hughes, C., & Tight, M. (1996). How to research. Milton Keynes: Open University Press.

Brosnan, M. J. (1998). The Impact of Computer Anxiety and Self-Efficacy Upon Performance. Journal of Computer Assisted Learning 14, 223-234.

Brush, L. (1985). Cognitive and Affective Determinants of Course Preferences and Plans Women and Mathematics in S., Chipman, L., R., Brush & D., M., Wilson (Eds). Women and Mathematics Balancing the Equation. Hillsdale, NJ : Lawrence Eribaun Associates.

Burger, William F., and J. Michael Shaughnessy. (January 1986).Characterizing the van Hiele Levels of Development in Geometry. Journal for Research in Mathematics Education.17, 31-48.

Campbell, D. & Stanley, J. (1963) Experimental and Quasi- Experimental Designs for Research, Boston, MA:Houghton Mifflin Co.

Carroll, John, B. (1970). Problems of Measurement Related to the Concept of Learning for Mastery. Educational Horizone, 48, 3, 71-80.

Carroll, John, B. (January /February, 1989). The Carroll Model A25 – year Retrospective and Prospective View. Educational Researcher, 18, 1.

Chipman, S., Wilson, D. (1985). Understanding Mathematics Course Enrollment and Mathematics Achievement: A Synthesis of the Research in S., Chipman, L., R., Brush & D., M., Wilson (Eds). Women and Mathematics Balancing the Equation. Hillsdale, NJ : Lawrence Eribaun Associates.

Christou , C & Filippou , G. (2001). Education Texts. Sentimental factors and learning of mathematics. Athens : Atrapos.

Cook, T. & Campbell, D. (1979). Quasi-Experimentation: Design and Analysis for Field Settings. Rand McNally, Chicago, Illinois.

Dudley – Marling, C. & Ownston, R. (July, 1988). Using Microcomputers to Teach Problems Solving: A Critical Review. Educational Technology, 27-33.
Fennema, E. (!985). Girls in Mathematics. The Crucial Middle School. Mathematics in the Middle School. (Yearbook): Restom NCTm.

Ebel, R. (1972). Essentials of Educational Measurement. New Jersey: Prentice-Hall.

Edwards, J. (1974). Associate Educational Data System,7, 122-126
Classroom Assessment. Retrieved December 15, 2004, from http: //fcit.usf.edu/assessment/index.html

Fennema, (May 1974). Mathematics Learning and Sexes: A Review. Journal for Research in Mathematics Education, 126-138.
Fennema, E. (1990). "Teachers' Beliefs and Gender Differences in Mathematics." in Elizabeth Fennema and Gilah Leder (Eds.), Mathematics and Gender. New York: Teachers College Press.

Fennema, E & Peterson P. (1985). Autonomous Learning Behavior: A Possible Explanation of Gender-Related Differences in Mathematics. In Jane Gaskell and John Willinsky (Eds.), Gender Influences in Classroom Interaction: From Interaction t to Transformation. New York: Teachers College Press.

Filippou, A. & Christou, C. (2003). Performance and sentimental factors in teaching of mathematics in a computers environment. Paper Presented in a Symposium: Pepresentations and Geometric Models in learning of Mathematics. Forth intensive program in Education Mathematics. Nicosia: Intercollege.

Filippou, G.(May,1991). The Performance in Mathematics of 3rd Class Students, Aegean University Pedagogical Department of Rhodes.

Filippou, G. (January, 1992). The Sixth Grade Student's Performance in Mathematics. Aegean University Pedagogical Department of Rhodes.

Freidman, L. (1989). Mathematics and the Gender Gap. A meta-analysis of recent studies on sex differences in Mathematical task. Review of Educational Reserch, 2, 19-42.

Gibbons, B., Herman, J.,(1997). True and Quasi – Experimental Designs Practical Assessment, Research & Evaluation, 5(14). Retrieved December 20, 2004 from: http://PAREonline.net/getv:asp?=5&n

Hativa, N. & Reingold, A. (1987). Effects of Audiovisual Stimuli on Learning Through Microcomputer- Based Class Presentation. Instructional Science,163, 287-306.

Hativa, N. (April, 1991). Cognitive, Effective and Social Impacts of Arithmetic Practice with I.L.S.: An Integration of Findings from 6 – years Qualitative and Quantitative Studies. Paper Presented in a Symposium. Alternative Models of Using Computer – Based Integrated Learning Systems (I.L.S.) and their Effectiveness. The annual meeting of the American Educational Research Association.

Hudson, L. (1966). Contrary imaginations: A psychological study of the English schoolboy. London: Methuen.

Jackiw, N. (1995): The Geometer's Sketchpad, Key Curriculum Pres,Berkeley,California.

Johnson, D. & Johnson, F. (2003). Joining together: group theory and group skills. (8th ed.). Englewood Cliffs, NJ: Prentice Hall.

Bennet, N. & Gass, A. (1988). The Effects of Group Composition on Group Interactive Processes and Pupil Understanding. British Educational Journal, 15 , 19-32.

Karagiorgos, D. (2002). Methodology of research in the education sciences. Athens : Savvalas.

Kihlstrom, J.(2001).Memory Research: The Convergence of Theory and Practice. Retrieved March 19, 2005 from: http://ist-socrates.berkeley.edu/~kihlstrm/pam94.htm

Kulik, J., Bangert R., & Williams, G. (February, 1983). Effects of Computer Based Teaching on Secondary Schools Students. Journal of educational Psychology, 216-214.

MathNet (2001) Geometer's Sketchpad 4.0 Review. Retrieved December 10, 2004, from http: //www. mathsnet. net/articl es/gsp4. html.

Mavridou, A (1991). The computer as a teaching mean. Nicosia: Pedagogical Institute.

Michaelidou, A. & Simeou, L. (2001). Dianellios Technical High School Larnaca.. Project Findings. Nicosia: Pedagogical Institute - Research and Evaluation department.

National Council of teachers of Mathematics. (2005). Principles and Standards for School Mathematics. Retrieved February 12, 2005, from http://my.nctm.org/standards/document/index.htm

Niemiec, R. & Walberg, H. (1992). The Effects of Computers on Learning. Educational Research, 17, 1, 99-108.

Papanastasiou, K & Yiancou (1997). Girl's performance is significant better than boy's in High Scholl. Nea Paideia, 83, 90-103.

Papanastasiou, K. & Christou K. (1992). Effects of Type of School and Sex on Mathematics of 1st year students in High School in Cyprus. Nicosia : Pedagogical Institute.

Quilter, D. & Harper, E. (1988). Why we didn't like Mathematics and why we can't do it. Education Research, 30(2), 121-129.

Raptis, A & Raptis , A. (1997). Information technology and Education: Total approach. Athens: Telethrion.

Raptis, A & Raptis , A. (2002). Learning and Teaching in the Season of Information. Athens: Raptis Aristotle.

Sacks, C., Bellisimo, Y. & Mergendoller, J. (1993). Attitudes toward computers and computer use: The Issue of Gender. Journal of Research on Computing in Education, 26, 257-269.

Simeou, L., Markatzis, E,. Efthimiou, E. (2004)The attitude of the Technical School students towards their school as well as towards those factors that are related to these attitudes. Nicosia: Pedagogical Institute.

Talsma, G. & Hersberger, 1990). Star Experimental Geometry: Working with Mathematically Gifted Middle School Students. Mathematics Teacher, 83, 5, 351-357.

Tiedemann, J. (2000). Gender-related Beliefs of Teachers in Elementary School Mathematics. Education Studies in Mathematics, Vol. 41, 191-207.

Zhang, Y. & Espinoza, S. (1998, Summer). Relationships among computer self-efficacy, attitudes toward computers, and desirability of learning computer skills. Journal of Research on Computing in Education, 30(4), 420-436.

Bibliography

American education research association.
http://www.aera.net/

An introduction to Trigonometry.
www.ping.be/~ping1339/gonio.htm

Arvanitis, T.& Toumasis, M. (2003).Teaching of mathematics with the use computer. Athens : Savvalas.

Assessment in Education
http://www.carfax.co.uk/

CEO Forum on Education and Technology. (2001, June). The CEO Forum school technology and readiness report: Key building blocks for student achievement in the

21st century. Retrieved February 21, 2005, from
http://www.ceoforum.org/downloads/report4.pdf

British educational communications and technology agents.
http://www.becta.org.uk/

Classroom Assessment
http://fcit.usf.edu/assessment/index.html

Dave's short course in Trigonometry.
www.aleph0.clarku.edu/~djoyce/java/trig/.

Ethics of Research Involving Human Participants
http://www.has.vcu.edu/psy/faculty/fors/ethics.htm

Ethics resources center
http://www.ethics.org/

Exarchakos, T. (1988). Didactic of Mathematics. Athens: Ellinika Grammata.

Gialamas, G., (2005). Statistical Techniques and Applications in Social Studies. Athens: Patakis.

Hanson K. teaching mathematics effectively and equitably to females.
http://www2.edc.org/gdi/publications_SR/teachmathwp.pdf

How Students Learn Vs How We Teach.
honolulu.hawaii.edu/intranet/committees/ FacDevCom/guidebk/teachtip/teachtip.htm

International Journal of Instructional Technology & Distance Learning
http://www.itdl.org/index.htm

Mathematical Association of America
http://www.maa.org/

Mathematical Sciences Education Board (1990). Reforming Mathematics at school. Retrieved February 12, 2005, from
http://www7.nationalacademies.org/mseb/MSEB_Completed_Projects.html

National Council of Teacher of Mathematics
http://www.nctm.org.

New technologies in education,Pedagogical Institute of Greece.
http://www.pi-schools.gr/hdtc/material/ict.htm

Practical assessment research and evaluation
http://pareonline.net/Home.htm

Resources to help you learn and use SPSS. UCLA academic technology services.
http://www.ats.ucla.edu/stat/spss/.

Statistics and Experimental Design
http://www.colorado.edu /che/CLASSES/chen5838/statisticsanddesign.html

STATS - STeve's Attempt to Teach Statistics
http://www.childrens-mercy.org/stats/

Teaching Tips.
www.teachingtips.com/

The Geometer's Sketchpad resource centre.
http://www.keypress.com/sketchpad/

The Data and Story Library
http://lib.stat.cmu.edu/DASL/DataArchive.html

Toumasis, M. (1994). Modern didactics of Mathematics: Didactics, Theory and Praxis. Athens: Gutenberg.

Trigonometry
www.acts.tinet.ie/trigonometry_645.html

Tsantas, N., Mosiades, C., Mbayiantis, N. & Hadjipantelis, T. (1999). Data Analysis with tha Assistant of Statistical Packages. Thessalonica: Ziti.