Early Exposure of Pre-College Students to Information Technology

Keshav S. Varde
University of Michigan-Dearborn, Dearborn, USA

It is known that information technology plays an important role in employment and productivity of current U.S workers and will do so even at a faster rate in years to come. Yet, the exposure of pre-college students to the technology has been very slow. This is even more evident in some of the major city school systems where inadequate facilities, poor infrastructure and ill-trained teachers have contributed to further deterioration of any planned educational activities in this area. This paper highlights a program that was recently instituted by a non-profit organization, in collaboration with local universities and industry partners, to address the problem and expose pre-college students to information technology and related STEM disciplines. The program is based on past research on students' learning through hands-on activities. Preliminary assessment of the program outcomes is presented in the paper.

Objectives and Rationale

There is no doubt that unfamiliarity with information technology (IT) discipline will limit students' educational opportunities and their future economic status (Gannod, 2003; U.S. National Science Board, 2004). This is nowhere more evident than in the U.S. where current data and future projections show that IT will play a crucial role in increasing the nation's productivity and creating a productive workforce.

It is true that more and more U.S. schools are equipped with computers and associated facilities compared to the scenario that existed in the mid-1990 (National Education Association Homesite, 2004). However, the utilization of computer technology has been limited. A recent study of utilization of computer technology in high schools showed that the primary use has been for word processing and Internet access (Gupta and Houtz, 2000). The study also revealed that students seldom use the technology for learning or developing skills in area of programming, information storage, data manipulation and retrieval, web page development and for communicating through graphics. Graphical com-

munication is a concise language used by scientists, engineers and technically skilled personnel. The lack of properly developed technology education and utilization, combined with a lack of interest on the part of students to pursue science, technology, engineering and mathematics (STEM) based career, has been a national concern in the U.S. for quite sometime. Motivating high school students to pursue technical career has been a challenging task and large metropolitan city schools have not been very successful at the challenge.

Because of this, the Detroit Area Pre-College Engineering Program Inc. (DAPCEP), a non-profit organization, in collaboration with several local universities and corporations, developed a program in IT and related disciplines. The objective of the 4-year, 2-cycle project is to provide hands-on education and skills opportunities to underrepresented minority students in middle and high schools from the Detroit area. It allows the sponsors and university participants to assess if the approach would help to elevate IT skills amongst pre-college students in predominantly minority schools. The major funding for the project is provided by the National Science Foundation (NSF) under the Information Technology Experience for Students and Teachers (ITEST) program. The University of Michigan-Dearborn (UM-D), along with the University of Michigan-Ann Arbor (UM-AA), Michigan Technological University (MTU), University of Detroit-Mercy (UD-M), Lawrence Technological University (LTU) and Ford Motor Company (FMC), are providing the majority of instructional and laboratory activities to student participants.

Project Design and Procedure

The project was designed to provide educational activities and hands-on laboratory experience over a 2-year period to students starting in the 7th and 9th grades. An extensive process was developed to admit students into the program. The admitted students were required to make a two-year commitment to the program. The major focus of the project is IT; however, other related activities including uses of IT in the sciences, mathematics and related disciplines are included as part of the project. These activities are crucial to a successful career in the IT arena or application of IT in STEM disciplines. The two-year program at each grade level includes six Saturdays of classes in autumn and spring each and a four-week program each summer, for a total of about 150 hours of instruction and activities per year. Research has shown that students' learning is more effective if it is accompanied by hands-on activities. The UM-D project included evaluation of effective modes of learning IT and related skills in a classroom and laboratory environment.

A partial list of topics covered and assessed at UM-D in year No 1 is listed:

- Development of short computer codes with simple algorithms, storage and retrieval of code on a server, use of security to access, modify and restore code or similar information.
- Use of database to store, retrieve and sort information; present information through various graphical modes of communication and presentation data and results through text, oral and graphical communication.
- Use technology to analyze experimental data, present and communicate results through IT, and develop alternate methods of storing and presenting the information.
- Use of Internet and development and use web pages for business and marketing, for storing and retrieving information, and for communication

Preliminary Findings

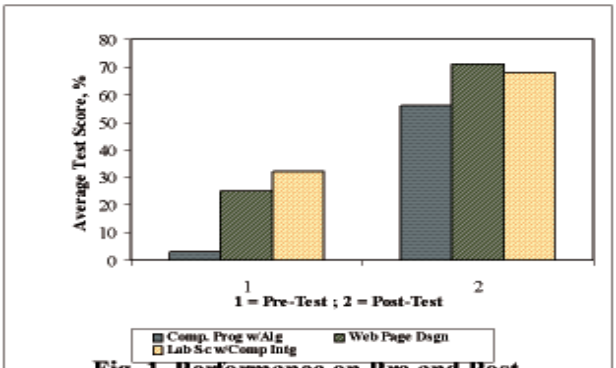

Fig. 1 Performance on Pre and Post Test

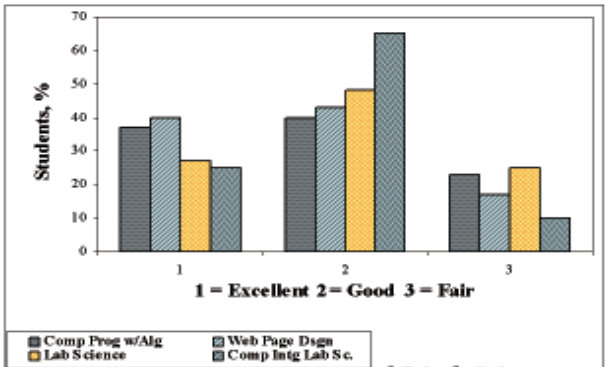

Fig. 2 Performance of 7th & 9th Grade ITEST Students

The project target areas were assessed by an external evaluator to determine improvement in participants' knowledge and comprehension of the topics. This evaluation was done through various approaches, one of them being the pre and post-test performance. Figure 1 shows impact of instructional and hands-on activi-

Task Name (No of Students)	Instruction & Learning	Skills Development
Storage & retrieval to/from server (60)	Small group Inst/Learning	Small group
Computer code/program development (30)	Small group and individual	Individual
Conduct lab exp and collect data (48)	Large or small group	Team
Data reduction/analysis, store/ret/modify (48)	Team	Team
Creation of simple web page (30)	Large or small group	Individual
Use of data base and data manipulation (48)	Large group	Team
Graphical Communication (48)	Small group	Small group

Table 1

ties in IT and related areas in three target areas. It shows significant improvement in some areas but not so good in other areas. The performance was averaged for the cohorts in the group. Figure 2 shows relative performance of students in the target areas on a graded level. The assessment in each target area was based on learning outcome defined for the grade level and utilized tests, projects, quizzes and assignments. The approaches used in different components of the project were analyzed to evaluate their impact in improving participants' learning and comprehension of IT and their skills in applying the subject matter. The methods focused on large and small group instruction, hands-on laboratory experimentation in an individual group setting, individual and team work in graphing, graphical communication and report, oral presentation using technology work, and use of packaged software. Table 1 show approaches that worked better in some of the project tasks.

Acknowledgement

This project was supported by a grant from the National Science Foundation to DAPCEP, Inc, under the ITEST Program (*Award No 0322934*) with UM-D as a subcontractor. The author would like to thank Dr. Julia Clark, Program Manager at NSF and Margaret Tucker, Program Director at DAPCEP, Inc. for the funding. The author acknowledges support provided by Ms McNair in evaluating and assessing some of the outcomes of the UM-D program to-date.

References

Gannod, B. D. (2003) Technology Education for Kids: Cultivating Technology Professionals of Tomorrow and Today, *Proc. ASEE*, Session 1660.

U.S. National Science Board (2004) *Science and Engineering Indicators 2004*, Chapter1, www.nsf.gov/sbe/srs/seind04/cl/cls7.htm.

National Education Association Homesite (2004) *Technology in Schools*, http://www.nea.org/.

Gupta, U. G. and Houtz, L. E. (2000) High School Students' Perceptions of Information Technology Skills and Careers, *J. Ind. Tech*., Vol 16, No 4.