Web-Assisted Instruction in Physics: An Enhancement to Block Scheduling

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Abstract

There was a dramatic increase in Physics Honors final exam scores when a high school physics teacher implemented a website for instruction in a block schedule. The site was used to deliver weekly lecture notes, plans, and assignments while also providing links to other sources of information in physics. More time in class was available for demonstrations, group lab activities, and multimedia presentations. The research involved comparing the final exam scores in honors physics during three consecutive four-year periods from 1991-2002. Class means showed that the exam scores decreased when the school switched from the seven period day to the 4 by 4 block, and then increased when the block schedule was enhanced with Web-Assisted Instruction.

Introduction

This study addresses a particular application of computer technology that can play an important role in enhancing instruction in secondary schools. The extent of use and the nature of Web-Assisted Instruction with its impact on the learning environment was investigated through research findings and, more importantly, from my own experience as a physics teacher. Web-Assisted Instruction can be defined as using the Internet with email and World Wide Web (WWW) browser software to setup and maintain a web-page in order to supplement conventional instruction (Churach and Fisher, 2001). Other terms synonymous with Web-Assisted Instruction are Web-Based Instruction(Newman, 1997), Internet-Assisted Instruction(Truell, 2001), and to some extent, Computer Assisted Instruction(Cotton, 1997).

The origin of my involvement with computers in education occurred in the late 1970's and early 80's at a high school in suburban Pittsburgh, Pennsylvania. I used a Hewlett PackardTM 9830 computer system to teach programming classes in HPTM-BASIC and FORTRAN, to process numerical and graphic results from physics experiments, and to manage attendance and grading data. Students accessed the system through cards that were either keypunched, or marked with a #2 pencil. The system was also busy four nights a week in the evening-school since many adults also wanted to learn how to program. An advanced placement program in physics and computer science also was developed at the school during this time. Since then, I have remained committed to the use of computers in education and more recently to Web-Assisted Instruction.

Further evidence of my commitment can be found at the website I created in 1999, and maintain on a weekly basis for the physics students at Boca Raton (FL) High School. During the past four years there have been nearly 400 students taking physics at the school and the site has accumulated 40,000 hits. The site can be accessed by typing-in the address, http://home.earthlink.net/~aaronal.

STUDY OF THE PROBLEM

In order to understand the rationale for Web-Assisted Instruction, it is important to delineate the conditions that led to its use. Near the end of the 1993-94 school year at a South Florida high school, the principal convened a meeting of department chairs, including myself, to inform them that the school would be changing to the "4 by 4" block schedule for the following year. With this type of schedule, there is a four-period day, with each being ninety-two(92) minutes, instead of the traditional seven periods of fifty(50) minutes each. All courses are offered for one semester instead of the whole year. The reasons given for the change ranged from "teachers will be able to get more done" to "it will be more like college for the students." Attempts to determine if any real empirical research data existed in favor of block scheduling produced no conclusive results.

After teaching in the block schedule for four years, I began to examine and compare some empirical data on final exam scores in physics. In the four years before block scheduling, the class mean and standard deviation on the final exam were 78.2 and 7.4, respectively. During the first four years of the block schedule the mean had slipped to 65.7 with a standard deviation of 6.4. Since the physics student website has been in existence for the past four years, a noticeable improvement has been observed in the class mean on the final exams. During this period of time the mean has improved to 72.4 while the standard deviation has increased to 7.1.

Table 1 below illustrates these results, indicating, of course, that not only had the average grade decreased, but also the drop in standard deviation meant that there were more students clustered around the mean. There had never been this kind of distribution before my previous 25 years of teaching physics. (Students who take physics have not changed much over the years.) Could this downturn in the mean score on the final exam have been caused by the scheduling change? And, could the Web-Assisted Instruction enhancement have induced the improvement in the mean final exam score? There is research that tends to support this hypothesis.

Web-Assisted Instruction offers a way for students to remain connected to their instructor even when absent from school. Make-up work can be sent in using email attachments. The weekly plans and assignments are included on the website along with lecture notes, links to other specific sites for enrichment and practice, on-line quizzes and tests, and the email link for communication. More class time can be devoted to demonstrations, student lab work, and other

TABLE 1
Final Exam Scores in Physics I Honors for Four Years

Time Period	*Schedule*	*Web-Assisted*	*Median*	*Mean*	*SD*
1991-94	7 Period day	No	75.3	78.2	7.4
1995-98	4 by 4 Block	No	67.8	65.7	6.4
1999-02	4 by 4 Block	Yes	70.6	72.4	7.1

group activities, so that the class period does not have the effect of lasting too long or being filled with busy work.

ACHIEVEMENT IN WEB-ASSISTED INSTRUCTION

Academic achievement was compared during a 12-year period for traditional instruction methodology, traditional instruction supplemented with computer and web-assisted instruction, and computer and web-assisted instruction alone. (Christmann, Badgett, and Lucking, 1997). An overall mean effect size of .187 which indicated that students receiving traditional instruction supplemented with web-assisted instruction attained higher academic achievement than did 57.2% of those receiving only traditional instruction. Furthermore, the typical student moved from the 50th percentile to the 57.2th percentile when exposed to some form of computer or web-assisted instruction

In another study, which compared science students who were instructed by traditional methods of teaching with those who received traditional instruction enhanced with computer (web) assisted instruction; similar results were reported (Christmann and Badgett, 1999). The overall mean effect size of .266 was calculated which again indicated that students whose traditional instruction was supplemented or enhanced with web-assisted instruction attained higher academic achievement than did 60.4% of those receiving traditional instruction alone. Again, this suggested that the typical student moved from the 50th to the 60.4th percentile when computer (web) assisted instruction was combined with traditional methods. In the same study it was also mentioned that the most significant gains occurred in general science, compared to biology, chemistry, and physics. The computer(web) assisted general science students scored, on average, better than 78% of those general science students exposed to traditional instruction alone.

STUDENT ATTITUDES TOWARD WEB-ASSISTED INSTRUCTION

Another aspect of computer or web-assisted instruction that was researched was the attitude of the student toward using computer animations and graphics compared with text-based or mental models (Szabo and Pookay, 1996). In this study, animations and slide-presentations using PowerPoint™ for example were utilized in the classroom and/or posted on a website to teach geometry and trigonometry. One group was taught using animations, another with graphics, and the third was instructed using text only. Pre and posttests were administered. The research findings were as follows: the animation group score was 21.3% higher than the graphics group and 34.8% higher than the text-only group.

Still another study reported on student attitudes toward and evaluation of Internet assisted instruction(Truell, 2001). The research consisted of student responses to questions, with answer options ranging from (1) strongly agree, (2) agree, (3) disagree, and (4) strongly disagree. The participant's overall attitude toward internet-assisted instruction was 1.93, which is slightly higher than an "agree" response since "strongly agree" is rated at 1.00. An interesting internal-comparison of the results of Truell's study was also obtained because a Group Embedded Figures Test(GEFT) was administered to determine learning styles of the participants. The neutral learning style category produced the most positive attitude toward internet-assisted instruction illustrated by a mean score of 1.65. Furthermore, attitudes based on gender were computed with female students having a slightly more positive attitude toward internet-assisted instruction than males, although the difference in gender group attitudes was not considered significant at alpha = .05.

Chou (August, 2000) reports on a computer-assisted testing and evaluation system developed and posted on the World Wide Web. Student's reactions to the Web-based testing system were positive. A total of 59 students in science and engineering classes were asked, through a series of written questions, about their experience of taking a test that was posted on a website. The results indicated that about 70% preferred this kind of test, with 68% stating that they thought the testing was more efficient, and 75% reporting that the test was easy to read on the screen(Chou, 2000). Other positive comments about the web-based testing were, "I can type faster than I write, and my handwriting is poor", "The web-test is environmentally friendly", and "Computers are part of our lives, and web-testing will be done more in the future." These findings by Chou should be considered preliminary in nature since an experimental design to compare the achievement of experimental and control groups was not used.

In comparing instructional delivery methods, a course on computer systems performance analysis was offered using four different formats (Lilja, 2001). One was taught live on-campus, another was delivered using remote TV, the third method was remote-live, and the last option was web-based independent study. The number of students who enrolled for each format was 60 for live on-campus, 14 for remote TV, 29 for remote live, and 20 for web-based independent study. Students who chose the web-based independent study claimed that they did it for the scheduling flexibility and liked the "anywhere anytime" learning opportunity, even though two-thirds of them lived near campus. Final grades were assigned the standard point values of 4.0 for "A", 3.0 for "B", 2.0 for "C", and 1.0 for "D". The results indicated that the remote and web-based independent study students outperformed their on-campus counterparts. In particular, the final grades for the web-based students produced a 3.60 average, compared to the on-campus final average of 3.46.

FUTURE TEACHERS' VIEWPOINTS

The sentiments of prospective educators with regard to Web Based (Assisted) Instruction were the subject of still another study published on the Internet by the University of South Carolina's College of Library and Information Science. A website was setup to supplement a teacher training course called "Applications of Information Technology". Upon completion of the coursework, the students completed course evaluation survey questions. In response to the survey item, "The website enhanced the educational value of this course", 84% of the respondents agreed. 93% of the students agreed that, "The website broadened my general knowledge of the subject area". Another significant result was the 96% agreement to the survey statement, "The website helped me locate resources that I can use in my own classroom"(Newman,1997).

SOME WORDS OF CAUTION

With all the evidence given thus far supporting Web-Assisted Instruction, a few statements of concern must be mentioned. Instructors should be very careful when setting-up a website to supplement and/or enhance their educational setting. Kumar and Libidinsky(2000) conducted an analysis of science education resources on the World Wide Web. Their study analyzed World Wide Web-based K-12 science education resources in the United States using the Science, Technology, and Society (STS) competencies developed from the National Science Education Standards (NRC, 1996). According to the results of the study, instructors must proceed with caution when including links for student use on a website. Out of the 51 resources analyzed, only 12% addressed 25% or more of the STS competencies. Two researchers with about 95% agreement reviewed the 51 resources independently.

The results were organized by state with 36 states represented. The top five states based on the percentage of STS competencies met were, in order, California 67%, New Jersey 33%, Texas 33%, Delaware 27%, and Florida 27%. The rest of the states met the competencies at 20% or less. Furthermore, when grade levels were examined in the 51 resources, it was apparent that the elementary level received limited attention. Efforts at creating web resources for the elementary level seemed to be hampered by the apparent inability of teachers to develop, evaluate, and adapt appropriate web-based instructional materials.

CONCLUSIONS

The physics student website at this particular high school is the only one of its type at the school. It seems that, considering the available access to technology at our high school combined with the demographic of an educated community, more instructors would be maintaining one for their students. Three other teachers out of the approximately 100 on staff did approach me three years ago inquiring about how to setup a website to supplement class instruction. All three were given instructions and demonstrations pertinent to the steps involved. Of the three, two actually posted websites but at this time only a single instructor still has one, which is just an informational page requiring no maintenance.

When questions are asked or surveys are completed regarding the use of technology in the curriculum, the overwhelming majority of instructors would say that they are integrating technology. Evidence of this was the subject of a study by Baines, Deluzain, and Stanley, dealing with technology in Florida and Georgia secondary schools. In an initial survey question about integrating technology into the curriculum, 96% of teachers said that they do integrate technology. And, according to the data, Florida leads the nation with a ratio of six students per computer. At 13:1, Georgia has one of the lowest ratios of students per multi-media, internet-ready computers in the nation. The researchers videotaped 85 different teachers for a total of 500 hours over two years. What they uncovered was surprising. In the classrooms of the 51 teachers at various grade levels observed in Florida, only a few had access to any sort of computer. Of six who had Internet access, only three allowed students to use it but "only for half a period on Fridays, if they are good". Computer labs were found in remote, but secure locations, not classrooms, and their use was restricted. From the observations of these researchers, only 4% of teachers attempted to integrate some sort of technology into their instruction(Baines, Deluzain, and Stanley, 1999).

Based on the success of this author, it seems that Web-Assisted Instruction can be used to enhance learning physics by students in the block schedule. It should also be apparent to instructors, and school administrators for that matter, that the rudiments of using technology effectively to enhance teaching methods must be mastered and utilized by all.

REFERENCES

Baines, L. A., Deluzian, R. E. & Stanley, G. K. (1999). Computer technology in Florida and Georgia secondary schools: Propaganda and progress. *American Secondary Education, 27*(4), 33-38.

Chou, C. (2000). Constructing a computer-assisted testing and evaluation system on the World Wide Web – the CATES experience. *IEEE Transactions on Education, 43*(3), 266-272.

Christmann, E. & Badgett, J. (1999). A comparative analysis of the effects of computer-assisted instruction on student achievement in differing science and demographic areas. *The Journal of Computers in Mathematics and Science Teaching, 18*(2), 135-143.

Christmann, E., Badgett, J. & Lucking, R. (1997). Progressive comparison of the effects of computer-assisted instruction on the academic achievement of secondary students. *Journal of Research on Computing in Education, 29*, 325-337.

Churach, D. & Fisher, D. (2001). Science students surf the Web: Effects on constructivist classroom environments. *The Journal of Computers in Mathematics and Science Teaching, 20*(2), 221-247.

Cotton, K. (1997). *Computer-Assisted Instruction*. School Improvement Research Series (SIRS) Close-Up #10. Portland, OR: Northwest Regional Educational Laboratory.

Kumar, D. D. & Libidinsky, L. J. (2000). Analysis of science education reform resources on the World Wide Web. *American Secondary Education, 28*(4), 16-21.

Lilja, D. J. (2001). Comparing instructional delivery methods for teaching computer systems performance analysis. *IEEE Transactions on Education, 44*(1), 35-40.

Newman, V. (1997). *The New Community: Web based Instruction, The Internet, and The Classroom*. [Online]http://www.conterra.com/crr/wbi/html

Szabo, M. & Poohkay, B. (1996). An experimental study of animation, mathematics achievement, and attitude toward computer-assisted instruction. *Journal of Research on Computing in Education, 28*, 390-402.

Truell, A. T. (2001). Student attitudes toward and evaluation of Internet-assisted instruction. *Delta Phi Epsilon Journal, 43*(1), 40-49.