Comparing Technology Skill Development in Computer Lab versus Classroom Settings of Two Sixth Grade Classes

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Abstract

Preparing elementary students for online learning begins with basic computer competency. Computer competency skills were taught using integration of learned skills in the regular academic curriculum to sixth grade students under two conditions: (a) in a classroom with four computers, and (b) in a computer lab. Students of mixed ability (N = 53) were given pretest and posttest measures of technology skill development based on school district curriculum before and after eight weeks of instruction. Results showed that the group using the computer lab had higher overall scores in computer skills when compared to the classroom integration group. Higher scores for the lab were interpreted as the result of efficient and enhanced academic-engaged time inherent to the lab setting. An attitude survey given to all students indicated no significant differences between groups on perceived fear of computers, attribution of learning through computers, or enjoyment derived from using computers.

Today's public schools are compelled to provide students with technology competency skills that will allow them to supplant their learning through online sources and succeed in an ever-increasing technological workplace. In order for students to use technology as a tool to improve learning, they must have ready access to technology and the competency to use this technology effectively (National Educational Technology Standard for Students, 1998). Unfortunately, sufficient computer equipment is not always available in schools. Funding to support computer use in classrooms is often difficult to obtain. State legislatures and other oversight bodies are requiring proof that the money that is spent improves academic achievement. Therefore, school districts with ever-limited budgets ask, "Where can available computers be put to *best* use—in individual classrooms or in a computer lab?" This issue has become a source of controversy given equipment limitations, the need for schools to maximize computer effectiveness in promoting academic achievement, and accommodation of varied skills among teachers and students.

Perspectives on Computer Settings in Education: A Review of the Literature

"Integrate, don't isolate computers" (Davis & Shade, 1994) captures the current perspective on where and how to use computers in schools. Proponents of this view

(Davis & Shade, 1994; Federico, 1995; Fowler, 1990; Junaid, 1996; Watson, 1990) argue that the use of computers within classroom settings is superior to computer labs in promoting an integrated curriculum and maximizing the benefits of computer usage to improve learning.

Davis and Shade (1994) infer that use of computers directly in a classroom will maximize the availability of usage. Papert (as cited in Davis & Shade, 1994) further argues that "in the computer lab, students have access to about 1/50th of a computer in school, far from the critical level needed for this technology to have a major impact on educational practices or learning experiences of children." (p. 1). Watson (1990) observes that computers in classrooms are a more "easily managed resource" (p. 34). As a result, computers are more accessible to students during instruction and promote more interactive kinds of teaching (Junaid, 1996).

A second argument supporting classroom computers is the idea that placing computers directly in the classroom facilitates instruction with them. Salomon (1990) believes that isolated computer labs are ineffective because the separation may reduce integration of computers in basic learning activities in the classroom. "One acquires computer skills…not for the sake of mastering them, but for the sake of doing something worthwhile with them" (p. 51). Computer labs are often configured in a single room where children come once a week to receive special instruction in computer skills (Davis & Shade, 1994, p. 1). As a result, they function as a "timetable fixed resource" (Watson, 1990, p. 34), thereby impeding integration efforts. Other recent authors (Kulik 1994; Butzin 2001; Mann, Shakeshaft, Becker, & Kottkamp, 1999) also support the placement of computers in classrooms where their easy access and integrated use will make a greater impact on student learning.

Such an approach has led some (e.g., Fowler, 1990) to advocate a consultant role for the computer lab instructor. Teachers' increased computer literacy is considered imperative if technology is to become a vehicle in educational reform (Plotnick, 1995). Consequently, more should be done to educate classroom teachers in computer use and technology integration.

A minority of writers currently sees computer labs as beneficial to classroom instruction. Federico (1995), for example, has pointed to the need for computer labs to supplement instruction through (a) increased time in using computers for vicarious development of skills; (b) supporting students who may benefit from more individualized help; and (c) as a way to decrease school truancy. At the same time, there is a need for determining the most effective uses of computer labs

Despite the advocacy for using computers in the classroom over the existence of computer labs, there is a paucity of empirical evidence supporting one approach over the other. One important area that needs to be addressed is whether there is a difference in the development of computer skill competency between these two settings.

This study was conducted to examine the impact of two computer settings—computer labs and computers placed in classrooms—on the computer competency skills of sixth grade elementary students. Such information will be of use to educators examining the efficacy of current settings employed by schools.

Method

Students (N = 53) in two sixth grade classrooms from a small semi-rural school in south central Idaho were assigned to computer skill instruction under two conditions: a computer lab setting and an integrated instruction approach in a classroom with four computers. Both settings included Pentium class computers with Internet access through a school district local area network. Pre and posttest data were collected using a 24-item criterion-referenced performance-based test derived from district curriculum guides and a 37-item student attitude survey based on previously validated student attitude instruments (Davidson & Ritchie, 1994)

Teacher Variables

The two teachers in this study were chosen for their similarities in training and experience in both experimental settings. Both teachers had equal or similarly high experience with competencies taught during the study: word processing, file management and computer navigation, and telecommunications software. Both teachers had over two years experience integrating computers into the core curriculum.

Student Population

Students came from two existing sixth grade classrooms. Both sets of students were of mixed ability in academic achievement and computer proficiency. Table 1 gives student demographics for the computer lab instruction group ($N = 27$) and the classroom integration group ($N = 26$).

Table 1

Student Demographics

	Gender		Socio-Economic Status			Race/ Ethnicity		Academic Achievement	
	Male	Female	MI	FRL	T1	H	W	Reg. Ed.	Sp. Ed.
Classroom Integration group	15	11	0	9	5	5	21	23	3
Percent	58	42	0	15	39	19	81	88	12
Computer Lab group	14	13	0	16	8	7	20	24	3
Percent	52	48	0	59	30	26	74	89	11

FRL = Free/Reduced Lunch Program
T1 = Title I
MI = Migrant Status
W = Caucasian/ White
H = Hispanic/ Mexican-American
Reg. Ed. = Number of students not identified for Special Education services
Sp. Ed. = Number of students identified for Special Education services

Classroom Settings

The computer lab (hereafter referred to as LAB) group used the school's existing computer lab, which consisted of 25 multimedia personal computers. The classroom integration (hereafter referred to as) group used a four-computer bank of the same type as in the LAB condition. The LAB group worked in two one-hour blocks per week for eight weeks. The CI group was provided access to their computers at various times throughout the day for eight weeks.

Instrumentation and Evaluation

A performance-based assessment adapted from a test developed by the National Study of School Evaluation (Fitzpatrick and Pershing, 1996, p. 106-110) and based on the National Educational Technology Standards for Students (ISTE, 1998) was used for both pre and posttests. Items were chosen to comply with the school district technology curriculum in the areas of word processing, file management, and Internet use. To facilitate the length of time taken to conduct a performance-based assessment, both classrooms used the computer lab to administer the test. In this way, all pre and posttests were administered in approximately the same amount of time and under the same conditions.

The assessment required students to take a written test and produce a sample word-processing document on a disk. Each student was given a copy of the assessment, an assessment disk, and a blank disk. The skills for each area tested are outlined in Table 2.

Table 2

Test Components of Pre and Posttest for Computer Competency

File Management	create a folder and name it; make a copy of the assessment disk on their blank disk; delete the folder from the hard drive; vocabulary
Word Processing	launch MS Works; open a file; edit and revise the document using spell check; delete; cut; copy; paste; type over; insert a table and clipart; save to floppy disk; and proofread; print; identify tool bar icons
Internet	open browser (Internet Explorer); type in address; print; capture and save a graphic and save to floppy disk; choose and use a search engine; conduct search on Toothpaste; print one page of search; vocabulary

Students were also asked to complete an attitude survey. The 37-item questionnaire used a five-point Likert scale and was derived from previously validated attitude surveys drawn from the literature (Davidson & Ritchie, 1994). Item responses were subjected to a factor analysis on the pretest and subsequent analyses of the survey were based on the factor groups derived. These results are presented later. Both tests were hand scored and an initial baseline was established.

Instructional Procedures

Instructional content and delivery time were matched across conditions. The only intended differences between the experimental groups were (a) computer skill instruction in a computer lab or in the classroom, and (b) different access to computers based on the individual setting for setting validity.

In the CI setting, skills that would support an assignment related to the core curriculum in other subject areas were targeted first. The teacher used direct instruction techniques to define the skills and model them on the chalkboard in a whole class setting. Instruction took approximately 15-20 minutes a week. Once whole class instruction was complete, groups of four students each were allowed to begin rotating through the four-computer set to complete the assignment. Because the class consisted of 26 students, this process took an entire week. To monitor time use, the teacher attached a chart to each workstation for students to record their time on the computer.

The class was given approximately 20 minutes on the day of instruction to work on assignments. Students were also allowed access to the four computers during the day as they completed other subject assignments. For example, open computer time was available on Mondays during spelling class for approximately 30 minutes and another 40 minutes on Thursdays during writing time. Students also had access to the computers 40 minutes a day at the end of each day to work on their projects. Adding instructional time, specific class time and open access times (310 minutes) and dividing by the total number of students and computers (26/4 = 6.5), individual students had access to the computers for approximately 48 minutes per week.

In the LAB setting, students attended lab sessions with the teacher twice a week in one-hour periods. The first 15 to 20 minutes of the week would be spent on computer skill instruction. The students would then practice while completing an integrated assignment. After students completed each lesson, they printed out their results. Then, students were free to explore activities on the computer within teacher-set guidelines. During this time, the teacher would provide review lessons for students having difficulty with skills.

Upon completion of the eight-week period, the teachers used the computer lab to administer the posttest computer competency test (identical to the pretest). The same student attitude survey during pre-testing was also administered as a posttest.

Results

Because of student attrition (absence, illness, or moving from the area) during testing, 43 of 53 student pre and posttests were used in analysis ($n_{LAB} = 19$, $n_{CI} = 24$). Higher pretest scores were recorded for the LAB setting ($\overline{X}_{LAB} = 9.0$, $\overline{X}_{CI} = 2.0$, $p < .01$). These scores may be explained by the fact that students in the LAB setting had been to the computer lab twice before the study began. This gave them experience that the students in the CI group did not have. Therefore, to account for these differences, data were analyzed using analysis of covariance (ANCOVA) between groups. The pretest was used as a covariate in comparing the posttest scores.

Factor analysis was conducted on student attitude surveys to determine unique characteristics of item responses. Analysis of variance (ANOVA) was conducted on the factor-analyzed survey data to compare student attitude responses.

Pre and Posttest Results

Tables 3 and 4 present descriptive statistics of pre and posttest scores on both the performance-based test (Table 3) and the written test (Table 4). A significant difference was found favoring scores by students in the LAB group on both pre ($F_{1, 40} = 23.8$, $R^2 = .36$, $p < .0001$) and posttest scores ($F_{1, 40} = 47$, $R^2 = .56$, $p < .0001$). Table 5 summarizes

ANCOVA results of this analysis. Students using the computer lab scored over 12 points (20%) higher on the posttest compared with students in the classroom.

Table 3

Descriptive Statistics of Pretest and Posttest Mean Scores of Performance-Based Computer Skills Test

	CLASS	Mean	Std. Deviation	N
Pretest	LAB[a]	9.0	6.0	19
	CI[a]	2.0	3.5	24
	Total	5.0	6.0	43
Posttest	LAB[a]	30.0	4.0	19
	CI[a]	18.0	7.0	24
	Total	23.0	8.0	43

[a]LAB = Use of a computer lab. [a]CI = A 4-computer set within the classroom

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Table 4

Descriptive Statistics of Pretest and Posttest Computer Competency Scores

	CLASS	Mean	Std. Deviation	N
Pretest Percent Correct	LAB	18.5	12.2	19
	CI	4.1	7.0	24
	Total	10.5	12.0	43
Posttest Percent Correct	LAB	59.8	8.6	19
	CI	35.3	13.6	24
	Total	46.1	16.8	43

Table 5

Tests of Between-Subjects Effects of Class Condition on Posttest Scores

Dependent Variable: Posttest scores

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Squared
Corrected Model	1711.431	2	855.716	26.984	.0001	.574
Intercept	8318.432	1	8318.432	262.313	.0001	.868
Pretest	114.939	1	114.939	3.624	.064	.083
CLASS	639.315	1	639.315	20.160	.0001	.335
Error	1268.476	40	31.712			

Total	25819.000	43
Corrected Total	2979.907	42

R Squared = .574 (Adjusted R Squared = .553)

Analysis and Results of Student Attitude Surveys

Factor analysis of pretest responses in the student attitude survey revealed three stable factors: perception of increased learning through computers (Learning), perception of enjoyment in the use of computers (Enjoy), and perceived fear of computers (Fear). Loadings for these three factors were found highly reliable using Cronbach's alpha (r_{xx} = .82, .88, and .90 for Fear, Enjoy, and Learning respectively).

No significant differences were found between the groups as a whole or between girls and boys across conditions. Results indicate students had a low perceptual fear of computers, a moderate perception that computers help to increase learning and a high perception of enjoyment in the use of computers under either condition.

Discussion

Analysis of performance-based assessment on computer competency indicates a significant main effect favoring the computer lab setting. This effect may be due to superior efficiency of the LAB setting to provide longer and sustained academic-engaged time for learners.

An important feature distinguishing the LAB setting was that students were able to spend over double the time in using computers per student than was possible in the four-computer classroom setting. Despite the provision in the CI setting allowing students to use the computer throughout the day, this group never was able to average more than approximately 48 minutes of computer time per student weekly. Students in the LAB setting were scheduled regularly for two 1-hour blocks.

This difference in time use was, at the outset, not intended. Both teachers made plans to provide equal amounts of time for computer skill development. However, because of the logistical constraints involved in ensuring equal access to all students with only four available computers, there simply was not enough time in the week for those in the CI setting to match the LAB setting. To match the amount of time provided in the lab, students in the CI setting would have had to forego inordinately more instruction in their curriculum thereby producing even more inequality between the groups. The teachers were, thus, placed in a logistical paradox untenable for providing a "fair" examination of the two settings.

Teacher Reports of Experimental Conditions

Table 6 presents teacher reports (based on individual observation and assessments) comparing general conditions in their classrooms during the eight-week period. Their descriptions illuminate the "logjam" created by trying to serve 26 students with only four computers and how this logjam was avoided by the scheduled use of a computer lab large enough to accommodate individual use per student. Therefore, the significant difference in computer skill scores favoring the LAB setting may best be attributed to that setting's capacity to promote increased and sustained time of computer use per individual.

Table 6

Teacher Reports of Student Activity during Study

Computer Lab	Classroom Computers
24 computers for 24 students, 2 hours each week = 2 hours access per week per student	4 computers for 27 students, average of 48 minutes per week per student
All students participated in the computer exercises at the same time.	Four students practiced at the computers at a time.
Students were focused and engaged during computer work time.	Students were focused and engaged during computer work time.
All students had access to the same software and hardware	All students had access to the same software and hardware
All students used the same amount of practice time at the computers.	More proficient students monopolized the computer time. Less proficient students avoided the computers.
All students practiced immediately after instruction	Time delay between instruction and practice for most students.
All given same instruction at the same time.	All given same instruction at the same time.
Teacher presented smaller chunks of work at a time. Teacher gave step-by-step instruction and distributed practice.	Teacher gave longer blocks of instruction with larger pieces of work for students to complete. Mass practice.
Teacher's help was spread over entire class during a period.	Teacher was able to individualize follow-up help and work one-on-one.
All students exhibited positive attitudes toward both instructional and free exploration computer times.	Students had mixed attitudes toward computer work. All students enjoyed free exploration on the computers. Only proficient students looked forward to computer skill assignments.

An important aspect reflected in the data was the greater variability among test scores of students in the four-computer setting ($\overline{X}_{\text{CI}}$ = 18.0, *SD* = 7) and the relative uniformity of scores among students in the LAB setting ($\overline{X}_{\text{LAB}}$ = 30, *SD* = 4). The teacher in the CI setting reported that student use of computer time tended to vary according to differences in general motivation and academic ability: those who were highly motivated found time to use the computers and learn skills. Their scores were often at a rate equal to those in the computer lab. However, less motivated students scored much lower and tended to spend less time on the computer. Although students had equal access to computers, a self-selection process operated which allowed low-skilled students to avoid computer practice time perpetuating their lower performances.

A second factor contributing to lower scores for CI group students may have been the time lapse from delivery of skill lessons to the time students were able to apply these skills at the computer. Only four students, because of the logistical difficulties of the four-computer setting, were able to practice skills modeled immediately.

Finally, a third reported factor indicated that CI classroom distractions might also have contributed to poor student performance. Students working at the computers in the classroom had to contend with noise and stimulation from other daily business that continued in the classroom.

Students in the LAB setting did not have to deal with these issues because the focus of class time for all students was directly on building computer skills. These students had immediate access to computer practice time once skill instruction was complete. They also had the opportunity for mini lessons when the teacher noticed more than one student having difficulty with a specific skill.

Limitation of the Study

A better examination of the two conditions would have been to equalize computer time per student in the CI setting to match the time per student in the LAB setting. Equalizing time would increase the internal validity of the study. However, by doing so, external validity—namely, generalizability—of these findings, would be decreased. Because of the limited number of classroom computers, for each student to have an additional hour of computer practice time, teachers would have to allocate four more hours of class time to computer free-use time per week. In a classroom primarily based upon whole-group instruction, this would significantly cut into instructional time for the regular curriculum. It is unlikely that teachers responsible for a full complement of academic curricula would want to add significantly more time to computer skill instruction if such skill could be taught more efficiently in a lab setting.

Implications for Future Research

Findings of this study indicate that the impact of current classroom integration perspectives supporting preferential use of computers in a classroom over development and maintenance of computer lab settings may be impractical for the early development of basic computer skills competency. Studies examining the impact of computer technology on learning need to account for such variables as competency-building requirements in the use of technology and how such variables may affect outcomes.

The question of whether students using a classroom computer set, given adequate time, will achieve similar or better results on computer skills achievement as students learning in a computer lab remains in need of further study. Such a study would provide information for schools where smaller numbers of computers may be available and the decision as to how to allocate computer equipment is consequently more acute. Additional studies should be conducted also to examine these settings with more equal treatment in pretest matching of students and of computer time use (to the best degree possible given the natural conditions of the classroom).

Conclusions

The results of this study do not contradict current research on the impact of computer technology in promoting academic achievement. Nor do these findings negate the importance of integration of technology into the curriculum. Both groups of students were provided instruction in skills necessary for using technology in academic tasks. What these results do seem to indicate is that computer lab settings may be more efficient in building essential skills necessary for such integration to take place effectively.

Students in the sixth grade appear to benefit from learning basic computer skills in a computer lab setting. The immediate access to computers to practice skills necessary for use in core area assignments more efficiently increased skill attainment for students in the computer lab. Schools with limited technology budgets should consider the skill proficiencies of their students in weighing the relative benefits of small computer banks within single classrooms or the maintenance of a computer lab. Of fundamental importance in such decisions is assurance that all students have access to appropriate and efficient instruction in the skills needed for making appropriate use of technology in the curriculum.

Notes

This investigation is part of a set of technology evaluation studies supported by subcontract with the Jerome School District as part of federal Goals 2000 Grant #84.276. The authors would like to acknowledge Sandra Thompson, Curriculum Coordinator, and Connie Pepper, Technology Coordinator, for their assistance in this study. Acknowledgement is also given to Leo Yacinsky of Boise State University who helped in data entry and analysis for this study.

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