The Relationship Between Computer Literacy and Education: An Empirical Assessment

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ABSTRACT: *Computer literacy is crucial to survival in today's world of rapidly increasing advances in information technology. Society is increasingly exposed to a wider variety of computer applications, beginning as early as elementary school in many cases. The purpose of this study is to assess the effect of exposure to computers on computer literacy. Sources of exposure examined include high school, home, work, and college.*

Students in an introductory computer course were given a survey to assess their perceptions of their own literacy. Responses were examined for differences due to such factors as breadth of computer exposure, years of computer experience, and sources of computer exposure. Findings indicate that basic computer skills are affected by breadth of experience and where experience is gained, whereas advanced skills are affected by breadth and years of experience. Home use has more effect on basic skills than do formal education sources, yet neither seem to increase advanced skills.

KEYWORDS: *Computer Literacy, DPMA IS'90 Model, Computer Experience*

INTRODUCTION

College is no longer the first place that students encounter computers: many begin using them in high school, and an increasing number begin in grade school and at home. Although computer usage in secondary education has been encouraged since the 1970s, [1] it was the advent of the microcomputer in the 1980s that gave rise to the number of schools that could integrate technology in the classroom. This integration has been steadily fueled by the decreasing cost and the increasing user friendliness of computer technology. Many aspects of secondary education are moving into entirely new realms through such technologies as multimedia and hypertext that did not exist ten years ago.[2] According to one survey, 85% of school libraries are likely to be using CD-ROM by 1995, compared to 25% in 1987.[2]. Furthermore, many states have taken the initiative to form partnerships with industry, higher education, and federal agencies to improve the integration of technology into their educational systems.[3] It was estimated that in 1982, the ratio of students to computers in the secondary education system was 125 to 1; that ratio is approximately 12 to 1 today.[1]

Further evidence of the growth in computer use prior to entering college is the number of students who report such exposure. In a 1991 survey of 213 undergraduates at a university in the Southeast U.S., approximately 33% reported having used a computer for more than four years,[4] compared to 48% in similar survey in 1993.[5] Because most undergraduate students finish school in four or five years, those who have used a computer five years or longer may have begun to use a computer prior to entering college.

It is likely that college students in an introductory college-level information systems (IS) course have more prior knowledge about computers today than they would have had just a few years ago. However, exposure to computers does not necessarily increase computer literacy. One survey found that the average college freshman did not understand many basic aspects of computing.[6] Furthermore, even students who reported moderate to medium exposure to computers throughout their high school and college careers scored less than 50% on a computer literacy exam.[7] Has computer literacy increased in the last few years since these surveys were conducted? If so, higher education's approach to teaching basic computing concepts should reflect the increasing computer literacy of its students. The purpose of this paper is to examine students' levels of computer knowledge upon entry into a college level introductory IS course, and to examine whether greater exposure to computers improves literacy.

COLLEGE LEVEL INTRODUCTORY IS COURSE

Most colleges require students to take at least one course that covers basic computer concepts — often referred to as a computer literacy course. The American Assembly of Collegiate Schools of Business (AACSB) requires schools of business to incorporate basic computer concepts into their curriculum in order to be accredited. Although this requirement could be met through courses offered outside the school of business (e.g., in computer science) or by incorporating computer concepts into a variety of courses, schools often choose to offer a course that is oriented specifically toward business applications — regardless of whether that school offers other IS courses.

Because it is required for all business students, the computer literacy course generally has relatively high enrollment and consumes a significant proportion of resources (e.g., FTE hours, teaching assistants). However, this component of the IS curriculum is often ignored. Research and discussion about IS courses/curriculum focus largely on course content appropriate for IS majors.[8,9] Although it could be argued that the curriculum for IS majors is the first responsibility of IS educators, it can also be argued that ignoring the introductory service course is a disservice to non-majors and to the business world in general.

The DPMA (Data Processing Management Association) IS'90 model suggests that the fundamental concepts of information and computer technology should cover "the use of a PC with current end user software to solve problems within an organizational environment".[10, p. 16] The goals are to provide a "broad foundation for students in information and computing technology...".[10, p. 16] Upon completing study of this topic, students should, according to DPMA, be able to describe hardware and software components of a computer system; use an operating system and its utilities; use some types of applications software; and be able to identify PC applications. Note, however, that in the DPMA model, this topic is not completely addressed in a single course! Instead, learning is an incremental, progressive process over several courses.

Knowledge of these fundamental concepts is both important and appropriate: however, at what level should these concepts be taught? One model of learning suggests that there are several progressive levels or stages of the learning process ranging from general knowledge of a topic to the ability to analyze, synthesize, and evaluate relevant issues.[11] DPMA IS'90 modifies Bloom's model to include six levels of depth of understanding for students in IS courses: no assumed knowledge, awareness, literacy, concept, detailed understanding, and skilled use.[10]

In the DPMA model, students are assumed to have no knowledge of any of the fundamental topics prior to entering the course in which the topics are taught: they are expected to have attained literacy upon exit from most of the topics (e.g., auxiliary storage, hardware, operating system utilities) and to have attained awareness for a few more advanced topics (e.g., hypermedia, local area networks, 4GLs). Awareness is defined to be introductory recall and recognition, and includes the ability to define, list characteristics of, name components of, diagram, list advantages/disadvantages of, and classify topics. Literacy is defined as the knowledge of framework and contents, and includes the ability to compare/contrast concepts, execute and write simple applications, and describe the interrelation of a given factor to other factors in the same context. Given the increased exposure to computers in secondary education, perhaps the assumption of no prior knowledge is no longer valid. Many students may enter college at the awareness level, and a few may be at the literacy level.

Computer literacy is thought to be affected, not only by years of computer use, but also by the variety of applications to which a student is exposed.[7] Thus, the following general hypotheses are tested:

H1: Students who have used computers prior to entering the introductory course are more computer literate than students who have not.

H2: Students who have been exposed to a variety of computer applications are more computer literate than students who have been exposed to fewer applications.

METHODOLOGY

A survey was administered to a convenience sample of 141 students in an introductory level IS course during the second week of class in August 1994. The questions addressed demographics (e.g., major and classification), computer exposure prior to entering the course, and students' levels of computer literacy. Prior computer exposure includes use of a computer in high school, other college classes, at work, or at home. A self-reported computer self-efficacy scale was used to measure computer literacy. It was adapted from one developed by Murphy, Coover, and Owen,[12] and was chosen because it has been demonstrated to be high in construct validity and reliability.[13] Furthermore, the questions in this scale are consistent with DPMA's IS'90 definition of awareness and literacy discussed above.

RESULTS

A profile of respondents is provided in Table 1.

Table 1: Profile of Respondents

Category	Percent of Respondents*
Major	
Accounting	2.8
Finance	2.8
Economics	1.4
Marketing	13.5
Management	5.0
Information Systems	9.9
General Business	12.1
Other (non-business majors)	52.5
Classification	
Freshman	22.3
Sophomore	39.7
Junior	22.7
Senior	10.6
Graduate Student	2.1
Years of Computer Experience	
No more than 1	47.5
>1 and <=2	15.6
>2 and <=3	7.8
>3 and <=4	6.4
>4 and <=5	3.5
5 or more	15.1

* Percentages may not sum to 100% due to missing values.

Principle factor analysis was used to derive the dimensions of perceptions of computer skills. Results are consistent with results of previous studies that used this scale. As is shown in Table 2, two factors emerged: one consisting of nine indicators of basic computer skills and another consisting of eleven indicators of advanced computing skills. Names were given to the factors in accordance with those given in prior studies.[13] The factor labeled *advanced computing skills* (eigenvalue = 11.95) accounted for 79.14% of the covariance, and the factor labeled *basic computing skills* (eigenvalue = 1.66) accounted for 10.96% of the covariance.

Multivariate analysis of variance (MANOVA) was used to determine whether major and classification were significantly related to computing skills. There is no statistically significant relationship between classification and either basic or advanced computing skills (overall $F = 0.91$; $p > 0.5076$). Major is not significantly related to basic computing skills ($F = 0.80$; $p > 0.6401$), but is significantly related to advanced computing skills ($F = 2.48$; $p > 0.0203$) at the _ = 0.05 level. However, because of the small number of respondents in several of the majors, a posteriori analyses do not provide useful information about where the differences in skills lie.

It is interesting to note that classification does not affect computing skills; particularly in light of the supposition that students use computers throughout their college careers. These results indicate that seniors have about the same level of computer skills as freshmen.

Multiple regression was used to test the hypotheses that years of experience and breadth of experience affect computer skills. One regression analysis was performed to examine the relationship between the two experience variables and *basic computing skills* and another was performed to examine the relationship between the experience variables and *advanced computing skills*. Years was measured by asking students to indicate the number of years they had been using a computer. Breadth of experience was measured by asking respondents to indicate their experience with various types of software (e.g., word processing packages, spreadsheets, programming, CD-ROM). Responses were averaged to arrive at a measure of overall breadth of experience. Results of each regression are provided in Table 3.

Years of experience has no effect on basic computing skills, but is significantly related to advanced skills at the $\alpha = 0.05$ level. Because basic skills are likely gained early in the user's experience, years has no effect: a person who has used a computer four years has no better basic skills (e.g., moving the cursor around the screen, printing, saving) than one who has been using the computer for only one year. However, the longer a person has been using a computer, the greater the opportunity he/she has had to gain advanced skills (e.g., using advanced features of packages, troubleshooting a variety of problems).

Breadth of experience affects both advanced and basic skill levels. This is not surprising, because of both the similarities and the differences in knowledge required by different packages. Basic skills (e.g., saving, printing, calling up files) are reinforced when subjects use a variety of software packages. Thus, basic skills are greater for those who have greater breadth of experience. These subjects also gain the foundation of knowledge and the confidence needed to acquire more advanced skills (e.g., determining why a program won't run; explaining hardware terminology). The more opportunities a person has to apply skills, the better those skills become.

Finally, we examined the effect of where skills are gained. Subjects were asked whether the majority of their exposure to computers was in high school, in college, at home, or at work. Results of an analysis of variance indicates that where students gain their skills is significantly related to basic computing skills ($F = 2.54$, $p > 0.0599$) at the $\alpha = 0.10$ level. *A posteriori* analysis using Scheffe's test for difference in means, indicates that students whose primary computer exposure is at home have better basic skills than those whose primary exposure is in high school. Other locations are not significantly different.

Table 2: Factor Analysis Results

Dimension (Cronbach's alpha) Variable	Factor Score
Basic Computer Skills (.95)	
Working on a PC	.84006
Calling up a file to view on a screen	.81399
Using the computer to write a letter/essay	.79109
Saving data	.75223
Printing	.73334
Storing software	.72927
Using a floppy disk	.72456
Deleting files	.71088
Moving the cursor around the screen	.68857
Advanced Computer Skills (.95)	
Learning advanced skills in a package/program	.80185
Working with numeric data	.79422
Using the computer to organize information	.79388
Explaining why software won't run	.76868
Explaining the three stages of data processing (input, processing, output)	.76776
Using a variety of programs/software	.75685
Troubleshooting computer problems	.70873
Understanding hardware terminology	.69981
Getting help for computer system problems	.65343
Using the user's guide when help is needed	.62261

Despite the evidence about exposure to computers that students receive in high school today, students who primarily use computers in this setting do not attain the same level of basic skills as those who use computers at home. One explanation is that people who have computers at home are more interested in using a computer or may use the computer more than others; particularly others who use a computer in a high school classroom setting because they are required to do so. Home may also provide greater opportunity for use. Although it could be argued that many use the computer at home for games, there are certainly other things students use their home computers for such as on-line services, reference guides, word processing, and using a variety of educational software. A home computer is not subject to school lab hours and demand. A person has more control over the specific software packages on their own computer than on a school computer, and has more control over applications for which those packages are used. This is consistent with the finding that breadth of exposure affects basic skills: perhaps home computers have a wider variety of applications than those in a high school. Thus, home users have better basic skills.

However, it seems that this group would also have more advanced skills, yet location of experience is not significantly related to this dimension. Thus, even those who are motivated enough to have a computer at home are limited in what they learn. This may be partially explained by the fact that basic skills can be learned relatively quickly, with less effort than advanced skills, and that basic skills may be more conducive to self-teaching than are advanced skills. Someone learning on a home computer may have little trouble learning the basics, but may not know either how to get beyond that level or what there is to learn beyond that level.

SUMMARY AND CONCLUSIONS

Findings indicate that basic computer skills are affected by breadth of computer experience and where experience is gained, whereas both years and breadth of experience affect advanced skills. Experience gained from using different applications may help reinforce what people have already learned, thereby increasing the level of knowledge. Using computers at home may provide easy access to the breadth of applications/experience necessary for this type of learning and reinforcement to occur. Although home use does nothing to in-

Table 3: Results of Multiple Regression Analysis

Dependent Variable (overall F, p)*	Independent Variable	T*	P
Basic Computer Skills (F = 23.70, p > .0001)	Years of Computer Use	1.03	.3073
	Computer Experience	5.36	.0001
Advanced Computer Skills (F = 30.99, p > .0001)	Years of Computer Use	2.35	.0205
	Computer Experience	5.29	.0001

*The overall F and p for a dependent variable indicate the overall strength of the relationship between it and the two independent variables. The T and p indicate the strength of the individual relationship between each independent variable and the dependent variable.

ncrease advanced skills, neither does exposure in school.

These findings have several implications for educators. First, educators should determine why students who have home computers are better at basic skills. Intuitively, it is because using computers at home reinforces what is learned at school — greater exposure leads to greater skills. However, if this were the entire explanation, then home computer users should also have better advanced skills; which they do not. Perhaps acquiring basic skills is a function of more than exposure — maybe home users use more interesting programs or have more relevant applications. If so, then perhaps these aspects should be incorporated more fully into the school environment.

Another implication is related to advanced skill levels. The greater the breadth of experience, the greater the advanced skills. It also seems that advanced skills are related to depth of experience; an issue not addressed in this study. Perhaps educators should examine the effect of this factor on advanced skills, and look for ways to ensure depth as well as breadth of experience.

Although this sample is from an introductory computer course, 25% have used a computer more than three years and 15.1% have used a one at least five years; thus this is not the first time many have used a computer. However, students who have used a computer longer seem to have no better skills than fairly inexperienced users. This indicates that perhaps college educators should examine the way they are using computers in their classes. Unless students are encouraged to explore advanced features of routinely used packages (e.g., word processing packages, spreadsheets), then they will not get beyond the basics, and the computer will be no more than a glorified calculator or typewriter for them. Unless students understand more than basics, they will not be prepared to function in today's information technology driven world.

REFERENCES

[1] Lidtke, D.K. and Moursund, D. 1993. "Computers in Schools: Past, Present, and How We Can Change the Future," *Communications of the ACM*, May, 36(5), p. 84-92.

[2] Berger, P. 1993. "The Best CD ROMs for High Schoolers: 29 Essential Titles," *CD-ROM Professional*, November (6:6), p. 58-70.

[3] Pea, R.D. 1993. "The Collaborative Visualization Project," *Communications of the ACM*, May, 36(5), pp. 60-63.

[4] Jones, M.C. and Arnett, K.P. 1992. "Computer viruses: An Assessment of Student Perceptions," *Journal for the Education of Business*, July/August, pp. 349-352.

[5] Jones, M.C. 1994. "Student Perceptions of Computer Viruses Revisited: A Two-Year Longitudinal Comparison," forthcoming, *Journal of Education for Business.*

[6] Pearson, R.A. and Arnett, K.P. 1989. "Evaluating the Computer Literacy of Today's College Seniors," Proceedings of the *17th Annual North American Conference of the International Business School Computer Users Group*, Hershey, PA, July, pp. 22-27.

[7] Pearson, R.A. and Arnett, K.P. 1990. "Assessing Levels of Computer Literacy: A Longitudinal Study," *Proceedings of the 18th Annual North American Conference of the International Business School Computer Users Group*, Omaha, NE, July, pp. 101-105.

[8] Nelson, R. 1991. "Educational Needs as Perceived by IS and End-User Personnel: A Survey of Knowledge and Skill Requirements," *MIS Quarterly*, December, 15(4), pp. 503-521.

[9] Trauth, E.M., Farwell, D.W., and Lee, D. 1993. "The IS Expectation Gap: Industry Expectations Versus Academic Preparation," *MIS Quarterly*, September (17:3), pp. 293-307.

[10] DPMA, 1991. *The DPMA Model Curriculum for a Four Year Undergraduate Degree*, Data Processing Management Association, Park Ridge, IL.

[11] Bloom, B.S., 1956. *The Taxonomy of Educational Objectives: Classification of Educational Goals, Handbook 1: The Cognitive Domain*, McKay Press, New York, NY.

[12] Murphy, C.A., Coover, D., and Owen, S.V. 1989. "Development and Validation of the Computer Self-Efficacy Scale," *Educational and Psychological Measurement*, 49, pp. 893-899.

[13] Harrison, A.W. and Rainer, R.K., 1992. "An Examination of the Factor Structures and Concurrent Validities for the Computer Attitude Scale, the Computer Anxiety Rating Scale, and the Computer Self-Efficacy Scale," *Educational and Psychological Measurement*, 52(3), pp. 735-745.

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