DOCUMENT RESUME

ED 462 945 IR 021 103

AUTHOR	Schaumburg, Heike
TITLE	Fostering Girls' Computer Literacy through Laptop Learning: Can Mobile Computers Help To Level Out the Gender Difference?
PUB DATE	2001-06-00
NOTE	10p.; In: Building on the Future. NECC 2001: National Educational Computing Conference Proceedings (22nd, Chicago, IL, June 25-27, 2001); see IR 021 087.
AVAILABLE FROM	For full text: http://confreg.uoregon.edu/necc2001/program/.
PUB TYPE	Reports - Research (143) -- Speeches/Meeting Papers (150)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Comparative Analysis; *Computer Literacy; Computer Uses in Education; Foreign Countries; Grade 9; High Schools; Internet; *Sex Differences
IDENTIFIERS	Confidence; Germany; *Laptop Computers

ABSTRACT

The goal of this study was to find out if the difference between boys and girls in computer literacy can be leveled out in a laptop program where each student has his/her own mobile computer to work with at home and at school. Ninth grade students (n=113) from laptop and non-laptop classes in a German high school were tested for their computer knowledge and computer confidence. A computer literacy test was developed that included the following scales: (1) confidence in using computers; (2) confidence in using the Internet; (3) computers as a tool or toy; (4) knowledge in hardware and operating system; (5) knowledge in common office applications and presentation software; (6) knowledge in using the World Wide Web for search tasks and in using e-mail; and (7) knowledge in basic security issues. Students from laptop classes outperformed students from non-laptop classes in computer knowledge, while there was no difference in computer confidence. In comparison to the non-laptop classes, the gender gap in computer knowledge was much smaller in the laptop classes. In computer confidence, no harmonizing effect of the laptops was found. (Contains 15 references.) (MES)

Fostering Girls' Computer Literacy through Laptop Learning: Can Mobile Computers Help to Level Out the Gender Difference?

By: Heike Schaumburg

Fostering Girls' Computer Literacy through Laptop Learning: Can Mobile Computers Help to Level Out the Gender Difference?

Heike Schaumburg
Freie Universität Berlin, Center for Media Research
Malteser Str. 74-100
Berlin, Germany 12249
heike@cmr.fu-berlin.de

Abstract

One of the goals of introducing computers to the classroom is to support students who are more reluctant to the use of technology or who do not have a computer at home in acquiring computer literacy. Studies have shown that these students are often girls. The goal of the present study is to find out if the difference between boys and girls in computer literacy can be leveled out in a laptop program where each student has his/her own mobile computer to work with at home and at school. 113 students from laptop and non-laptop classes were tested for their computer knowledge and computer confidence. Students from laptop classes outperformed students from non-laptop classes in computer knowledge while there was no difference in computer confidence. In comparison to the non-laptop classes, the gender gap in computer knowledge was much smaller in the laptop classes. In computer confidence, no harmonizing effect of the laptops was found.

Theoretical framework

Traditionally, girls tend to be less interested in computers, use them less often in their spare time and have a more negative attitude toward computers (Bannert & Arbinger, 1996; Brosnan, 1998; Metz-Goeckel et al., 1991; Okebukola, 1993; Shashaani, 1994). Consequently, they are often less computer literate then boys. The introduction of computers to the classroom is meant to help especially these disadvantaged students to become more computer literate. However, it has been observed that computer projects, particularly those where students share a computer, can easily be counterproductive: Students, who already know more about computers tend to dominate teams (at least technology-wise) when computers are used for collaborative work, while the non computer literate, i. e. mostly the girls, become mere observers (Kauermann–Walter & Metz–Goeckel, 1991). Thus, computer projects may benefit students with a high degree of computer literacy more than those they are actually meant for (Sinhart-Pallin, 1990). If every student gets his/her own computer, which can be used flexibly in and outside of the classroom, this problem might be overcome because every student gets the chance to learn about computers individually. However, so far no data exists to support this claim.

Data sources

The development of boys' and girls' computer literacy is one of the core questions that are investigated in a laptop program, which started in March 1999. In this program, approximately 300 students and their teachers from a German high school are gradually furnished with networked laptop computers. Over the course of four years, four cohorts of seventh graders will enter the program. Currently, 220 students and their teachers have entered the program, two 9^{th} grade classes being in their third year, three 8^{th} grade classes in their second and three 7^{th} grade classes in their first year.

Method

In a review of different definitions of "computer literacy" (e. g. Higdon, 1995, Richter, Naumann & Groeben, 1999; Tully, 1996) and "Internet literacy" (Doyle, 1996, Levine & Donitsa-Schmidt, 1998; Richter et al., 1999) the following dimensions were identified as central to the construct:

1. theoretical and practical knowledge about computers (hardware, software) and the Internet (communication, information retrieval),

2. self efficacy/confidence regarding computers and the Internet

3. responsible use and critical reflection regarding computers and the Internet.

Accordingly, a computer literacy test was developed for this study. Existing questionnaires and tests for computer literacy were considered and adapted/updated for the purpose of this study (e. g. Pelgrum, Janssen Reinen & Plomp, 1993; Richter et al., 1999). The resulting test includes the following seven scales:

1. CONF_COM: Confidence in using computers: Rating scale for self-assessment of the students' subjective level of confidence in using computers (confidence)

2. CONF_INT: Confidence in using the Internet: Rating scale for self-assessment of the students' subjective level of confidence in using the WWW to find information and in using e-mail (confidence)

3. COM_TOOL: Computers as tool or toy: Rating scale to measure students attitude towards computers and the Internet (tool or toy/critical reflection)

4. HW_OS: Knowledge in hardware (PC) and operating system (Windows95/98): Test items with one right answer and three distracter alternatives (theoretical and practical knowledge)

5. OFFICE: Knowledge in common office applications and presentation software (MS Word, MS Excel, MS PowerPoint): Test items (see above, theoretical and practical knowledge)

6. INTERNET: Knowledge in using the WWW for search tasks and in using e-mail: Test items (see above, theoretical and practical knowledge)

7. SECURITY: Knowledge in basic security issues (virus protection, passwords): Test items (see above, responsible use/critical reflection)

In addition, the test included items measuring descriptive data, e. g. the students' age and gender, access and use of computers at home and at school, access and use of the Internet.

In November 2000, the test was distributed to 45 students from two laptop classes (9^{th} grade, age 14–15), who are in their third year of laptop use and to 68 9^{th} graders from the same school who do not use laptop computers but have regular access to the school's computer labs.

Results

Descriptive analyses of the sample showed that home access to computers was almost equal in both groups: all of the students in the experimental as well as in the control group reported having a computer at home. However, in the control group only 54,4% have their own computer while in the experimental group every student has his/her own laptop computer. On average the computer is used every day in the experimental group (Median = 6 (≈ daily)), while in the control group it is slightly lower (Median = 5 (≈ several times per week). Considerable differences exist in the use of computers at school. While the laptop students reported having used the computer almost daily (Median = 5), the control group students reported having used a computer only one to six times throughout the school year (Median = 1).

Before results of the computer test were analyzed, some basic test statistics and item analyses were carried out. To increase internal consistency, one item was excluded from scale COM_TOOL and OFFICE respectively. Table 1 shows the test and item statistics for the remaining items.

	M_{Scale}	SD_{Scale}	N	R	r_{it}	P	α
CONF_COM	26.55	4.76	7	7-35	.50	.76	.78
CONF_INT	25.59	4.94	7	7-35	.48	.73	.76
COM_TOOL	22,39	4,35	6	6-30	.51	.75	.75
HW_OS	3.88	1.82	6	0-6	.47	.65	.72
OFFICE	4.03	3.39	8	0-11	.62	.38	.84
INTERNET	3.02	2.33	9	0-9	.40	.39	.72
SECURITY	1.68	1.22	5	0-5	.25	.34	.46

Table 1: Test and item statistics

(M_{Scale}: scale mean, SD_{Scale}: standard deviation, N: number of items, R: range, r_{it}: mean item discrimination coefficient, P: mean discrimination power, α: standardized Cronbach's alpha)

The effect of the use of laptops on boys and girls was determined using a 2-factorial, multivariate analysis of variance (GLM) with laptop/non laptop as one factor and gender as the other factor and the seven scales of the computer test as dependent variables. To test if the homogeneity assumption for this procedure was violated, a Levene test for homogeneity of variances was carried out. For four of the seven scales, a violation of the homogeneity of variance assumption was detected (see table 2). Generally, it is assumed that the F statistic is robust against such violations (Bortz, 1995). However, in these cases, non-parametric tests were calculated to verify the main effects found.

	F	df1	df2	α
CONF_COM	.821	3	99	.485
CONF_INT	.564	3	99	.640
COM_TOOL	3.817	3	99	.012
HW_OS	8.990	3	99	.000
OFFICE	10.739	3	99	.000
INTERNET	2.918	3	99	.038
SECURITY	1.913	3	99	.132

Table 2: Levene test for homogeneity of variances

(design: Intercept+GENDER+LAPTOP+GENDER * LAPTOP)

Overall, the multivariate test (Wilks-Lambda) showed significant main effects for LAPTOP and GENDER. The interaction of LAPTOP and GENDER was not significant on the multivariate level (see table 3).

Effect	Value	F (exact)	Hypothesis df	Error df	Sig.
Intercept	,015	869,349	7	93	,000
SEX	,745	4,541	7	93	,000
LAPTOP	,276	34,800	7	93	,000
SEX * LAPTOP	,911	1,291	7	93	,263

Table 3: Multivariate tests (design: Intercept+GENDER+LAPTOP+GENDER * LAPTOP)

Gender effects

To help interpretation of the differences found, interaction plots were created (see Fig. 1 and 2). The pattern is similar for most of the scales. Girls in the control group scored consistently lower than boys on almost all of the subtests. In the laptop group, lower scores were only found for the general confidence in using computers, for the knowledge on hardware and the operating system and for the knowledge on security issues. On the COM_TOOL and the OFFICE scale girls of the experimental group scored slightly higher than boys.

To investigate the statistical significance of the descriptive differences found, between-subjects effects were calculated for each variable based on the GLM. The factor GENDER was significant for the variables CONF_COM ($F(1, 99) = 14.58$, $p = .000$) and HW_OS ($F(1, 99) = 8{,}75$, $p = .000$)[1]. Furthermore, the factor approached significance for the variables CONF_INT ($F(1, 99) = 3.09$, $p = .082$) and SECURITY ($F(1, 99) = 3.48$, $p = .065$). Thus, gender differences seem to occur particularly in the subjective confidence of boys and girls regarding the use of computers and the Internet, and regarding the rather technical areas of computer use.

[1] A Man-Whitney U-test confirmed this result.

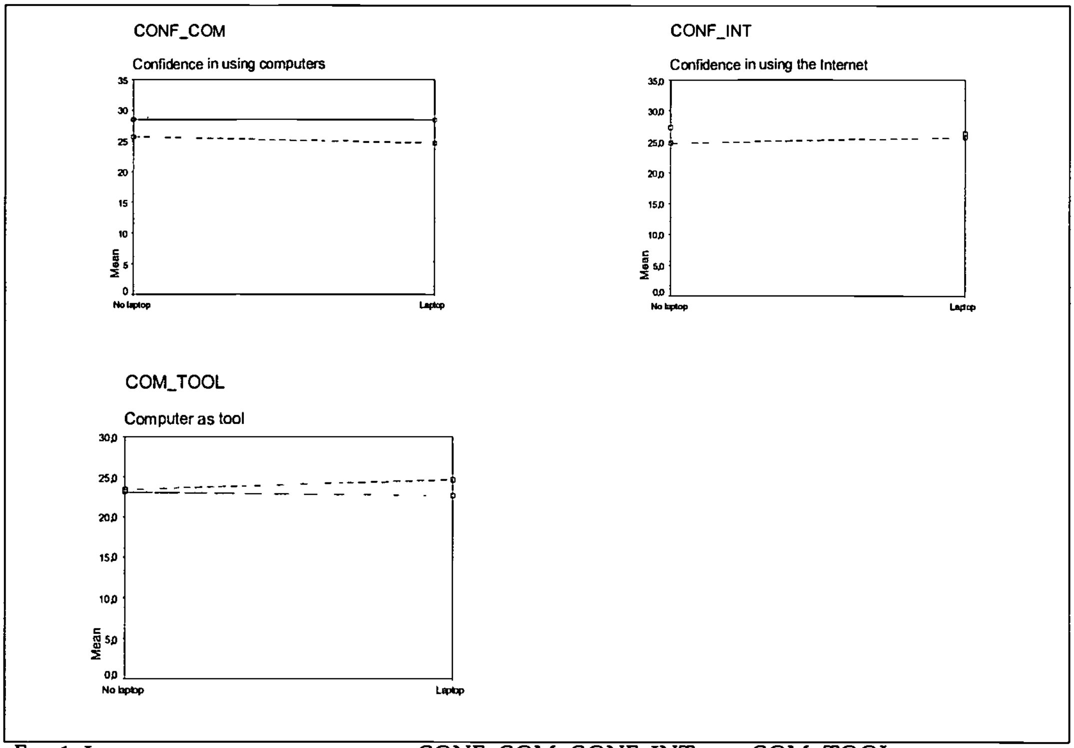

Fig. 1: Interaction plots for the variables CONF_COM, CONF_INT, and COM_TOOL

Boys ———

Girls --------

Laptop effects

As can be seen from Fig. 1 and 2, the use of laptops has only impacted the knowledge about computers (hardware and operating system, office applications and Internet) but not the subjective confidence in using computers or the Internet. Gains were particularly high for office software, which was also used most frequently in the laptop program, while only moderate knowledge was gained in the area of hardware and operating system and of the Internet. For the scale SECURITY, laptop students were found to score slightly lower than the control group students. Verification of the between-subjects effects for the factor LAPTOP showed significant effects for the variables HW_OS ($F(1, 99) = 188.03$, $p = .000$), OFFICE ($F(1, 99) = 202.27$, $p = .000$) and INTERNET ($F((1, 99) = 8.74$, $p = .004$), corroborating the pattern identified in the interaction plots[2].

[2] Man-Whitney U-tests confirmed these results.

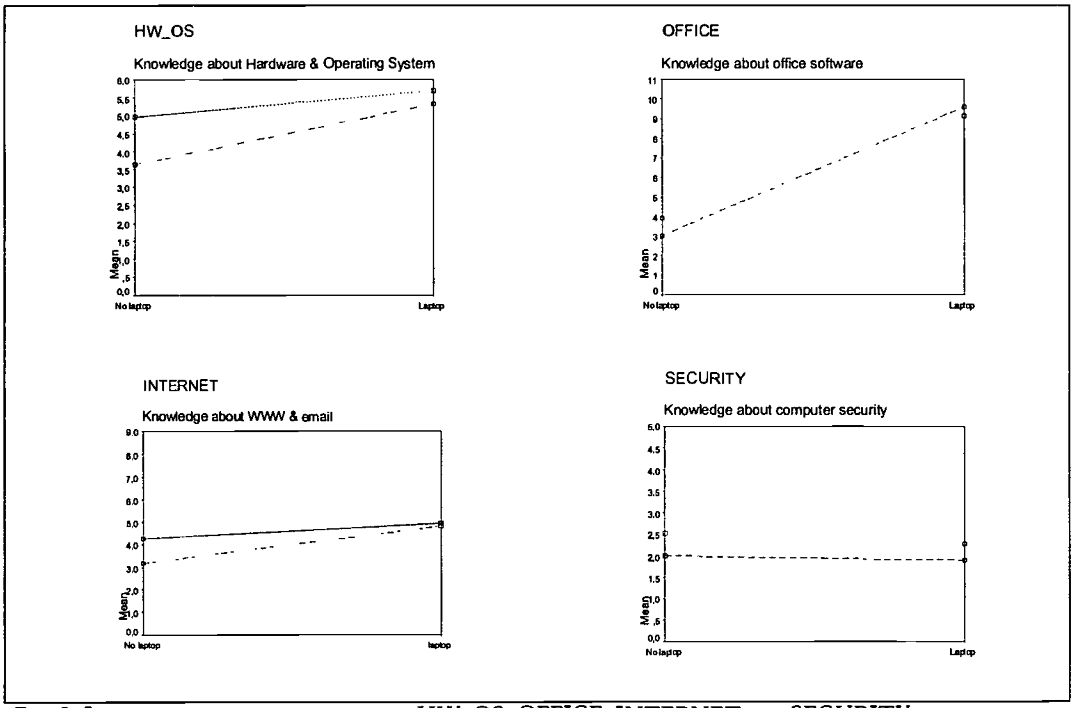

Fig. 2: Interaction plots for the variables HW_OS, OFFICE, INTERNET and SECURITY

Boys ————

Girls -------

Interaction of gender and laptop

The plots reveal some interesting interaction patterns. For three of the four scales, which measure computer knowledge, girls show a higher relative gain than boys, thus reducing the gender difference in comparison to the control group. In one case (office applications) girls of the laptop group even outperformed the boys. Among the knowledge tests, only the performance on the SECURITY subtest shows no interaction of laptop use and gender.

In contrast, the plots of the two scales that measure the students' confidence in using computers and the Internet and the computer-as-tool scale show no differential effect. Regarding computer confidence, girls score lower than boys in the control as well as in the experimental group. The scores for Internet confidence of girls and boys lie close together in both groups. Again, there is no clear effect of using laptops for either the boys or the girls. The same is true for the students' attitude toward computers as tool. Differences are rather small and difficult to interpret.

The descriptive interaction could not be definitely verified, as there were no significant interactions in the between-subjects tests. In two cases however, the interaction of GENDER and LAPTOP tended to be significant. These were the variables that also show the highest relative gains of the girls in comparison to the boys, HW_OS ($F(1, 99) = 2{,}86$, $p = .094$) and OFFICE ($F(1, 99) = 2.89$, $p = .092$).

Conclusion

Although boys and girls in this study where equipped with computers almost equally well, the results show that the participation in the laptop program had a significant effect on students' computer literacy. In particular, the project fostered their knowledge of computer hard- and software as well as their knowledge on using the Internet for information retrieval and for communication. The only knowledge subtest where no difference was found between laptop and non-laptop students was the knowledge on security issues. A likely reason for this is that security issues were not dealt with in the laptop classes, while hardware and operating system, office software and the use of the Internet (particularly for information retrieval) where explicitly covered within the subjects' curricula. The subjective confidence in using computers and the Internet was not impacted by the project however. Different explanations might account for this finding. All students (laptop and non laptop) were relatively experienced in using computers (all of them had access to a computer at home and on average used it several times per week or more often). Since many studies have shown that computer experience is directly related to computer confidence (e. g. Levine & Donitsa-Schmidt, 1998; Rosen & Maguire, 1990), the finding that computer confidence was high in both groups is not surprising. In addition, the finding might be attributed to a ceiling effect, because the mean discrimination power of both confidence scales is rather low (see tab. 1). In order to find out if participation in the laptop program can increase computer and Internet confidence of students, the discrimination power of the scale should be increased.

The effects described above were particularly true for girls. In comparison to the girls of the control group, the girls in the laptop group had considerably more knowledge of computer hard- and software and of the Internet after participating in the project. The gender gap between boys and girls in computer knowledge was much smaller in the laptop classes. On some of the subtests it disappeared entirely. Thus, it can be concluded that the ownership of an individual computer and the extensive use of the machine in the school context contributes to leveling out gender differences in computer literacy. Surprisingly, the gain in computer knowledge did not have an impact on the girls' computer confidence. The gap in computer confidence between boys and girls did not close in the laptop classes. The reason for this is not clear. While the gender difference in computer confidence is often interpreted as a lack of confidence on the part of the girls, it could also be that the boys are over-confident in their computer skills. Possibly, girls are more aware than boys of how much they do not know about computers, and thus do express less confidence in their computer skills. Another explanation might be that the prejudice that girls are less technically apt then boys, which is deeply rooted in the female role model, impacts the girls' feeling of self-confidence with computers. In this case it would be necessary to foster girls' self-confidence so that they judge their computer competence more appropriately. In any case more research is needed to find out what exactly determines self-confidence in using computers. Also, the results warrant for caution when computer literacy is measured by self-assessment only, as self-assessment scales might be systematically distorted.

References

Bannert, M. & Arbinger, R. S. (1996). Gender-related differences in exposure to and use of computers: Results of a survey of secondary school students. *European Journal of Psychology of Education, 11 (3),* 269-282.

Bortz, J. (1995). *Statistik für Sozialwissenschaftler* (4. edition). Berlin: Springer.

Brosnan, M. J. (1998). The role of psychological gender in the computer-related attitudes and attainments of primary school children (aged 6-11). *Computers and Education, 30 (3-4),* 203-208.

Doyle, C. (1996). Information literacy: status report from the United States. In D. Booker (Ed.), *Learning for life: information literacy and the autonomous learner* (p. 39-48).

Higdon, J. (1995). *The evolution of computer literacy for preservice teachers.* Retrieved from the WWW on 7/24/2000: http://www.coe.uh.edu/insite/elec_pub/html1995/092.html

Kauermann-Walter, J. & Metz-Goeckel, S. (1991). Quiet, accommodating, and cooperative, but better alone. Observations of gender differences in behavior during a computer course. *Paed extra, 19 (11)*, 43-45.

Levine, T. & Donitsa-Schmidt, S. (1998). Computer use, confidence, attitudes, and knowledge: a causal analysis. *Computers in Human Behavior, 14, 1,* 125-146.

Metz-Goeckel, S., Frohnert, S., Hahn-Mausbach,-G., Kauermann-Walter,-J. (1991). *Girls, boys, and computers. Gender-specific social and learning behavior in dealing with computers.* Series: Sozialverträgliche Technikgestaltung, Vol. 24. Opladen: Westdeutscher Verlag.

Okebukola, P. A. (1993). The gender factor in computer anxiety and interest among some Australian high school students. *Educational Research, 35 (2)*, 181-189.

Pelgrum, W.J., Janssen Reinen, I.A.M., and Plomp T. (Hrsg.). (1993). *Schools, Teachers, Students and Computers: a Cross-National Perspective.* IEA COMPED. First Report Stage II. Retrieved from the WWW on 8/15/2000: http://www.mscp.edte.utwente.nl/sitesm1/extern/comped/fr2/contents.htm

Richter, T., Naumann, J. & Groeben, N. (1999). Das Inventar zur Computerbildung (INCOBI): *Ein Instrument zur Erfassung von Computer Literacy und computerbezogenen Einstellungen bei Studierenden der Geistes und Sozialwissenschaften.* Universität zu Köln: Unpublished paper.

Rosen, L. D. & Maguire, P. (1990). Myths and realities of computerphobia: a meta analysis. *Anxiety Research, 3,* 175-191.

Sinhart-Pallin, D. (1990). Computer education: In the end, the knowledge gap is still there. Results of a study on the effects of computer usage. *Zeitschrift für Sozialisationsforschung und Erziehungssoziologie, 10 (3),* 279-286.

Shashaani, L. (1994). Gender-differences in computer experience and its influence on computer attitudes. *Journal of Educational Computing Research, 11 (4),* 347-367.

Tully, C. (1996). Informal education by computer—ways to computer knowledge. Computers & Education, 27, 1, 31-43.

About the presenter

Heike Schaumburg is currently working as an associate researcher at the Center for Media Research of the Freie Universität Berlin. She is in charge of the evaluation of the project "Notebook classes for the future", one of the first laptop projects carried out in Germany in cooperation with the Bertelsmann Foundation and Toshiba Corp. She earned a M. A. in psychology from the Freie Universität Berlin and a M. S. in Instructional Technology from Indiana University. For more information, please visit http://www.cmr.fu-berlin.de/~heike.