VI. Effects Due to Computer Exposure

Finding 2. Early initial computer exposure (grade 1) in school increases Computer Enjoyment by approximately two-thirds of a standard deviation.

Finding 3. Early computer exposure in school increases perceived Computer Importance by approximately one-half standard deviation.

> *Early exposure of 40 minutes or more per week in school boosted... perceived Computer Importance and Computer Enjoyment to a point where 8 to 12 years (based upon regression slopes) would be expected to elapse before the attitudes of computer users again match those of non-computer users (Knezek, Miyashita, & Sakamoto, 1993, p. 196).*

These findings are based upon comparisons of Japanese computer-using to non-computer-using students[5] during 1991, 1992, and 1993. Findings are consistent across all three years (Miyashita, 1991, 1994; Miyashita, Knezek, & Sakamoto, 1993; Knezek, Miyashita, & Sakamoto, 1994). Statistical and graphical representations of the results are presented in this section.

The results of analyses of variance for Japanese data for 1991, 1992, and 1993 are provided in Tables 5, 6, and 7. Six public schools in Japan were used for the analyses of 1991 first- and second-grade data: three with computers, and three without. However, two Japanese schools which did not have computers in 1991 had started to use computers in 1992. Therefore, data from the one remaining school which did not use computers and its neighbor school which did use computers, were included in the 1992 analysis involving students in grades 1-3. These same two schools were also used for the 1993 analysis based upon data from students in grades 1-4.

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[5] Increases for Importance and Enjoyment were calculated for each of three years, then averaged to produce the values reported in Findings 2-3. For example, the increase in Computer Importance (effect size) for 1991 is calculated from Table 5 as [Mean(with computers) - Mean(without)]/Standard Deviation(without), or (3.33-2.99)/.70 = .52 standard deviation increase. The range of 8-12 years is derived from the points where projected lines for Japan with versus without computers cross; see Figures 5-6 for equations.

Table 5.
1991 Analysis of Variance Results for Japanese Schools with and without Computers: Univariate F-tests with (1, 599) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig.of F
Imp.	14.21416	225.15764	14.21416	.37589	37.81475	.000
Joy	16.24652	198.62163	16.24652	.33159	48.99599	.000
Mot.	.36970	270.03417	.36970	.45081	.82007	.366
Study	.27585	257.84238	.27585	.43045	.64084	.424
Emp.	.00432	212.55508	.00432	.35485	.01217	.912
Create	.57150	187.36147	.57150	.31279	1.82711	.177

Variable Importance

GROUP	COUNT	MEAN	STANDARD DEVIATION	STANDARD ERROR	95% CONF FOR MEAN
Grp 2 (w)	348	3.3255	.5629	.0302	3.2662 TO 3.38
Grp 3 (w/o)	320	2.9902	.6982	.0390	2.9134 TO 3.07
TOTAL	668	3.1649	.6528	.0253	3.1153 TO 3.21

Variable Joy

GROUP	COUNT	MEAN	STANDARD DEVIATION	STANDARD ERROR	95% CONF FOR MEAN
Grp 2 (w)	355	3.6006	.5365	.0285	3.5446 TO 3.66
Grp 3 (w/o)	331	3.2761	.6467	.0355	3.2062 TO 3.35
TOTAL	686	3.4440	.6136	.0234	3.3980 TO 3.49

Table 6.
1992 Analysis of Variance Results for Japanese Schools with versus without Computers: Univariate F-tests with (1,308) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig.of F
Imp.	5.22880	127.94408	5.22880	.41540	12.58730	.000
Joy	13.21665	111.71870	13.21665	.36272	36.43730	.000
Mot.	.60976	114.46990	.60976	.37166	1.64066	.201
Study	.22172	127.12102	.22172	.41273	.53720	.464
Emp.	.83936	88.63160	.83936	.28776	2.91684	.089
Create	.51034	92.31137	.51034	.29971	1.70275	.193

Variable Importance

GROUP	COUNT	MEAN	STANDARD DEVIATION	STANDARD ERROR	95% CONF FOR MEAN
Grp 2 (w)	161	3.2875	.5602	.0441	3.2003 TO 3.37
Grp 3 (w/o)	162	3.0220	.7233	.0568	2.9098 TO 3.13
TOTAL	323	3.1544	.6597	.0367	3.0821 TO 3.23

Variable Joy

GROUP	COUNT	MEAN	STANDARD DEVIATION	STANDARD ERROR	95% CONF FOR MEAN
Grp 2 (w)	162	3.7062	.4230	.0332	3.6405 TO 3.77
Grp 3 (w/o)	163	3.2908	.7347	.0575	3.1772 TO 3.40
TOTAL	325	3.4978	.6341	.0352	3.4286 TO 3.57

Table 7.
1993 Analysis of Variance Results for Japanese Schools with versus without Computers: Univariate F-tests with (1,184) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig.of F
Mot.	2.42653	66.34593	2.42653	.36058	6.72959	.010
Study	3.10513	69.36120	3.10513	.37696	8.23722	.005
Create	.41621	51.07085	.41621	.27756	1.49955	.222

Variable Empathy By Variable SITE

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	1	.2437	.2437	.8196	.3664
WITHIN GROUPS	194	57.6804	.2973		
TOTAL	195	57.9241			

Variable Empathy

GROUP	COUNT	MEAN	STANDARD DEVIATION	STANDARD ERROR	95% CONF FOR MEAN
Grp 1	104	3.1806	.6135	.0602	3.0612 TO 3.2999
Grp 2	92	3.2512	.4559	.0475	3.1568 TO 3.3456
TOTAL	196	3.2137	.5450	.0389	3.1369 TO 3.2905

Variable Importance By Variable SITE

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	1	4.9884	4.9884	13.6816	.0003
WITHIN GROUPS	195	71.0988	.3646		
TOTAL	196	76.0872			

Variable Importance

GROUP	COUNT	MEAN	STANDARD DEVIATION	STANDARD ERROR	95% CONF FOR MEAN
Grp 1	104	3.3310	.5226	.0512	3.2294 TO 3.4327
Grp 2	93	3.0123	.6834	.0709	2.8715 TO 3.1530
TOTAL	197	3.1806	.6231	.0444	3.0930 TO 3.2681

Variable Joy By Variable SITE

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	1	9.7599	9.7599	41.7352	.0000
WITHIN GROUPS	191	44.6658	.2339		
TOTAL	192	54.4257			

Variable Joy

GROUP	COUNT	MEAN	STANDARD DEVIATION	STANDARD ERROR	95% CONF FOR MEAN
Grp 1	102	3.7824	.3210	.0318	3.7193 TO 3.8454
Grp 2	91	3.3319	.6170	.0647	3.2034 TO 3.4604
TOTAL	193	3.5699	.5324	.0383	3.4944 TO 3.6455

Figure 5. 1992 Mean Ratings for Computer Enjoyment

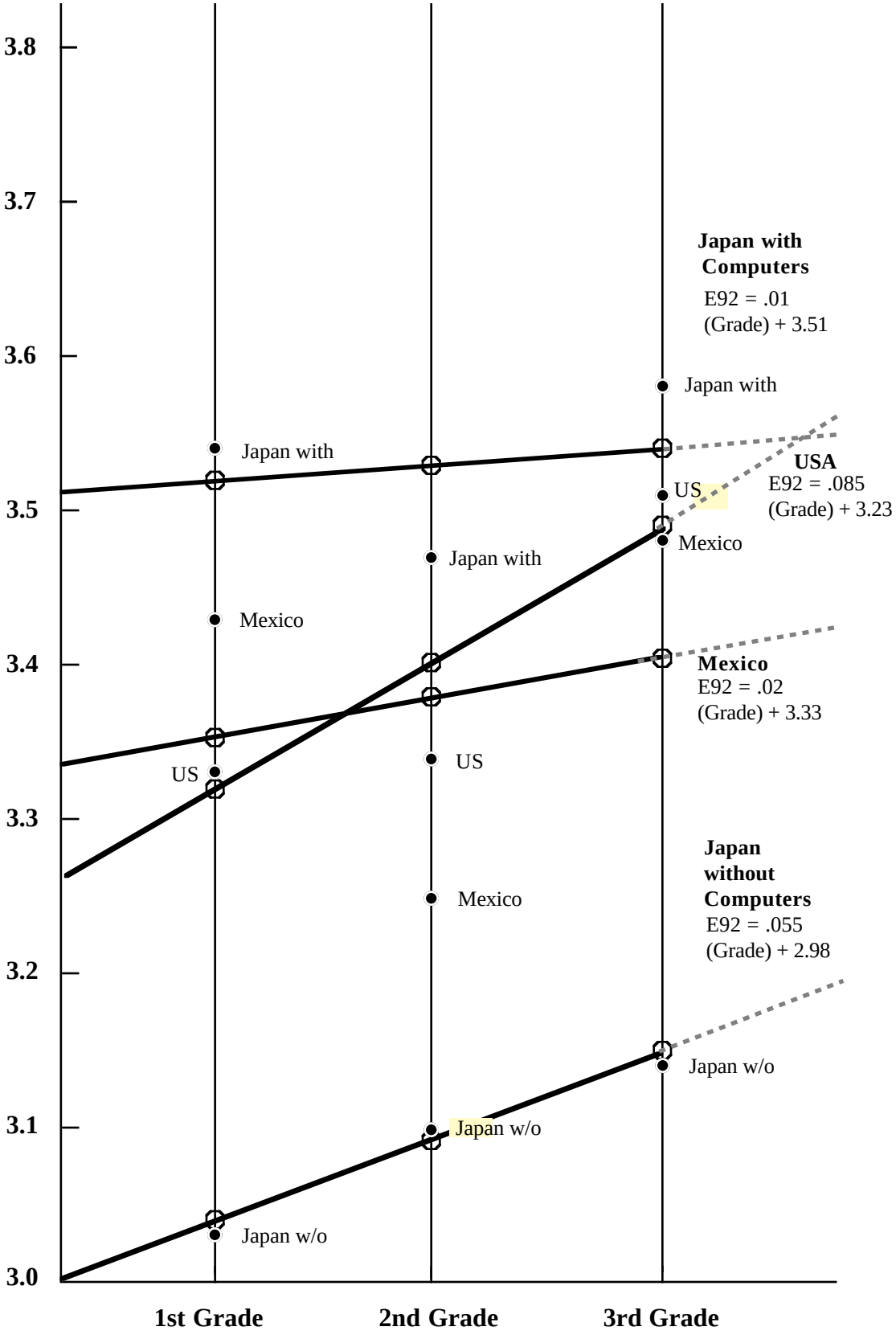
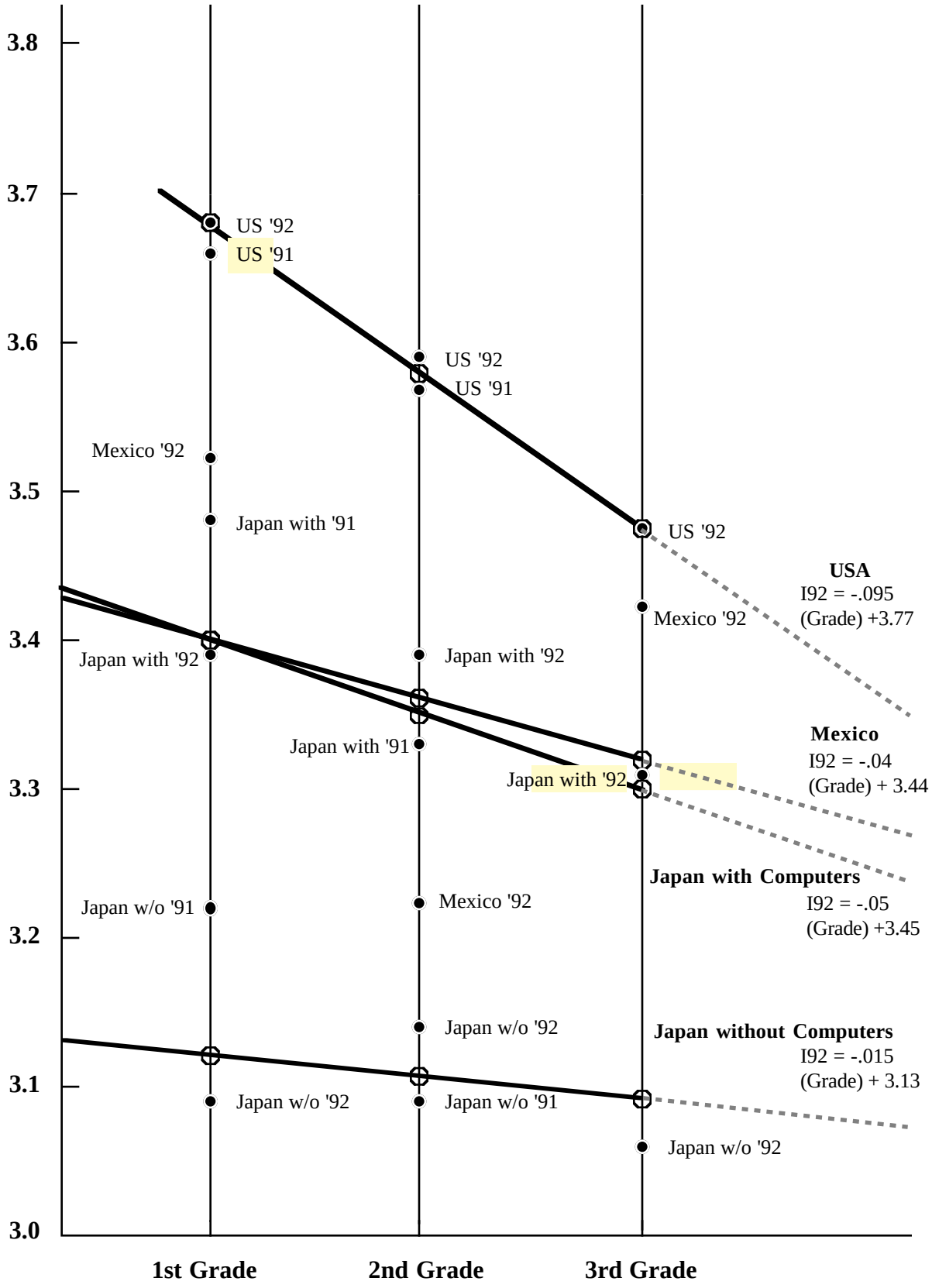


Figure 6. 1991 & 1992 Mean Ratings for Computer Importance



Previous studies have indicated that computer access can improve attitudes toward computers for students of high school and college ages (D'Souza, 1988; Justen, Adams, and Waldrop, 1988). A Soviet-U.S. study of 8-12 year old children also supported this claim (Martin, Heller, & Mahmoud, 1992). Our findings support the hypothesis that young children with computer experience in school will tend to have higher attitudes toward computers than young children without computer experience in school. Students in Japan who used computers, students in the U.S. who used computers, and students in Mexico who used computers, all rated the computer as higher in Enjoyment and Importance than did Japanese students who did not use computers (Miyashita, Knezek, & Sakamoto, 1993). These results are shown graphically in Figures 5 and 6.

Finding 4. Early computer exposure (up to four years) in school does not appear to have a negative effect on Empathy.

Finding 5. Early computer exposure (up to four years) in school does not appear to have a positive effect on Creative Tendencies.

Finding 6. Three or four years of computer exposure in primary school can have a measurable positive impact on Motivation and Study Habits.

> *... early computer exposure in school does not appear to lower student empathy, as the National Council on Educational Reform in Japan (1986, 1987) once feared might take place (Knezek, Miyashita, & Sakamoto, 1993, p. 198).*

The Software Publishers Association in the U.S. has gathered evidence to support the claim that microcomputers have the power to "... motivate students and to improve their attitudes about learning and themselves" (Bialo & Sivin, 1990). Studies by Clements and others (Clements 1987, 1991; Clements & Nastasi, 1988) have shown that Logo programming experiences can foster higher order thinking and certain forms of creativity in children. A study including 762 children grades 4-6 in Japan (Sakamoto, Zhao, & Sakamoto, 1991) found that a combination of word processing at home and programming in school was associated with higher self-reported creativity, but a more recent study (Sakamoto & Sakamoto, 1993) indicated that the causation is probably in the direction of creativity leading to increased computer use.

As shown in Tables 5 and 6, our analyses of student scores on Motivation/ Persistence, Creative Tendencies, Empathy, and Study Habits showed no consistent differences between Japanese students using computers, versus those not using computers, in the 1991 or 1992 data. (Miyashita, Knezek, & Sakamoto, 1993). However, as shown in Table 7, ANOVAs performed on the 1993 Japanese data reconfirmed that computer exposure can have a positive impact on Computer Enjoyment ($f=41.7$, 1x191df, $p<.00005$), Computer Importance ($f=13.7$, 1x195df, $p<.0003$),

Study Habits (f=8.24, 1x184df, p<.005) and Motivation/Persistence (f=6.73, 1x184df, p<.01) (Knezek, Miyashita, & Sakamoto, 1994). The positive findings for Study Habits and Motivation/Persistence were new for the 1993 survey, which also contained data for fourth-grade students (with four years of computer exposure) for the first time.

Analysis of variance for the 1993 data from Japan reconfirmed the positive impact of one year or more of computer exposure on Computer Enjoyment and Computer Importance (see Table 7). It also lends additional support to the concept that at least three or four years of exposure to computers in school is necessary before a measurable positive impact on Study Habits and Motivation/Persistence takes place. The analysis failed to confirm a positive effect of computer exposure on Creative Tendencies. This issue will be discussed in greater detail in a later section.