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ABSTRACT

This paper presents the 1992 findings of a three-nation longitudinal study of the psychological effects of computer use during primary school. Results are based on an analysis of Likert-type ratings by 3,036 students in grades 1 through 3 at 21 elementary schools in Japan (1,236 students), the United States (1,072 students plus 247 Hispanic American and 59 Japanese dependents), and Mexico (422 students). Computer access was found to raise enjoyment of computers and perceived computer importance. Computer access was not found to lower empathy. No strong influence was found on motivation, study habits, or creative tendencies; and gender differences emerged only for empathy. A novelty effect, which is a tendency for ratings to decline with increasing age over time, was confirmed for most of the dispositions measured, but none was found for computer enjoyment. An unanticipated outcome was that bilingual Hispanic students in the United States frequently reported dispositions more positive than either the students in Mexico or the native English-speaking students in the United States. Seven tables and five figures present study findings. An appendix lists the questionnaire items by strength of factor loadings. (Author/SLD)

Learner Dispositions Related to Primary School Computing in Three Nations: 1992 Results[1]

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Abstract

1992 findings are presented for a 3-nation longitudinal study of the psychological effects of computer use during primary school. Results are based upon analysis of Likert-type ratings by 3036 grade 1-3 students at 21 elementary schools in Japan, the United States of America (U.S.A.), and Mexico. Computer access was found to raise enjoyment of computers and perceived computer importance. Computer access was not found to lower empathy. No strong ($p<.01$) influence was found on motivation, study habits, or creative tendencies, and gender differences emerged only for empathy. A novelty effect, which is the tendency for ratings to decline with increasing age or over time, was confirmed for most of the dispositions measured, but none was found for computer enjoyment. An unanticipated outcome was that bilingual Hispanic students in the U.S.A. frequently reported dispositions more positive than either the students in Mexico or the native English-speaking students in the U.S.A.

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Theoretical Perspective /Framework

The childhood computing research project was conceptualized primarily as a quantitative (versus qualitative) policy study rather than a test of a psychological theory. Specifically, it began in 1990 as a Japan-U.S. collaborative effort to search for two kinds of evidence related to the use of computers in primary schools:

1. Evidence that computers can have a positive, lasting effect on learning-related dispositions such as creative tendencies, motivation, and study habits. This perspective was emphasized more strongly in the U.S., where teachers supported the early introduction of computers (Bruder, 1990) and previous research provided encouraging results (Clements 1987, Clements & Nastasi, 1988, Lehrer, & Randle 1987, Lever et al 1989), but pressure has continued to mount to document the educational effectiveness of computers in school, and

2. Evidence that computer use by primary school students does not have significant negative side effects such as loss of touch with reality or diminished concern for the welfare of fellow human beings. This perspective was emphasized more strongly in Japan, where computers were purposely not introduced into public elementary schools during most of the 1980's (Knezek, Miyashita, & Sakamoto, 1990), while both the "light and dark sides" of increased computer exposure were being contemplated (National Council on Educational Reform, 1986, 1987).

The initial research plan was to compare quantitative data on attitudes among students at schools newly equipped with computers in Japan, to attitudes at comparable Japanese schools without computers, using time-synchronized data from the U.S. as a cross-cultural control. This two-country approach was consistent with Brislin's contention that "If research hypotheses are supported in studies with very different populations, the findings can be taken more seriously than those hypotheses supported only in studies of homogeneous populations within one country" (1983, p.371). Mexico was added as a new research initiative for 1992, in keeping with Foschi's (1980) judgment that an explanatory model can be considered robust if it is supported in at least three cultures.

1992 Research Agenda

For 1992, the project focused on three goals:

1. To determine if differential changes in learner dispositions took place from 1991 to 1992 for computer users versus non-users who completed the survey both years, in the U.S.A. and Japan.

2. To develop and validate a Spanish Language version of the Young Children's Computer Inventory (YCCI), a 48-item, Likert-type instrument which measures student dispositions in the areas of attitudes toward computers, creative tendencies, empathy, study habits and motivation, and

3. To test cross-cultural generalizations of previously-formulated hypotheses regarding the relationship between computer use in school and learning dispositions, by jointly analyzing 1992 data from Mexico and Hispanic (bilingual Spanish-English) schools in the U.S. together with longitudinal data from Japan and traditional American students in the U.S., as well as new data from students attending a Saturday-only Japanese school in the U.S., and students from a bilingual Spanish-English school in Mexico.

The issues outlined in category #1 and category # 2 are summarized below and are more thoroughly addressed in separate publications (Miyashita, Knezek & Sakamoto, 1993; Knezek & Miyashita, 1993). This paper focuses on the trans-cultural issues raised in category #3.

Instrumentation

The Young Children's Computer Inventory (YCCI; Miyashita & Knezek, 1992) was developed to carry out this research. Its current form is a 48-item Likert-type self-rating questionnaire measuring six psychological dispositions (prevailing attitudes): Computer Importance, Computer Enjoyment, Motivation, Study Habits, Empathy, and Creative Tendencies (Knezek and Miyashita, 1993). The YCCI was pilot tested in the U.S. and Japan during 1990 (Knezek & Miyashita, 1991; Miyashita & Knezek, 1992), administered to first and second grade students in Japan and the U.S.A. during March 1991 (Miyashita, Knezek, & Sakamoto 1992), and administered to first, second, and third grade students in Japan, the U.S.A., and Mexico during March-April 1992 (Miyashita, Knezek and Sakamoto, 1993).

During 1990-91, an iterative procedure involving double back-translation, content validation, pilot testing, construct (factor) validation, and reliability verification was used to produce the 48-item Likert-type questionnaire from an initial pool of 155 potential items (Miyashita & Knezek, 1992). Because YCCI construction began with items translated from Japanese to English, and then back to Japanese, and because 1991 & 1992 survey administrations took place in March-April to correspond with the end of the Japanese school year, it is believed this research is not particularly prone to the "Western-bias" which is commonly found in cross-cultural research (Hulin, 1987).

Validity

Content validity for the YCCI is believed to be quite high. Approximately one dozen researchers, early childhood specialists, teachers, and parents have contributed their expert judgments to the selection and wording of items for the English, Japanese, and Spanish versions of the questionnaire. Construct (factor) validity has proven to be quite stable over time, and moderately consistent across cultures. The item numbers which have exhibited consistently significant (r>=.2) factor loadings on the six confirmed subscales, across ages and cultures, are listed in Table 1. Item stems can be found ordered by strength of factor loading, in Appendix A.

Table 1.
YCCI Factor Structure Based Upon U.S.-Japan 91-92 and Mexico 92 Data
(Loadings for 1991 Japan-U.S. Data in Parentheses)

Item Number	Computer Importance	Computer Enjoyment	Motivation /Persistence	Study Habits	Empathy	Creative Tendencies
1		.59(.69)				
2		.54(.49)				
3	.55(.51)					
4		.30(.36)				
5		.38(.50)				
6	.41(.42)					
7						
8	.60(.58)					
9	.68((.65)					
10	.33(.45)	.42(.32)				
11	.45(.50)					
12	.62(.66)					
14						
15			.27(.41)	.39(.20)		
16			.53(.51)			
17			.31(.48)			
18				.52(.46)		
19				.48(.43)		
20				.40(.32)		
21			.42(.46)			
22			.48(.51)			
23			.43(.32)			
24				.57(.47)		
25				.36(.33)		
26					.62(.60)	
27					.52(.47)	
28					.48(.53)	
29					.53(.56)	
30					.64(.62)	
31					.41(.46)	
32					.37(.37)	
33					.41(.47)	
35					.50(.46)	
36						.53(.56)
37						.48(.53)
38						.45(.45)
39						.48(.35)
40						.54(.54)
41						.40(.30)
42						.58(.58)
43						.46(.36)
44						.54(.46)
45						.38(.26)
46						.58(.48)
47						.43(.42)
48						.31(.30)

Table entries are pattern matrix factor loadings (regression coefficients showing contribution of factor toward item)

Reliability

Results of the most recent post-hoc reliability analysis for the six-factor YCCI structure shown in Table 1 are displayed in Table 2. The overall internal consistency reliability of the scale is .92, utilizing 44 of the 48 items contained in the instrument. Subscale reliabilities range from a low of .66 to a high of .85 when data from all language/culture administrations is combined. These reliabilites fall within the range of "minimally acceptable" (.65-.70) to "very good" (.80-.90) according to guidelines provided by DeVellis (1991).

According to these guidelines, current reliability estimates can be considered encouraging, but problems still exist. In particular, Computer Enjoyment and Study Habits appear to have unacceptable reliability in their present forms in the Spanish language version of the YCCI, and Motivation/Persistence definitely has an unacceptably low reliability (.34) in the current Spanish language edition. These problems place limitations on the degree of certainty with which findings related to Spanish language data can be stated.

Table 2
Internal Consistency Reliability For YCCI
English, Japanese, And Spanish Versions
Based Upon 1992 Data

	ITEMS	OVERALL	ENGLISH	JAPANESE	SPANISH
CREATIVE TENDENCIES	13	.85(.82)	.83	.83	.79
COMPUTER ENJOYMENT	5	.72(.70)	.66	.77	.57
COMPUTER IMPORTANCE	9	.77(.76)	.69	.77	.70
EMPATHY	9	.77(.76)	.74	.79	.61
STUDY HABITS	7	.80(.76)	.60	.70	.55
MOTIVATION /PERSISTENCE	6	.66(.64)	.65	.74	.34
OVERALL	44	.92(.90)	.90	.89	.86

(1991 Combined English-Japanese Results in Parentheses)

Subjects

For the 1992 study, data was gathered from 3036 students enrolled in grades 1-3 at 21 schools in Japan, the U.S.A., and Mexico during March and April of that year. The majority of the students were from six urban, suburban, and rural public schools in Japan (1236 total) plus

seven traditional public and private schools in the state of Texas, U.S.A. (1072 total). Data was also gathered from five additional bilingual-Hispanic elementary school programs in Texas (247 students total), two elementary schools in Monterey and Mexico City, Mexico (422 students total), and one weekend school for Japanese dependents living in Texas (59 students).

Questionnaires were completed during school time, under teacher supervision, at all but one U.S. and at both Mexico sites. All questionnaires at the Japan sites and the U.S. school for Japanese dependents were completed by the children, with their parents, at home. All students in grades 1-3 at each school were asked to complete questionnaires. Rates for completion of usable questionnaires varied from approximately 50% to 99%, by school.

All Japanese students, including those in the U.S., completed the Japanese language version of the questionnaire. All students at the traditional schools in the U.S. and at the Monterey, Mexico site completed English language versions of the questionnaire. All bilingual-Hispanic students in the U.S., and the students in Mexico City completed Spanish language versions of the questionnaire.

Cross Cultural Findings

Types of Attitudes Toward Computers

Major Finding: Computer Enjoyment as a construct is quite distinct from perceived Computer Importance. Probably there are many other types of attitudes toward computers as well.

The YCCI measures two types of attitudes toward computers: Computer Importance and Computer Enjoyment. According to Kay (1992a), ... "attitudes toward computers have been defined at least 14 different ways, including acceptance, affect, cognitions, comfort, confidence, courses, interest, liking, locus of control, motivation, programming, training, case scenarios, and stereotypes" (p.160). Her examination of ten different questionnaires showed that definitions of attitudes toward computers have spanned the cognitive, affective, and behavioral domains (Kay, 1992b). Much more work needs to be done in standardizing the indices and terminology in this area, so that future researchers can know whether previous findings are relevant.

Effect of Computer Use on Attitudes Toward Computers

Major Finding: Early exposure of 40 minutes or more per week in school boosted perceived Computer Importance and Computer Enjoyment .5 to 1.0 standard deviations, 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 (Miyashita, Knezek and Sakamoto, 1993).

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 and 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 Importance and Enjoyment than did Japanese students who did not use computers. These results are shown graphically for the U.S. and Japan in Figures 1 and 2. Mexico is not shown but is similar to the U.S.

Effect of School Computer Use on Other Psychological Characteristics

Major Finding: Computer access for one or two years in school does not appear to have a strong effect on motivation, study habits, empathy, or creative tendencies, for mainstream students in grades 1-3.

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, and Sakamoto, 1991) found that a combination of word processing at home and programming in school was associated with higher self-reported creativity.

Our analyses of student scores on Motivation/Persistence, Creative Tendencies, Empathy, or Study Habits have shown no consistent differences between Japanese students using

computers, versus those not using computers, in the 1991 or 1992 data. (Miyashita, Knezek, & Sakamoto, 1993). Nevertheless, the factor Computer Importance is correlated with Creative Tendencies (r=.48), Empathy (r=.41), and Study Habits (r=.34), so it is believed that the long range influence of these dispositions on each other is worthy of further study. Computer Enjoyment does not appear to be strongly associated with any of the other factors, except Computer Importance (r=.35).

Further research is needed to determine if the associations we have found with Computer Importance are causal in nature. Likewise, additional research is needed to determine if Computer Enjoyment is more strongly associated with non-school activities, such as home computer use, as we surmise. One absence of a significant finding that is good news is that 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.

Effect of Types of Computer Use

Major Finding: Any of several different kinds of educationally-relevant computer experiences can improve attitudes toward computers.

The most common type of computer use in primary schools in the U.S. has historically been drill and practice (Becker, 1990), but the trend is toward more tool type applications such as word processing, databases, or simulations (Martin, Heller, and Mahmoud, 1992). Guidelines developed by the National Association for the Development of Young Children in 1991 encourage open-ended tools and tutee-mode applications such as Logo programming to enhance children's development and creative potentials (Clements, Nastasi, and Swaminathan, 1993).

In our study, computer applications spanned a wide range from drill & practice, tutorials, and educational games in computer laboratories, to free-form story composition and graphics production in laboratories and classrooms, to group participation in single-computer story construction in a classroom. No particular form was restricted to any country. However, there was a tendency toward guided, uniform-participation whole-group or small group activities in Japan and Mexico, while individual student or small-group activities dominated in the U.S.

The Japan population of our study, in which three schools were each matched with comparable schools not using computers, confirmed that any of several different ki. ds of educationally-relevant computer experiences can improve attitudes toward computers: CAI at

the urban site ($p < .005$), Logo programming plus CAI at the suburban site ($p < .001$), and word processing plus graphics production at the rural site ($p < .001$). Our findings are consistent with those of the recent U.S.-Soviet study reported by Martin, Heller, and Mahmoud (1992) that "... most of the children thought that whatever they were doing on the computer was fun" (p. 182).

Gender Differences

Major Finding: No gender differences in Computer Importance or Computer Enjoyment were found for first grade students in Japan, the U.S.A., or Mexico; no consistent gender differences were found for attitudes toward computers in grades 1-3.

A recent meta-analysis by Kay (1992a) of ninety-eight studies found unequal attitudes toward computers by gender, in favor of males. Studies have often found higher attitudes toward computers among males in junior high, high school, and college (Collis, 1985; Collis & Williams, 1987; Wilder, Mackie, and Cooper, 1985). Elementary school results are more mixed. Wilder, Mackie, and Cooper (1985) found that in a New Jersey school district, "Boys like computers and video games more than girls do, from kindergarten through high school" (p. 220). They also explained that "the differences between the sexes in attitudes toward the computer are statistically significant, but quite small in an absolute sense" (Wilder, Mackie, and Cooper, 1985, p. 221). Martin, Heller, and Mahmoud (1992) found no significant gender differences in attitudes toward computers for 8-12 year old children in the U.S. and the Soviet Union.

As shown in Table 3, we found no strong ($p<.01$) gender differences among computer users in their attitudes toward computers at the first grade level, and no consistent differences at the second or third grade level (Knezek & Miyashita, 1993). This is true for the U.S.A., Japan, and Mexico. We also found no consistent gender differences in Motivation, Study Habits, or Creative Tendencies. These findings are especially convincing in light of the strong evidence for consistent gender differences in Empathy, which we define as a caring identification with the thoughts or feelings of others. Females appear to be more empathetic, even at this early age, in all three nations.

Table 3.
Mean Ratings by Gender on Six Likert Subscales for Grades 1-3 in Three Countries

		I	J	M	S	E	C
U.S.A.							
Grade 1	M	3.63	3.68	3.25	3.33	3.39	3.52
(N=184)	F	3.70	3.59	3.15	3.25	*3.59	3.52
Grade 2	M	3.50	3.44	2.98	3.23	3.32	3.34
(N=176)	F	3.59	**3.74	3.21	3.42	***3.68	3.51
Grade 3	M	3.35	3.58	2.82	2.96	3.11	3.16
(N=189)	F	3.46	3.66	2.91	3.09	***3.47	3.30
JAPAN							
		I	J	M	S	E	C
Grade 1	M	3.31	3.54	3.11	2.49	2.92	3.12
(N=359)	F	3.33	3.61	3.28	2.61	***3.32	3.19
Grade 2	M	3.33	3.64	2.99	2.35	3.04	3.16
(N=406)	F	3.24	3.58	3.13	2.45	***3.34	3.11
Grade 3	M	3.10	3.52	2.91	2.23	2.78	2.94
(N=412)	F	2.93	3.43	3.06	**2.49	***3.19	3.62
MEXICO							
		I	J	M	S	E	C
Grade 1	M	3.64	3.67	3.22	3.42	3.47	3.50
(N=111)	F	3.54	3.64	3.19	3.32	3.55	3.38
Grade 2	M	3.43	3.45	3.06	3.13	3.38	3.38
(N=106)	F	3.32	3.41	3.09	3.15	3.45	3.36
Grade 3	M	3.43	3.65	2.65	3.11	3.18	3.43
(N=121)	F	3.40	3.43	2.83	3.22	***3.48	3.30

* = .01 Sig
** = .001 Sig
*** = .0001 Sig

Rating Scale: 1 = no (strongly disagree), 2 = maybe no (disagree), 3 = maybe yes (agree), 4 = yes (strongly agree)

I Computer Importance (7 items, Alpha = .77)
J Computer Enjoyment (5 items, Alpha = .72)
M Motivation/Persistence (6 items, Alpha = .66)
S Study Habits (6 items, Alpha = .80)
E Empathy (9 items, Alpha = .77)
C Creative Tendencies (13 items, Alpha = .85)

Novelty Effect of Computers

Major Finding: Perceived Computer Importance does not decline from grades 1-3 as rapidly as some other psychological dispositions, and Computer Enjoyment runs the opposite direction predicted by a novelty effect.

In Wilder, Mackie, and Cooper's 1985 study involving 1600 K-12 students in the U.S., "The most striking finding with respect to attitudes toward the computer ... was one of decreased liking by all students (with increased age)" (p. 218). This phenomenon has come to be known as the novelty effect. It has recently been reconfirmed for 339 fourth through tenth grade students in the U.S., "... using longitudinal data from a large, representative sample to study the evolution of responses to computers over an extended period of time" (Krendl and Broihier, 1991, p 217).

We were unsuccessful in confirming a novelty effect for young children using computers. Figures 1 and 2 illustrate that, among U.S. and Japanese students who have used computers, 1992 third grade student ratings of Computer Importance tended to be lower than second grade student ratings, and both of these groups tended to rate Computer Importance lower than first grade students. These trends were also found to be true for Mexico in 1992. Yet Computer Importance for our 1992 second grade students, viewed as a class by nation, did not significantly ($p<.01$) decline from one year earlier, when they were first grade students (see Table 4). Neither was there a significant decline for the 1992 third grade students in Japan or the U.S.A.. In addition, there was no significant decline in Computer Importance or Computer Enjoyment for 89 third grade students at one Texas public school whose responses were paired with their own questionnaire responses from one year earlier (Miyashita, Knezek, Sakamoto, 1993).

Computer Enjoyment trends run the opposite direction anticipated for a novelty effect (see Figure 2). Computer Enjoyment either remains very high among computer-using students or continues to rise across grades 1-3. This is true for Japan, the U.S.A., and Mexico (not shown). Even among Japanese students who have never used computers, in school, the trend is toward increased computer enjoyment with age.

Figure 1.
1991 & 1992 Mean Ratings for Computer Importance: Grades 1-3 for USA, Japan with Computers, and Japan without Computers

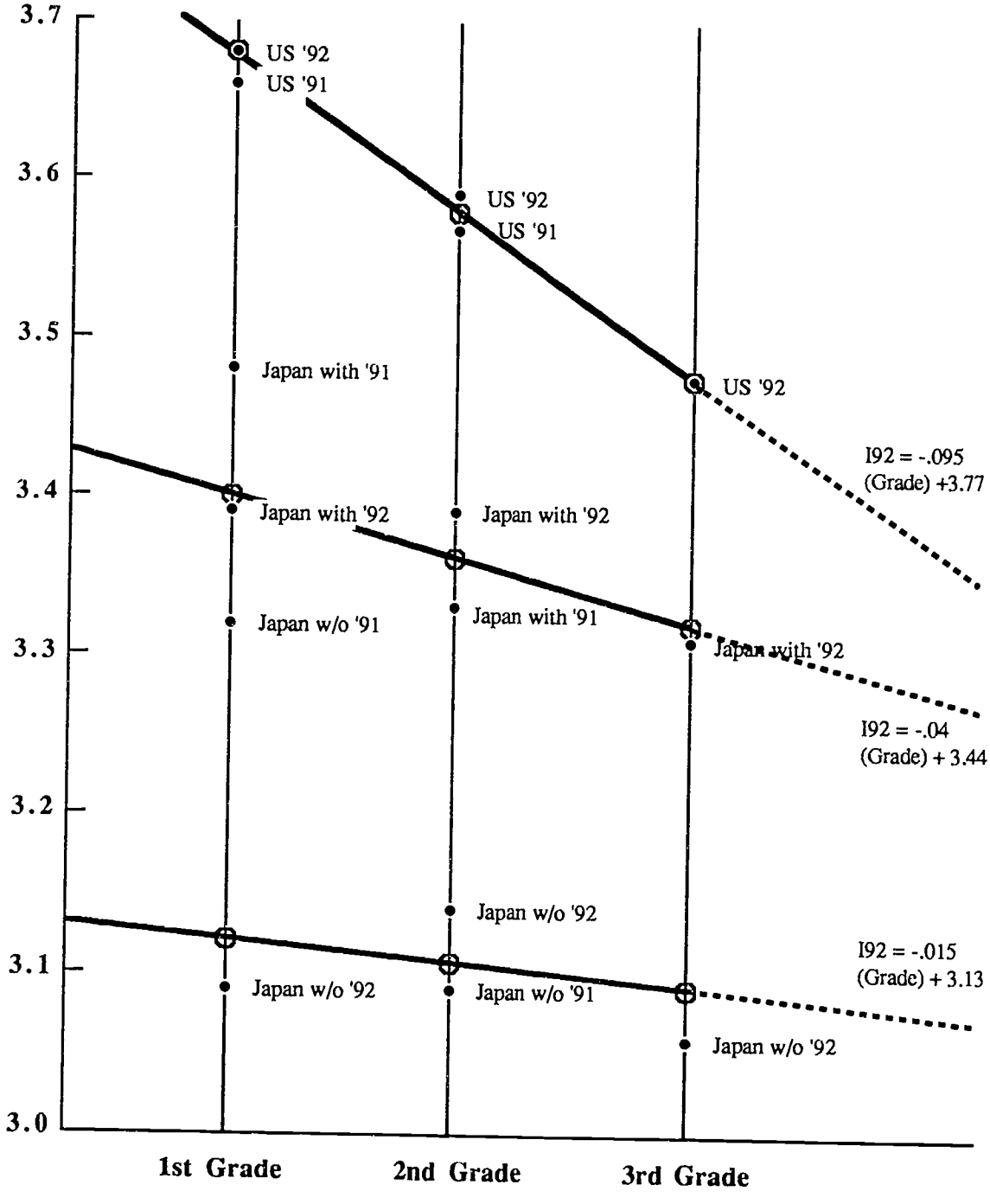


Figure 2.
1992 Mean Ratings for Computer Enjoyment: Grades 1-3 for USA, Japan with Computers, and Japan without Computers

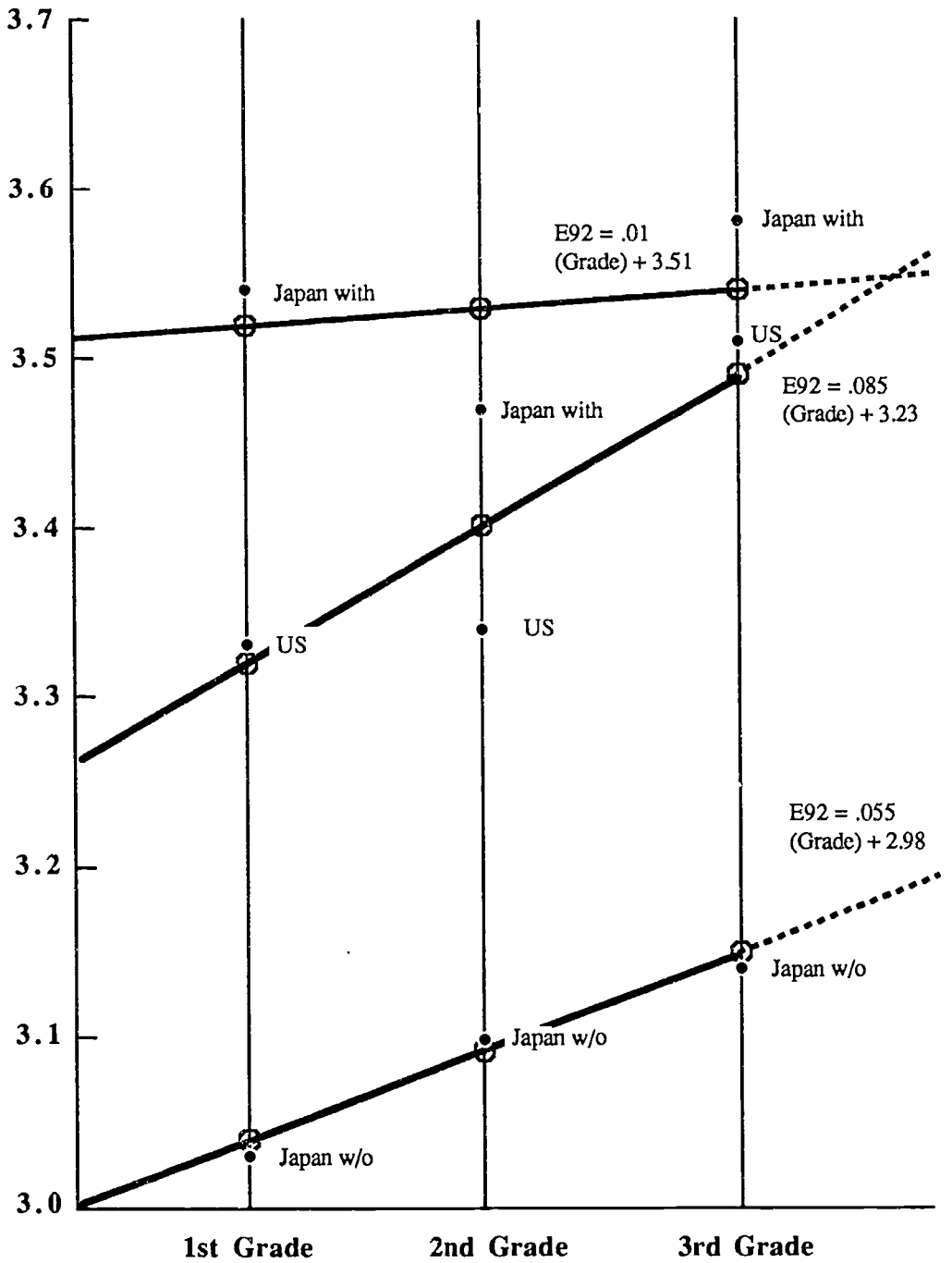


Table 4.
1991 to 1992 Changes in Computer Importance

	1991 SCORE	1992 SCORE	DIFFERENCE	.01 SIGNIF.
1991 FIRST GRADE STUDENTS				
U.S.A. (n=359)	3.66	3.59	-.07	NS
JAPAN/with (n=106)	3.48	3.39	-.08	NS
JAPAN w/o (n=109)	3.22	3.14	-.08	NS
1991 SECOND GRADE STUDENTS				
U.S.A. (n=382)	3.57	3.49	-.08	NS
JAPAN/with (n=97)	3.33	3.31	-.02	NS
JAPAN w/o (n=109)	3.09	3.06	-.03	NS

Three unanticipated discoveries during this portion of the research caused a reexamination of popular thinking about the novelty effect, from a broader perspective. First, as shown in Table 5, even though the decline for Computer Importance and Computer Enjoyment was not significant for the 89 students individually paired from 1991 second grade status to 1992 third grade status, the decline for these students was significant for Creative Tendencies ($p < .001$), Study Habits ($p < .01$), and Empathy ($p < .01$). Second, as illustrated in Figure 3, the general trend for all four non-computing constructs in Japan, the U.S.A. and Mexico (not shown), was down, as student ages/grade levels increased. Third, and also illustrated in Figure 3, absolute ratings for all non-computing dispositions except Study Habits in Japan were quite tightly clustered. If one overlays Figure 3 with Figures 1 and 2, then the attitudes toward computers of the students without school computer access fall at the very bottom of the student dispositions cluster, while attitudes toward computers of students with computer access lie at the top.

Table 5.
Results of T-Tests on Six Learner Disposition Indices for 1991 2nd Grade Students in the U.S. A. Paired with their Third Grade Responses in 1992 (n = 89)

	1991	**1992**	**t**	**Sig (.01)**
Creative Tendencies	3.41	3.12	4.1	.001
Study Habits	3.22	2.99	2.6	.01
Empathy	3.44	3.26	2.5	.01
Computer Enjoyment	2.83	2.72	2.3	NS
Computer Importance	3.58	3.48	1.3	NS
Motivation/Persistence	2.85	2.86	-.1	NS

Figure 3.
1992 Mean Item Ratings on Four Learner Disposition Subscales

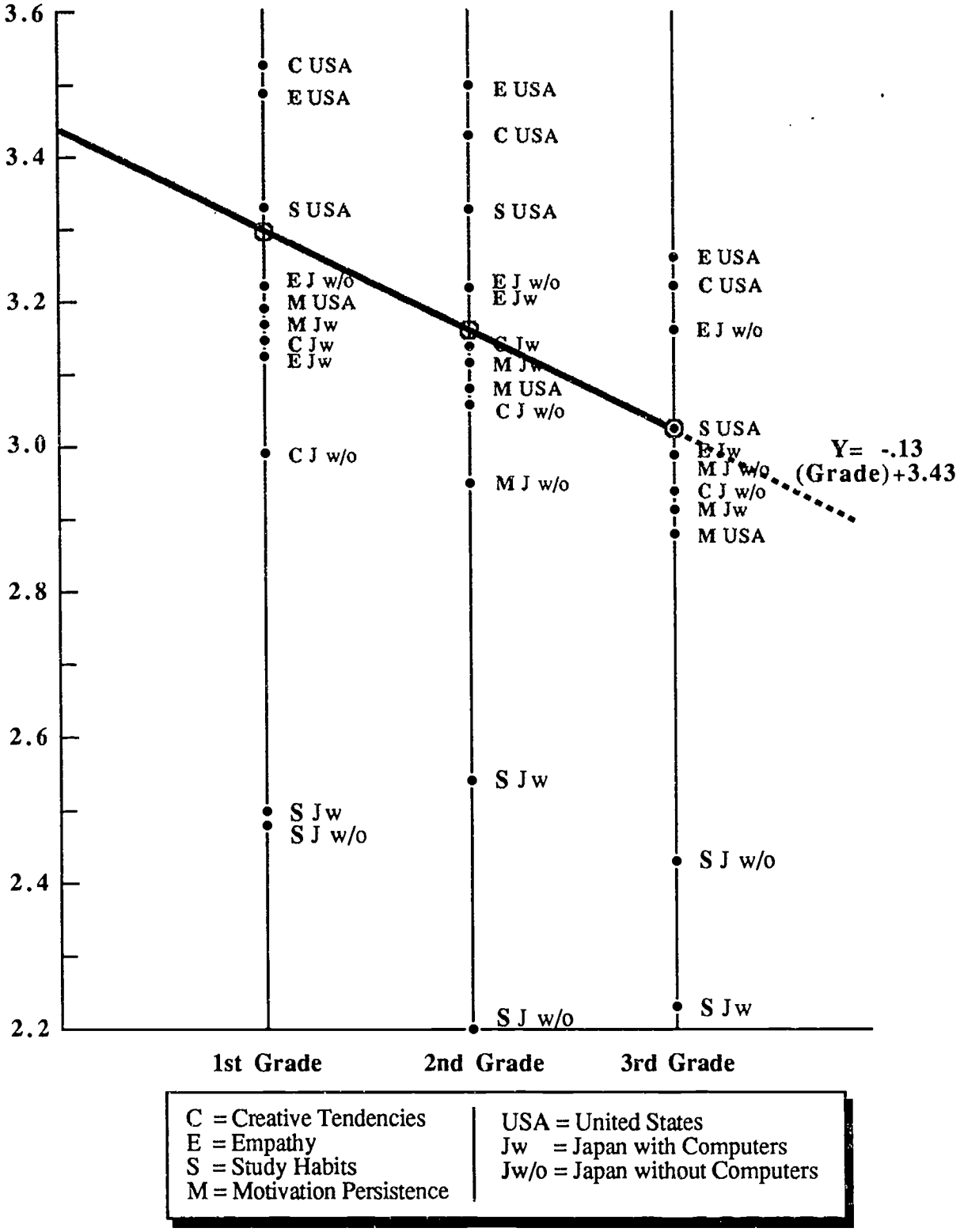


Figure 4.
Japan 1992 Computer Importance
(Mean Ratings)

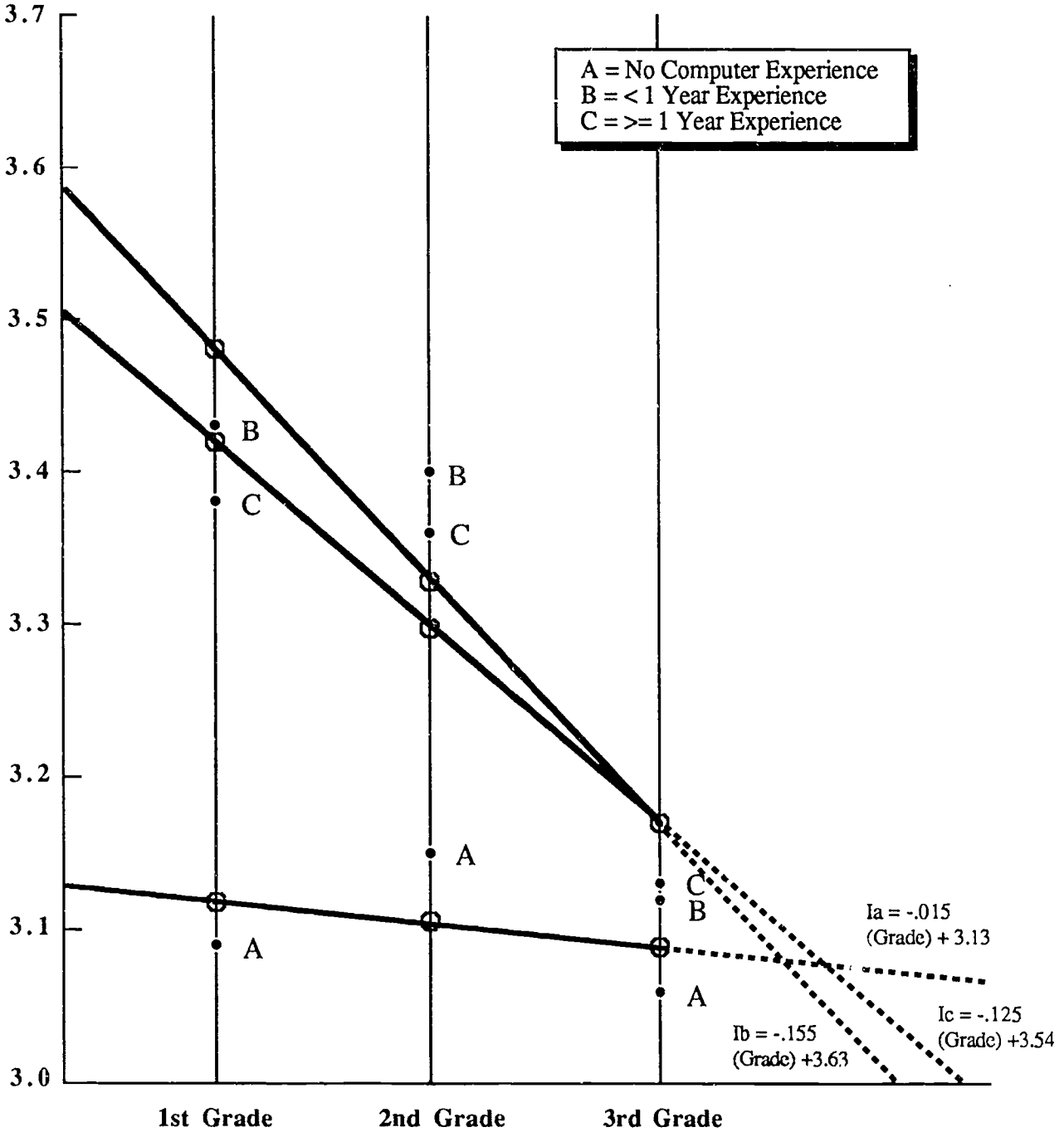
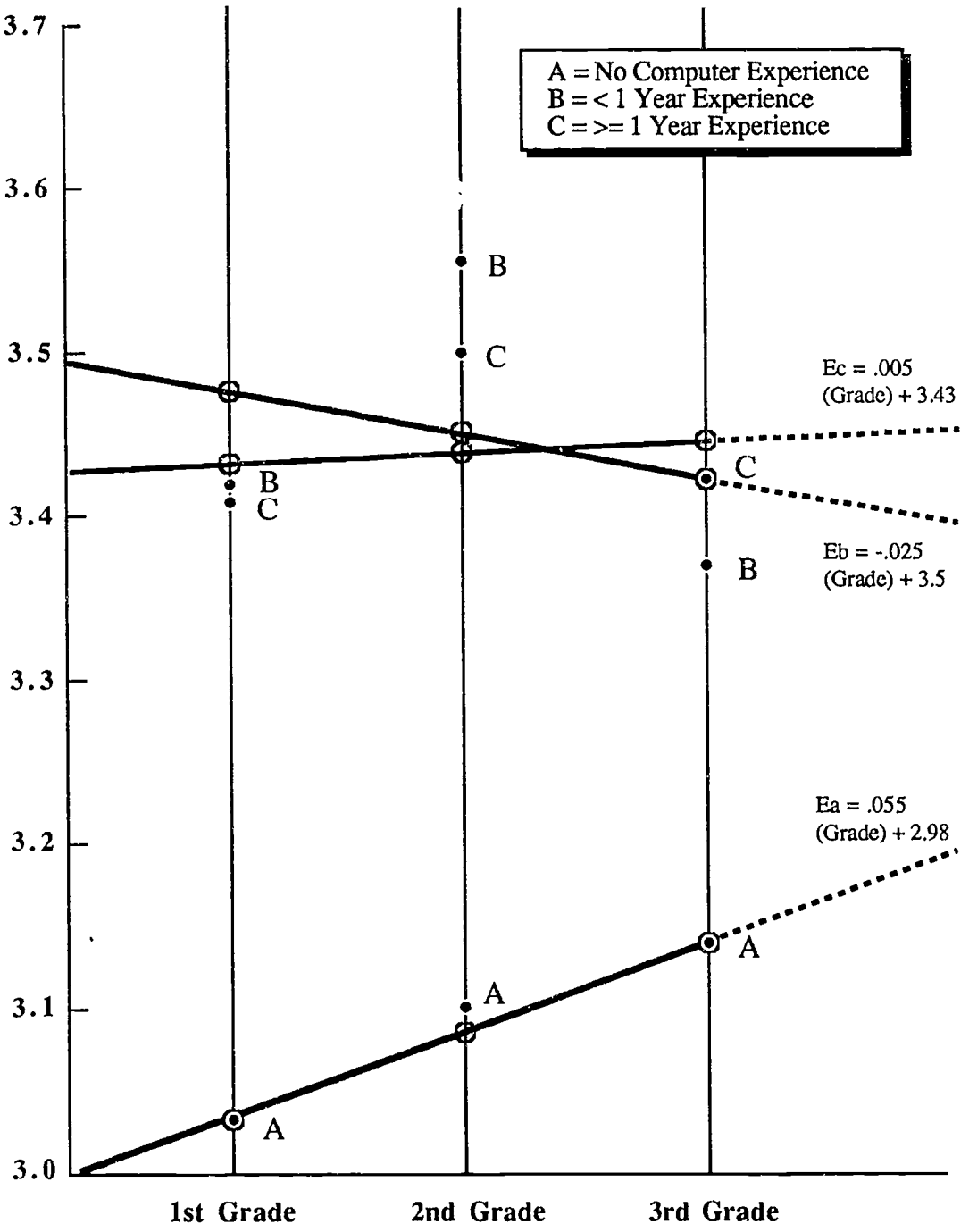


Figure 5.
Japan 1992 Computer Enjoyment (Mean Ratings)



Several conclusions can be drawn from these combined results. First, the novelty effect applies to several of the constructs parents and educators might hope would remain high or increase during school years, not just to attitudes toward computers. These include motivation, study habits, empathy, and creative tendencies. All regression slopes in Figure 3 for these four constructs for Japan and the U.S. are negative. Perhaps attitudes in general become less positive (more realistic) because the students get older or go to higher grades or something happens related to their maturity and/or their schooling.

Apparently the kinds of attitudes toward computers we measured do not go down because of increased computer use. Japanese students using computers for less than one year and the students using computers for more than one year both scored significantly higher ($p<.01$) on the two computer attitude subscales than the group not using computers. However, the students using computers for less than one year were not significantly different from the group using computers more than one year, on either subscale. As shown in Figures 4 and 5, students in Japan with three months of exposure had roughly the same attitudes toward computers as did their peers of the same age with one year plus three months of exposure.

It is possible that attitudes toward computers go counter to the downward trend (like some research with older students and adults shows), but they are not strong enough to overcome the general trend toward less positive dispositions among older students on almost all psychological dispositions we measured. One plausible explanation for this might be a "chameleon effect" -- that is, the ability of "the computer" to change software and grow with the student as the student matures.

The Hispanic Immigrant Anomaly

Major Finding: Bilingual Hispanic students in the U.S. maintain (and in some cases increase) their initially high learning-related dispositions from grades 1-3. This trend is contrary to the novelty effect found to be common among English-speaking students in America, Japanese-speaking students in Japan, and Spanish-speaking students in Mexico.

Bilingual Hispanic students were included in the 1992 analysis in an attempt at cross-cultural replication of the 1990 findings for Japanese dependents living in the U.S. However, the outcome was radically different.

Exploratory data analysis conducted on "pilot-test year" data gathered in 1990 at one school in Japan, one school in the U.S., and a Saturday school for Japanese dependents in the U.S., showed the U.S. primary school students to be higher than Japanese students on study habits, lower on empathy, and not significantly different from their Japanese peers with respect to motivation or creative tendencies . In addition, students at the U.S. school which used computers had higher attitudes toward computers than did students at the Japanese school which did not use computers. When viewed as a group, students at the weekend school for Japanese dependents, who attended traditional U.S. schools Monday-Friday, had scores lying between those of the traditional American students and the traditional Japanese students in the areas with significant Japan-U.S. differences (Knezek & Miyashita, 1991a, 1991b).

The expectation for Hispanic students in the U.S. was that their psychological dispositions would generally lie in between those of students in Mexico and those in the U.S. Instead, bilingual Hispanics as a group were higher ($p<.01$) than all other groups on Computer Importance and Study Habits. As shown in Table 6, the grade 1 - 3 trends for the six psychological dispositions measured are not like the trends for the other students shown in Figures 1-5. Four of the six dispositions measured (Computer Importance, Computer Enjoyment, Creative Tendencies, and Empathy) have positive regression slopes for grades 1-3, and slopes for the other two are practically flat (-.04 and -.08).

A sizable portion of the bilingual Hispanic students in our study were from families who recently immigrated to the U.S. Duran and Weffer (1992), in their review of the literature, pointed out that recent U.S. immigrants from Mexico "are in a certain sense a select group" (p. 167), better educated than their Mexican counterparts, and economically and technologically different from earlier agricultural immigrants (Portes, 1979; Portes, McCleod, & Parker 1978). According to Duran and Weffer, Matute-Bianchi (1986) found that students recently migrated from Mexico valued education and hard work similar to Japanese Americans. "Mexican immigrant students stressed a goal-directed approach to education and had a stronger achievement level and graduation rate than American-born students" (Duran & Weffer, 1992, p. 167). Duran and Wiffer themselves found that successful Hispanic high school students who were immigrants attributed their success to family encouragement and their willingness to work hard in school. Parents of these students believed that education was not an end in itself, but "... the means to better jobs and higher income" (Duran and Wiffer, 1992, p. 179).

Table 6.
1992 Descriptive Statistics by Grade Level for Bilingual Hispanic Students on Six YCCI Subscales (n=247)

GROUP	COUNT	MEAN	STANDARD DEVIATION
Computer Importance			
Grade 1	77	3.7236	.3989
Grade 2	117	3.7302	.3523
Grade 3	47	3.8176	.2821
Computer Enjoyment			
Grade 1	77	3.6442	.4764
Grade 2	117	3.6906	.4263
Grade 3	45	3.8844	.2153
Motivation/Persistence			
Grade 1	75	3.2244	.4622
Grade 2	120	3.2986	.5310
Grade 3	47	3.1915	.5304
Study Habits			
Grade 1	73	3.7009	.3310
Grade 2	119	3.5952	.4103
Grade 3	46	3.7138	.4590
Empathy			
Grade 1	72	3.4707	.4804
Grade 2	116	3.4780	.4740
Grade 3	46	3.5121	.3640
Creativity			
Grade 1	72	3.6410	.4027
Grade 2	106	3.4659	.5064
Grade 3	46	3.7625	.4635

Instrumentation Issues

Several measurement issues peculiar to cross-cultural research have been addressed during this project. This section identifies major issues and offers suggestions to future researchers, if solutions to the problems identified are known.

Likert Scales as Measurement Instruments for Children

Major Finding: Young children in grades 1-3 are able and willing to convey the extent to which they agree or disagree with an item, once they understand the question. This technique is reasonably reliable for classroom administration in a group, under the supervision of a teacher, as well as for home administration under direct supervision of a parent.

In this study, practical considerations forced us to gather U.S. data in classes (teachers were afraid children would not return forms taken home) and Japan data at home (principals could not permit school time to be taken for completing forms). We have found home administration to yield slightly more reliable data, but school administration probably produced less response bias. Early pilot tests with children confirmed that they are very honest in their opinions and have definite opinions.

Circling Responses versus Coloring Faces

Major Finding: Smiley-face Likert-type response choices are unreliable indicators of young children's attitudes.

Graphically-oriented alternatives to traditional paper-and-pencil measurement have been advocated for use with young children in order to make the rating less difficult (Alreck and Settle, 1985), more valid (Dennis, 1966), or to help reduce biases such as children choosing the responses they believe will please attending adults (Mueller,1986). Martin, Heller and Mahmoud (1992) found that analysis of responses to the instruction "draw a picture of one or more persons using a computer" reinforced the findings from their yes-no attitude items and revealed generally positive attitudes by U.S. and Soviet 8-12 year old children.

In our study, one U.S. school used a smiley-face version of our instrument, which they responded to by coloring in one of the following responses:

However, after two years of use by approximately 600 subjects, we cannot recommend use of such a response format, even though children like the smiley face forms. As shown in Table 7, subscale internal consistency reliabilities for the smiley face format were lower than those resulting from circling numbers representing "yes, maybe yes, maybe no, no" (Knezek and Miyashita, 1993a). The average subscale reliability deficit for the smiley face version was .21.

We obtained far more reliable results by maintaining the standard rating procedure, which parents and teachers understood, and allowing some flexibility for the attending adult to explain vocabulary and interpret instructions for the students.

Qualitative and Quantitative Cross-Cultural Data

Major Finding: Both qualitative and quantitative methods are useful for drawing accurate conclusions about young children's attitudes toward computing in a trans-national research environment.

Quantitative, qualitative, and hybrid quantitative-qualitative research methods have been advocated to measure attitudes toward computers in children (Kay, 1992a). The primary goal of our research was to compare quantitative data on attitudes among students at schools newly equipped with computers in Japan, to attitudes at comparable schools without computers, using time-synchronized data from the U.S. as a cross-cultural control. Site visits, videotape recording and viewing, and discussions with principals, teachers, parents, and students were completed as a qualitative component of the research.

Culture-Free Tests in a Cross-Cultural Study

Major Finding: Direct comparisons of Likert-type indices across languages and nations are difficult due to cultural biases in item-responses.

This concept is possibly a contradiction of terms. Culture-free measurement instruments are supposed to provide the same kind of measurements regardless of the culture in which they are used. We have evidence that the meaning of our items and constructs remain reasonably stable across the three nations/cultures, but that the perceived magnitude of the rating category descriptors is subject to language/cultural bias. As one example, 1990 Japan-U.S. data was analyzed and conclusions drawn (Knezek and Miyashita, 1991b) based upon a three-point rating scale (yes, undecided, no), but 1991 and 1992 data was gathered through a 4-point rating scale (yes, maybe yes, maybe no, no). Results from the two forms were not entirely consistent. Detailed analysis of one class in Japan and one in the U.S. who took both 3-point and 4-point versions in 1992, showed that American students tend to choose more toward the extremes (1 and 4) if they are given four choices, whereas Japanese rating tends to be equally distributed across available choice categories, either three or four (see Table 8). An analysis of data from one second grade class in Mexico where both English and Spanish versions were completed, showed highly significant ($p<.001$) differences on all six subscales, for the same students completing versions in two languages.

Table 7
Internal Consistency Reliability For YCCI
Standard Versus Smiley Face Versions
Based Upon 1992 U.S. Public School Data

PART A: STANDARD RESPONSE FORMAT (Version 3.1)

	ITEMS	GRADE 1 (N=206)	GRADE 2 (N=182)	GRADE 3 (N=204)	AVERAGE
CREATIVE TENDENCIES	13	.80	.78	.72	.77
COMPUTER ENJOYMENT	5	.65	.68	.69	.67
COMPUTER IMPORTANCE	7	.64	.78	.72	.71
EMPATHY	9	.72	.73	.79	.75
STUDY HABITS	6	.39	.51	.50	.47
MOTIVATION	6	.49	.58	.68	.58
OVERALL	44	.84	.90	.89	.88

PART B: SMILEY FACE VERSION (3.2)

	ITEMS	KINDER (N=130)	GRADE 1 (N=140)	GRADE 2 (N=141)	AVERAGE
CREATIVE TENDENCIES	13	.48	.48	.69	.55
COMPUTER ENJOYMENT	5	.26	.34	.32	.31
COMPUTER IMPORTANCE	7	.51	.26	.60	.46
EMPATHY	9	.75	.60	.68	.68
STUDY HABITS	6	.50	.10	.12	.25
MOTIVATION	6	.30	.56	.40	.42
OVERALL	44	.74	.66	.80	.73

Table 8
3-Point vs. 4-Point Rating Distributions
for Japanese and American Students
(March 1992 Data)

4-Pt. Japan Distribution

	Middle (2-3)	Tail (1 or 4)	Chi-Square	.01 Signf.
Expected	.5	.5		
Japan	.484	.516	(N=1104)	
			.56 x 1df	no

4-Pt. U.S. Distribution

	Middle (2 -3)	Tail (1 or 4)		
Expected	.5	.5		
U.S.	..223	.777	(N=761)	
			126.8 x 1df	yes

3-Point Distribution (Comparative)

	Middle (2)	Tail (1 or 3)		
Japanese	.345	.655	(N=1198)	
American	.214	.786	(N=816)	
			40.4 x 1df	yes

4-Point Distribution (Comparative)

	Middle (2-3)	Tail (1 or 4)		
Japanese	.484	.516	(N=1104)	
American	.223	.777	(N=761)	
			132.2 x 1df	yes

Because of verifiable trans-language/culture rating biases, we have attempted to draw most of the conclusions listed from trends found within one country which have also been replicated in another. We recommend that future cross-cultural researchers wishing to make direct comparisons between cultures, use just three rating categories on Likert instruments designed for young children (Knezek and Miyashita, 1993). Dichotomous (yes-no) rating categories such as were used in the U.S-Soviet study (Martin, Heller, and Mahmoud, 1992) should be acceptable for direct trans-national comparisons as well.

Conclusions

Based upon analysis of 1992 self-report data gathered from 3036 grade 1-3 students in 21 elementary schools in three nations, the following cross-cultural conclusions can be made:

1. There is no evidence, based on the data gathered for this study, that computer use in primary school causes students to become less empathetic.

2. There is no direct evidence that computer use in primary school significantly enhances creative tendencies, motivation, or study habits over a period of one year. However, positive correlations found between these attributes and attitudes toward computers leave open the possibility that computer use may result in measurable student changes toward desirable learning dispositions over a period of several years.

3. There is no evidence that the gender differences reported in the literature regarding attitudes toward computers exist in grade 1, and little evidence for the existence of gender differences in attitudes toward computers for grades 1-3 in school. However, there is strong evidence for gender differences in empathy at the grade 1-3 level. The trend is for females to be more empathetic than males in Japan, the U.S.A., and Mexico.

4. There is strong evidence that computer access in primary schools significantly enhances attitudes toward computers, both computer enjoyment and perceived computer importance.

5. The strong effect of computer use on attitudes toward computers appears to be robust across types of applications, nations, and cultures.

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Appendix A. YCCI Items Ordered by Strength of Factor Loadings

Computer Importance		
9	I can learn many things when I use a computer.	.68 I
12	I believe that it is very important for me to learn how to use a computer.	.62 I
8	I know that computers give me opportunities to learn many new things.	.60 I
3	I will be able to get a good job if I learn how to use a computer.	.55 I
11	I believe the more often teachers use computers, the more I will enjoy school.	.45 I
6	I would work harder if I could use computers more often.	.41 I
10	I enjoy lessons on the computer.	.33 I
Computer Enjoyment		
1	I enjoy doing jobs which use a computer.	.59 J
2*	I am tired of using the computer.	.54 J
10	I enjoy lessons on the computer.	.42 J
5	I enjoy computer games very much.	.38 J
4	I concentrate on a computer when I use one.	.30 J
Motivation/Persistence		
16	If I do not understand a problem, I will not stop working on it.	.53 M
22	I think about many ways to solve a difficult problem and I never give up.	.48 M
23	I never forget to do my homework.	.43 M
21	I enjoy working on a difficult problem.	.42 M
17	When I don't understand something, I keep working until I find the answer.	.31 M
15	I study by myself without anyone forcing me to study.	.27 M
Study Habits		
24	I like to work out problems which I can use in my life every day.	.57 S
18	I review my lessons every day	.52 S
19	I try to finish whatever I begin.	.48 S
20	Sometimes, I change my study habits.	.40 S
15	I study by myself without anyone forcing me to study.	.39 S
25	If I do not understand my teacher, I ask him/her questions.	.36 S
Empathy		
30	I worry when I see a sad friend	.64E
26	I feel sad when I see a child crying.	.62 E
29	I feel sad when I see old people alone.	.53 E
27	I sometimes cry when I see a sad play or movie.	.52 E
35	I feel happy when I see a friend smiling.	.50 E
28	I get angry when I see a friend who is treated badly.	.48 E
31	I worry when I see a sad friend.	.41 E
32	I do not like to see a child play alone, without a friend.	.37 E
33	I feel sad when I see an animal hurt.	.41 E
Creative Tendencies		
42	I find different kinds of materials when the ones I have do not work.	.58 C
40	I create many unique things.	.54 C
44	I make a plan before I start to solve a problem.	.54 C
36	I examine unusual things.	.53 C
39	I tend to consider various ways of thinking.	.48 C
37	I find new things to play with or to study, without any help.	.48 C
43	I examine unknown issues to try to understand them.	.46 C
38	When I think of a new thing, I apply what I have learned before.	.45 C
46	I invent new methods when one way does not work.	.43 C
41	I do things by myself without depending upon others.	.58 C
45	I invent games and play them with friends.	.38 C
47	I choose my own way without imitating methods of others.	.43 C
48	I tend to think about the future.	.31 C

* Reversed Items