THE UNIVERSITY OF CALGARY

PERSISTENCE OF ATTITUDES TOWARD COMPUTING OF STUDENTS IN A COMPULSORY COMPUTER LITERACY COURSE

by

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A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE

DEGREE OF MASTER OF ARTS (EDUCATION)

DEPARTMENT OF EDUCATIONAL POLICY AND ADMINISTRATION

FACULTY OF EDUCATION

SEPTEMBER, 1986

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ISBN 0-315-32619-0

THE UNIVERSITY OF CALGARY

FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled, "Persistence of Attitudes Toward Computing of Students in a Compulsory Computer Literacy Course", submitted by Ralph T. Mason in partial fulfillment of the requirements for the degree of Master of Arts (Education).

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ABSTRACT

This study involved the measurement of attitudes toward computing of a sample of 118 university students enrolled in a compulsory computer literacy course for Faculty of Education students. Subjects completed questionnaires at both the beginning and end of the 60-hour course. Instrumentation consisted of 25 semantic differential items related to one general and four specific factors, and eleven Likert-type statements related to one specific attitude factor and to exit motivation.

The course was found to have a small but significant positive effect on attitudes toward computing. Attitudes of students with prior computer experience had more positive attitudes both on entry and exit than did novices. Entry and exit scores correlated highly both for novice subjects and for those with prior experience, suggesting persistence of attitudes and accuracy of attitude prediction even without prior experience with computers. Semantic differential and Likert-type procedures provided similar results. All factors correlated significantly with each other, with enjoyment correlating very highly with exit motivation. No significant differences in attitudes were found based upon sex of subjects.

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CHAPTER ONE

INTRODUCTION

Computer literacy education has generally depended upon measures of content learned to determine success of computer literacy programs. However, agreement among course designers on what content to include has not been easy to achieve. Also goals such as encouraging students to continue involvement with computers are not content-linked, but have played a large part in course content decisions. Thus attitude measures could play a significant role in evaluating computer literacy programs and in determining the needs of potential students.

Standard techniques for measuring attitudes toward computing have not been developed. Goals and procedures for measuring attitudes toward computers vary widely, as Chapter II shows. Issues have included personal involvement with stimuli, dimensionality of attitudes toward computing, and item design. Two techniques, semantic differential items and Likert-type statements, have gained general acceptance, but in both the stimulus must be designed to obtain personal responses, if attitudes linked to motivation are desired.

Prior attempts to measure attitudes of the public toward computing have often been flawed. For example, surveys have obtained opinions in situations removed from any context involving personal involvement with computers and poorly linked to personal motivations. The representativeness of measures based upon participants in computer literacy programs is questionable, due to the effect of elective involvement with such programs. Also, because attitude studies have seldom included entry and exit measures of attitudes, differences discovered between those in courses and those not in courses cannot be attributed to the influence of the course. After describing comparable studies' procedures and results, Chapter II concludes with the hypotheses for this study.

This study used as subjects students in a compulsory computer literacy program for student teachers at the University of Calgary, in Winter, 1985. A questionnaire was assembled using both semantic differential items and Likert-type statements. The semantic differential items were designed by Zoltan and Chapanis and tested by Kerber (1982). The Likert- type statements were adapted from items in the National Assessment of Educational Progress analysed by Anderson and colleagues (1981). With both entry and exit questionnaires, the design was conducive to measuring attitude change attributable to the influence of the course. Chapter III describes the instrumentation and procedures in detail.

The results confirmed some expectations and offered surprises in some areas as well. Chapter IV provides details of the data analysis, including comparisons of attitudes for subgroups based upon sex and upon amount of prior experience with computers. Chapter V interprets the results as they pertain to the hypotheses, discusses the issue of dimensionality to the extent that these results bear upon it, and concludes with suggestions for further study.

CHAPTER II

REVIEW OF THE LITERATURE

Although coinage of the term 'naive user' has been attributed to Palme in 1975 (Dehning et al, 1981:3), Eason (1974:72) had defined the term earlier as, "individuals working within an organization who are not experts in computer technology but who use the computer as a tool to assist them in their work." The term found rapid acceptance in the business community, where computer experts often found themselves frustrated by the unwillingness to adapt to technological innovations of employees (Tomeski and Lazarus, 1975; Price, Summerfield in Infotech, 1980; Dehning et al., 1981; Bond, 1982; Klein and Hirschheim, 1983; Thiel, 1984; Sydow, 1984) and the public (Lovick, in Buckingham, 1973; Schneiderman, 1983; Hammer and Zisman, in Infotech, 1980).

Computer systems implementers attributed the source of the difficulties to the negative attitudes of naive users, as Schneiderman (1983:21) demonstrated in his statement: "Many people avoid using computerized devices ... because they are anxious or even fearful." Price (in Infotech, 1980:173) reflected the importance with which systems experts viewed the problem, stating: "Technological limitations to the development of the electronic office are minor by comparison to the challenges made by existing social, cultural and organisational attitudes." Yet, the consensus among early systems analysts was that the solution lay not in education, but in systems design and redesign (Cowie, in Buckingham, 1977:104; Dehning et al., 1981:3 and 30; Schneiderman, 1983:21 and 26). For example, Dehning, Essig, and Maass (1981:29) stated, "The system should react to and take precautions against disturbance of the interaction produced by typical human nature." The alternative of changing user attitudes through education was seldom considered by the systems designers and implementers.

Computing educators, on the other hand, quickly recognised the needs of the naive user as addressable by education. Perceiving those needs as generalizable beyond specific business interfaces mitigated against educators' use of the term 'naive user' in reference to their intended audience, however, and the term 'novice' has gained broader acceptance. The importance to the public of dealing with new computer technology was expanding to a degree where the term 'computer literacy' conveyed a universal need of fundamental (Ottabaek, in Jackson and Wiechers, 1979; Papert, 1980; Bork, in Seidel et al., 1982) and functional importance (Lidtke, 1981; Bent, in Cammaert, 1982; Anderson, in Seidel et al., 1982; Bonner, 1984).

Surveys quickly determined the extensiveness both of the public's ignorance about computers and their belief in computers' importance (Schiller and Gilchrist, 1971; Cooper and Pace, 1982; Semple, 1983; Schuttenberg, McArdle, and Kaczala, 1985). While conceptualizing what computer literacy meant, educators recognized the importance of creating positive attitudes toward computing (Hooper, in Johnson and Tinsley, 1977; Brumbaugh, Moursund, in Seidel et al., 1982; Zamora, 1982; Sloan, 1985). The assumption of novices' entry state of apprehension was evidenced by a spate of newly coined terms including user resistance (Croisdale, in Jackson and Wiechers, 1979); computer phobia (Watt, 1980, in Seidel et al, 1982); computer tension (Rottier, 1982); technological alienation (Ringle, in Lawton and Gerschner, 1982); technostress (Bond, 1982); chipophobia (Payne, 1983); and computer cowardice (Grobe, 1984).

However, when broad statements of aims for computer literacy were translated into educational objectives, affective goals became secondary at best, in deference to content statements that could define programs (Blakeley, in Johnson and Tinsley, 1977;

Johnson et al., 1980). The reasons were simple. Attitudinal objectives only guided decisions of what material was to be taught, while content objectives provided specification. Desired attitudinal outcomes were difficult to express in a behavioral sense, (Lower, in Lewis and Tagg, 1980:157) and resisted simple attempts to quantify degrees of success achieved. (Lopez and Hymel, 1981; Law, 1984) As Ayscough (Lewis and Tagg, 1980:10) complained when discussing software development:

> Attempts to assess attitudes on any quantitative scale are unlikely to be satisfactory, and the more finely one tries to analyse the details revealed by interview, questionnaire, etc, the more difficult it is to point to firm conclusions.

Yet, content-oriented objectives statements did not prove completely satisfactory. Establishing content objectives with unanimity proved more difficult than expected (Moursund, 1982; Laubacher, 1982; Laney, 1985), especially when attempts were made to transcend contextual limits (Shore, 1984; Talley, in Bonner, 1984; Brumbaugh, Seidel, Sonquist, and Zinn, in Seidel et al., 1982). Also, measures of knowledge and skills did not provide explanations for the varied reponses of naive users toward computers recognised in working environments. Schwaller (1983), referring to Bloom's taxonomy, suggested that people are motivated more from the affective domain than the cognitive or psychomotor. (See also Kling, 1982.) A more positive view developed toward sentiments such as that of Johnson and Tinsley (1977:14), "Probably more important than teaching informatics by itself is the development of a realistic attitude." Lumsden and Norris (1985:53) provided an example of the increased importance attached to attitudinal research, "Before reluctant teachers --and administrators --can be 'won over,' their beliefs and attitudes toward computers in education must be known and understood." (See also Mathews and Wolf, 1983:2.)

It remained for valid measurement of attitudes toward computing to be demonstrated. In general, two procedures are commonly used for measuring attitudes. The semantic differential involves a dichotomy of terms about the topic, with five to seven blanks provided for indicating one's position between the two extremes. A second procedure involves Likert-type scales. A statement about one aspect of the topic is provided, followed by five choices. These choices usually vary from strongly agree to strongly disagree, with variations on the choices depending on context.

In both procedures, analysis of responses to determine validity of items proceeds similarly. A principal components analysis of item correlation is followed by oblique and varimax rotations. This provides groupings of items that tended to be scored similarly by respondents, and the correlations of each item with the as-yet-unnamed factor identified. If sufficient items comprise the group, the identified factor can be named by the nature of the items. This provides an instrument that can be held to measure an attitudinal factor, and can be used to survey groups or, in conjunction with other data, to determine relationships with other factors.

Reece and Gable (1982) provide a good example of this procedure. In an attempt to find support for their belief that attitudes have cognitive, behavior and affective components, they assembled thirty statements with Likert-type scales attached. Ten statements were composed to relate to each of the three components. With a sample comprised of grade seven and eight students providing data, nine factors were isolated. Eight of them, however, were based upon too few items to provide meaningful interpretation. Table 1 (page 10) contains the ten statements with loadings exceeding .40 on the factor they labelled General

TABLE 1

Sample Likert-type Statements (Reece and Gable, 1982)

Statement (Component expected, loading obtained)	
1. I will use a computer as soon as possible.	(B, .83)
2. I will take a computer course.	(B, .73)
3. Learning about computers is boring to me.	(A, .58)
4. Computers can be used to save lives.	(C, .55)
5. Computers make life enjoyable.	(A, .55)
6. I enjoy computer work.	(A, .54)
7. Having computers in the classroom would be fun for me.	(A, .48)
8. I would never take a job where I had to work with computers.	(B, .46)
9. If I had the mmoney, I would buy a computer.	(B, .45)
10. I like learning on a computer.	(A, .43)

Components:

A = affective; B = behavior; C = cognitive

Attitude Toward Computers. Their prior categorizations of the statements are provided (A = Affective, B = Behavior, C = Cognitive) along with the loadings on the single factor that emerged. Reece and Gable suggested these ten items comprise an instrument for determining students' attitude (now singular) toward computers.

Full-statement stimuli as in Likert- type instruments can specify the intended interpretation more than semantic differential instruments, but appear also to tend to be context-specific and time-specific as a result. The passage of time influences the applicability of items: in Reece and Gable's instrument, item nine would be responded to differently by those who already own a computer, a possibility which is much more likely now (What's New, 1984) than when the test was first validated. Also, it may be susceptible to socioeconomic influence, making it less suitable for purposes involving comparison among different populations. Persons without any exposure to computers would find items six and ten difficult to answer intelligibly. Stimuli such as "I will take a computer course," will not determine attitudinal factors where such a course may be a compulsory part of the respondent's future. Concerns such as these limit transferability of Likert-type statement instruments from one context and purpose to another.

Semantic differential items may be more transferable, because two-word stimuli may not be as context-sensitive. Kerber (1982) demonstrated this to a certain degree by using an instrument designed by Zoltan and Chapanis with a different audience. Zoltan and Chapanis had administered a set of 41 semantic differential pairs with seven-position scales to a group of professionals, finding six factors emerging: Efficiency, Humanization, Enjoyment, Difficulty, Computer as Partner to Man, Computer as Slave to Man. Kerber, using college students as a sample, obtained four factors: Efficiency, Humanization, Enjoyment, and Difficulty. The items that provided loadings exceeding .40 on the four factors are listed in Table 2 (page 13) along with the mean response and standard deviation for each factor (on a scale from 1 to 7). Kerber (12) suggested,

> Reponses to the semantic differential items in the present study yielded factors that correspond very closely to ... [Zoltan and Chapanis{, despite different populations. The four dimensions may represent the most important features of the computer for non-computer scientists.

TABLE 2

Semantic Differential Items (Kerber, 1982)

Factor (with mean and standard deviation), followed by items and factor loading

1. Efficiency (mean = 2.02, standard deviation = 0.66)

precise ....inexact	.47
dependable.....undependable	.65
trustworthy....untrustworthy	.44
effective......ineffective	.59
efficient......inefficient	.60
reliable.......unreliable	.70

2. Humanization (mean =5.04, standard deviation =1.13)

personalizing..depersonalizing	.82
flexible.......rigid	.40
personal.......impersonal	.77
warm...........cold	.61
humanizing.....dehumanizing	.78

3. Enjoyment (mean = 2.27, standard deviation = 0.91)

stimulating....dull	.59
fun............dreary	.77
desirable......undesirable	.43
pleasing.......disgusting	.56
enjoyable......unpleasant	.81

4. Difficulty (mean = 3.81, standard deviation = 0.96)

difficult......easy	.55
demanding......obliging	.49
frustrating....satisfying	.45
bossy..........obedient	.51
dominant.......submissive	.51

TABLE 3

Semantic Differential Factors and Items

(Williams, Coulombe, Lievrouw, 1983)

Item	Factor loadings (General Evaluation, Quality, Ease of Use, Expense) *
good............bad	(.73, ---, ---, ---)
smart...........stupid	(---, .52, ---, ---)
interesting.....boring	(.52, ---, ---, ---)
easy............hard	(---, ---, .53, ---)
fast............slow	(---, .42, ---, ---)
beautiful.......ugly	(---, .53, ---, ---)
expensive.......cheap	(---, ---, ---, .55)
new.............old	(---, .50, ---, ---)
same............different	(---, ---, ---, .42)
special.........ordinary	(---, .58, ---, ---)
understandable..confusing	(---, ---, .71, ---)
big.............small	(---, ---, ---, .59)
simple..........complicated	(---, ---, .81, ---)
hardworking.....lazy	(.40, ---, ---, ---)
organized.......disorganized	(.55, ---, ---, ---)
important.......unimportant	(.44, .41, ---, ---)
colorful........dull	(---, .46, ---, ---)
creative........unimaginative	(.70, ---, ---, ---)
fun.............uninteresting	(.82, ---, ---, ---)

* only loadings exceeding .30 are given

Kerber also searched for relationships with the attitudes he measured. He determined participants' prior extent of experience with computers with a checklist listing various categories of experiences. He requested an indication of errors in learning within those experiences, and of prior courses in computer science. With other scales he measured locus of control and interpersonal trust. His findings suggested that locus of control and interpersonal trust were unrelated to attitudes. Also, the more errors subjects reported, the more they described the computer as difficult, but errors were unrelated to the other three dimensions. Lastly, "experience with computers (in the form of computer science courses) was associated with favorable attitudes." (10)

Williams, Lievrouw, and Coulombe (1983:5) used a similar instrument with 24 semantic differential items, with children aged 10 to 14 attending a one-day computer camp. The similarity of all respondents' context was increased by only using the responses of children who reported having no previous exposure to home computers. As a result of such homogeneity in the sample, a quite precise stimulus could be used. Students were asked to indicate their opinion toward, "computers like the ones they had been using or others they had heard of." Table 3 (page 14) shows the items that were found to have loadings of at least .40 on one or more of the four factors they found. An important difference exists in this set of four categories: two are relatively small, having only three items each, and there is considerable overlap between the other two factors, which was not the case for Kerber. Indeed, the General Evaluation factor accounted for over half of the variance extracted in the analysis.

Williams and his colleagues also looked for relationships with other measures. Neither sex nor age were related with General Evaluation or Expense, but both were slightly related to quality with girls and younger children tending to rate computers on this dimension slightly less favorably. That tendency was much stronger on the Ease of Use factor.

Central to the intent of Williams and his colleagues was the intention of demonstrating whether children's attitudes were simple and global, or complex and multi-dimensional. He described his results as having, "revealed a degree of complexity of attitudes between the two extremes." (5) As he had theorized earlier, in consideration of children's exposure to mass media and advertising, "it is quite likely that children are developing differentiated and complex attitudes towards these machines." (4)

Certainly Kerber's results, as well as Zoltan and Chapanis' results, support a multi-dimensional nature to public attitudes about computers. Yet not all studies have corroborated this view. As described earlier, Reece and Gable found only one factor, despite designing their instrument to differentiate among three, as their theory led them to expect. Others assume multiple dimensions (Lopez and Hymel, 1981) or single dimensions (Fine, 1979; Yuen, 1984), but do not verify that their instruments obtain such results. Collis (1985:5), who used Likert-type statements with students in grade eight and twelve, also expected multiple factors, but found that,

> A single factor was found to dominate the response patterns of students in all four sex/grade groups. ... The unidimensionality of students' attitudes toward computers is somewhat frustrating in that logical plans for intervention to produce attitudinal change are not readily suggested.

Collis makes a significant distinction regarding item design in attitude questionnaires. In comparison to items that inquire about personal involvement with computers, Collis (3) found much less effectiveness in items, "which convey a sense of the external world," concluding that, "secondary students respond to computers in a personal way."

The importance of this dichotomy in item types may be apparent in Reece and Gable (Table 1). The item, "Computers can be used to save lives," conveys a sense of computers in the external world, while the item, "I enjoy computer work" conveys a personal sense of involvement with computers. Of the ten statements out of thirty which Reece and Gable found effective, nine are personal, written to capture behavior or affective components of respondents' attitudes, along with one cognitively oriented question. For other examples of external-sense Likert-type items about computers, see Mathews and Wolf (1983) and Low (1984).

Is this dichotomy at the root of the incongruence between the generalized support for computers and computer literacy determined by so many studies, and the repeated instances of friction in the man-machine interface with naive users? Vermette, Orr, and Hall (1986:45) administered an instrument of 22 Likert-type statements of both external and personal orientations to elementary school teachers and their students, and found that, "While individuals in both groups tended to express positive views of computers in education, their perception of the effects of computerization on them personally and individually tended to be negative." However, no attempt to verify their instrument is reported, and analysis was conducted on an item-by-item basis.

It is harder to determine whether semantic differential questions extract externally oriented attitudes or personal ones. Kerber's difficulty and enjoyment dimensions would appear to be personally oriented toward the act of computing; precision and personalization may be more externally oriented towards computers themselves.

Also important would be the operant stimulus toward which the respondent is told to apply the semantic differentials. Although Williams and colleagues (see above) had the opportunity to use a precise descriptive stimulus because they had a limited sample population with common experience, most stimuli are single words or noun phrases. 'Computer science' (Lopez and Hymel, 1981) or 'micro-computers' (Yuen, 1984) may offer different degrees of personal involvement of the participant with the item than would 'computers'. Collis (1985:3) pretested to choose between the stimulus words computer, home computer, and microcomputer, but did not report any significant differences in response among them.

In the National Assessment of Educational Progress (NAEP) in 1980 in the United States, Likert-type items measuring attitudes toward computers reflected no attempt by their designers to personalize the stimulus sentence (Low, 1984). However in the same test, a different approach to personalizing the intent of the stimulus was adopted to study attitudes toward mathematics. (Anderson et al., 1981) They used verb form stimuli, such as 'solving mathematics problems,' 'learning mathematics,' and 'doing mathematics.' Thus reference was made to the act, rather than to the object, which may have created a more personal response. A similar style was used successfully by Boswell and Katz (1980) in a study which identified strong sex-based differences in attitudes toward mathematics, in keeping with reported differences in motivation toward the study of mathematics.

Table 4 (page 21) shows ten statements from the NAEP which Anderson and his colleagues found had loadings on the two attitudinal factors Enjoyment and Motivation. Notice that such stimuli would only have meaning to those who were involved in classes on the subject, something taken for granted with secondary

TABLE 4

Likert-type Mathematics Attitude Items, NAEP

Anderson et al., 1981

Enjoyment dimension:

1. I feel good when I complete a mathematics problem alone. (loading * = .56)
2. I usually do well in mathematics class and like it very much. (.71)
3. I enjoy mathematics. (.53)
4. I am good at mathematics. (.73)
5. Learning computing is mostly memorizing. (-.40)

Motivation dimension

1. I am willing to work hard to do well in mathematics. (.65)
2. Most of mathematics has practical value. (.40)
3. It is important to know mathematics in order to get a good job. (.40)
4. I would like to take more mathematics. (.54)
5. I am taking mathematics only because I have to. (-.47)

* Anderson obtained different loadings with different samples and tests. One result is reported for comparison purposes.

students of mathematics. Such an approach could only apply to computing in specific contexts.

Overall, can we conclude that computer literacy courses result in more positive attitudes toward computing? As this is a primary intent of such courses, (Watt, in Seidel et al., 236) one would assume that positive attitudes would be an outcome of a computer literacy program. Some research provides support for this, by demonstrating that those with computer literacy training have more positive attitudes toward computers than those without such training. The Collis (1985:4) study found that participation in a computer literacy unit was related to more positive attitudes about computers for boys, but not for girls. Others did not attempt to differentiate by sex. Kerber (1982:10) reported from his sample of undergraduate college students, "experience with computers (in the form of computer science courses) was associated with favorable attitudes." Yuen (1984), using a questionnaire that included 25 Likert-type attitude statements, obtained a correlation of .219 between microcomputer training and more positive attitudes among vocational education teachers. Holder (1984), following a survey of business education teachers, concluded,

> Those persons who had had computer training indicated that they do not feel tense and frustrated while those without training indicated that they are very tense and experience a high level of frustration when working with the computer.

There exists an alternate explanation for this relationship, however. Rather than claiming that the training created more positive attitudes toward computers, it could be claimed that those with more positive attitudes toward computing elect to enroll in computer training. Support for such a position is found in a study by Killian (1984). She compared the entry attitudes of teachers who chose involvement in computer literacy classes to a set of data from a national survey of teachers. Using the identical instrument, she found strong differences in interest in learning about computers. Course participants were much more positive about the influence of computers in education.

One study based upon a pretest/posttest design does demonstrate that a computer literacy program can impact positively upon attitudes of teachers toward computers, although its sample was comprised solely of voluntary participants. Using a 12-item semantic differential assumed to measure a uni-dimensional attitude toward computers, Lopez and

Hymel (1981) tested two groups' change in attitude during two comparable, extensive computer literacy programs for mathematics teachers. One program was for teachers who had under 18 hours of college mathematics and taught grades 5 to 9, while the other program was for those who had more than 18 hours of college mathematics and taught high school. The two groups, both of which were all female, received slightly different programs centered upon BASIC programming. Using the Wilcoxon Matched-Pairs Signed-Ranks Test, which uses only direction of change between pretest and posttest, without regard to magnitude, no significant difference could be claimed with group one, while for group two a slight but significant ($p < .05$) improvement in attitudes toward computers was obtained.

Is there a difference in attitudes toward computers between males and females? The evidence is mixed. Mathews and Wolf (1983) found a small variation between sexes among children on one of two dimensions, similar to the finding of Williams and his colleagues (1983) mentioned earlier in this chapter. However, their instrument consisted of external-sense items, and it is doubtful whether the small difference they obtained could be assumed of relevance to motivation to be involved with computers. In support of such a distinction, Collis (1985:4) found that females and males had similar views of computers' importance in the world, but that females personally express less desire to learn about them. She concluded, "Females feel that women as a group can be successfully involved with computers, but assess themselves, individually, as not being competent."

Sex-based differences appear to be a topic marked by strong statements. For example, Lockheed and Frakt (1984:16) summarize current research as saying that, "Survey after survey shows that the present generation of school-aged girls maintains a high degree of awareness of and interest in computer technology." However, Poplin, Drew, and Gable (1985:insert) conclude from a more recent study that "Women report significantly less interest in the computer ... than their male counterparts." A very similar statement was made by Jackson and Yamanaka (1985:13), who used four instruments similar to Likert-type scales to determine technical goals, technical literacy, computer enjoyment, and exposure to computers, along with a multiple-choice microcomputer vocabulary instrument. Their intent was to identify contributing factors to women's tendency to avoid occupations that included technical activities. With a sample designed to be representative of Canadian women, they found one strong and significant correlation (r = .427) relevant to this study. As distinct from computer exposure or knowledge, enjoyment was the greatest factor related to differences in women's technical goals. However, because no comparative data with men was obtained, we can not claim this to be either a sex-specific or a general conclusion.

Vermette, Orr, and Hall (1986:46) made an interesting distinction between sex-linked differences and sex-typing. From samples of 116 elementary students and 50 elementary teachers, they found that, "Significant sex differences in attitudes were generally not expressed among students or teachers, although there was some indication of sex-typing regarding domination by males of computer activities, skills, and interests." Sex-linked differences are apparently a delicate and unresolved issue in computer literacy education.

Results are equally inconclusive about whether attitudes toward computing are generally positive or negative among computing novices, even within teachers as a subgroup. In their study described earlier, Vermette and colleagues (1986:46) reported, "Both students and teachers acknowledged the educational value and potential of computers, but they were basically negative about the effects of computerization on them personally." Yet, Lumsden and Norris (1985:58) reported from a survey that involved over 75% of all teachers in a small school division, "87% of the educators in the survey agree or strongly agree that they do not feel threatened by computers. An even greater proportion (89%) would like to attend in-service training on computer use in education."

In summary, it is apparent that computing novices form a significant proportion of the general population, and of both teacher and student groups in general. Yet, little has been determined conclusively about their attitudes. Specifically, measures performed upon computer literacy course participants can not be applied to broader populations, as participation in such a course may select a specific set of entry attitudes toward computing. For the same reason, differences between participants and computer novices can not be attributed to the influence of the course, in the absence of comparable entry and exit measures. Studies based upon surveys of full populations about hypothetical involvement with computers may not garner responses based upon those personal aspects of attitudes that determine motivation toward learning computing skills. This study attempted to avoid such limitations.

Hypotheses

In general, it was my belief that entry attitudes would have significant bearings upon the impact of computer literacy courses. I expected that it was not appropriate to assume that novice users' entry attitudes were shallow or transient, nor that experienced users' entry attitudes were intransigent. Entry attitudes of both groups were expected to bear significantly on exit attitudes. Individuals from both groups were expected to experience attitudinal change as a result of an extensive computer literacy course, with novice users as a group becoming generally as positive regarding computing as experienced users. The following specific hypotheses were studied:

1. There will be no significant difference in the attitudes of male and female sub-groups.

2. The attitudes of experienced users are more positive than those of novices at the beginning of the course. The attitudes of both subgroups will not contrast significantly at the end of the course.

3. Experienced users' attitudes will not be changed significantly by the group. That a significant positive change will be observed among novices is a corollary of the prior statement and hypothesis two.

4. Exit attitudes will correlate highly with exit motivation. Of the four factors, enjoyment will correlate most highly with motivation.

The chapter that follows describes the experimental procedure followed. It specifies the population studied, the instrumentation, and the analyses which were used to explore these hypotheses.

CHAPTER III

DEVELOPMENT OF THE STUDY

Description of the Population

When the University of Calgary instituted a mandatory computer literacy course for Faculty of Education students in the academic year 1984-1985, it was the first teacher education institution to do so. (Black, 1985:1) The course was placed in the practicum year, which included practice teaching, so that its 30 hours each of lab and lecture time was compacted into seven weeks. Instruction covered five topics designed to operationalize the concept of computer literacy for future teachers: introduction to computers in education, programming in LOGO, word processing and utility programs, instructional design and computer assisted instruction, and programming in BASIC.

This study involved six of the seven sections in the winter session of 1985, totalling about 130 of the 400 education students in practicum that year. Students were grouped into sections dependent upon their teaching area, although there was considerable crossover to accommodate special cases and to balance class size. Instruction for each section was provided by one of three instructors, guided by a prescriptive course outline, common lab assignments and common final exams.

The population used may be held to be representative of university students in an Education route, since the compulsory nature of the course removes any sampling errors due to self-selection. However, generalizing the sample beyond such bounds would not be statistically justifiable. Further, because computer literacy courses vary considerably in their objectives and design, any influences of this course should not be generalized as indicative of all courses.

Instrumentation

The entry instrument had portions dealing with computing attitudes, prior experience with computers, along with categorical data regarding course section, educational major, and sex. (See Appendix A) The exit instrument repeated the computing attitudes portion of the entry instrument, and closed with a measure of exit motivation and enjoyment of computing. (See Appendix B.) There was one sex-typing inquiry. Both instruments requested a three-letter personal code that would allow matching of the two instruments without threatening anonymity of response. Both instruments also included other items not relevant to this study.

Attitudes toward computing were determined by a series of 25 semantic differentials, each with seven positions provided. Twenty items were chosen from the 41 semantic differential items designed by Zoltan and Chapanis (1981), these being the five found by Kerber (1982) to have loadings in excess of .40 on each four factors. (See Table 2, page 13.) Items were listed alternately so that items a, e, i, m, and q related to the Precision factor; items b, f, j, n, and r related to Humanization; items c, g, k, and o, and s related to Enjoyment; and items d, h, l, p, and t related to Difficulty.

Items u to y are the five items from Williams and colleagues (1983) found to have loadings exceeding .40 on a factor labelled General Evaluation of Computers. Because these items are all similar to items from various factors in Kerber's list, they served a correlative role, while serving as a unidimensional alternative to Kerber's four factors.

The stimulus word 'computing' was chosen for use in the semantic differential directions, in an attempt to obtain those aspects of attitudes relating to personal and individual involvement with the act of computing, as described in the previous chapter. The context of invovlement in a hands-on computer literacy course was also expected to encourage personal involvement orientations to the items.

The seven positions provided for each response were coded 1 to 7, with the total of five scores representing each factor. When the scores on the Difficulty factor were reversed, all factor scores ranged from a minimum of 5, which was generally positive, to a maximum of 35, which was generally negative. The name of Kerber's Difficulty factor was changed to Ease of Use, to correspond to its new orientation.

A checklist procedure used by Kerber (1983) formed the basis for measuring prior computing experience. A list of nine possible computing activites was provided, with three positions (corresponding to work, school and other) provided for each activity. Subjects checked those activities which they had previously done. Number of checkmarks had a theoretical range from a minimum of 0 to a maximum of 27. Participants also indicated the hours spent with a computer in the three environments, with four choices built upon an exponential scale.

Two categories were established for comparison purposes. Inclusion in the Novice group required less than four types of experience, and no more than one area with one to ten hours. Inclusion in the Experienced group required at least six types of experience and indication of at least twenty hours total experience.

Lastly, students were asked to provide demographic data, consisting of their program and sex.

The exit instrument begins with the same attitudinal items used in the entry instrument. There was also a second attitude measure, consisting of eleven statements, each with Likert-type response scales with five positions ranging from strongly agree to strongly disagree. These statements were adapted from Anderson and colleagues' selections of items the NAEP found effective in distinguishing the factors of Motivation and Enjoyment of 17-year-olds towards doing mathematics. Again, 'computing' served as the verb-form stimulus. Five measures of Enjoyment (items a, c, e, g, i) were alternated with five of Motivation (items b, d, f, h, j). The eleventh item (Computing is more for males than females.) checked for possible sex-typing in perceptions of computing. Five positions from strongly agree to strongly disagree provided a response scale.

Separate scores for Enjoyment and for Motivation were obtained from these Likert-type instruments by adding the scores from 1 to 5 obtained by each stimulus in each category, with items a through h reversed for similarity of direction among measures. Scores for each factor could range from a minimum of 5, which is generally positive, to a maximum of 25, which is generally negative.

Because the form of the Likert-type items requested feelings experienced during the act of learning computing, it could not be used in the entry instrument. As such, they could not be used in direct pre/post comparisons. However, the existence of Enjoyment factors in both the semantic differential and Likert-type procedures provided an opportunity to compare procedures. The Likert-type statements are definitely oriented toward personal or internal attitudes as Collis (1985) recommended, involving affective and behavioral attitudes, as Reece and Gable (1982) distinguish. Thus they were expected to provide an interesting comparison with the semantic differential items which provide less specification.

The Motivation factor was expected to serve another purpose. The designers of the course and the instructors emphasized the inadequacies of the course in providing students with sufficient content for significant involvement with computers in the schools. A stated intent was to encourage students to pursue more opportunities to learn. This intent could be expected of any study that introduces a fundamental and essential body of skills and knowledge, and is made more important as a measure of course success when that content tends to require updating as with computing. Thus, scores on the Motivation factor were regarded as an exit measure of course success, for comparing with other measures in search of attitudinal involvement.

Data Collection

Each subject completed two questionnaires during class time. The entry instrument was distributed in the first class, and a total return above 90% was obtained by a follow-up opportunity in the second class. The exit questionnaire was administered similarly at the end of the course. Although no attempt was made to include those who had discontinued the course after completing the first questionnaire, more than 80% of entry participants completed both instruments.

About ten per cent of questionnaires completed were not matched with its partner questionnaire. This resulted in their elimination from correlations and all pre/post comparisons, although they were included in group averages. Also eliminated were questionnaires with sections not completed. If four of five items in a section were completed, the questionnaire was included, with the missing score for that section replaced by the mean of the other four scores. A total of 118 instruments were left after these elimination procedures, or 82% of the enrollment.

The unique technique of identifying questionnaires by three-letter code was not wholly satisfactory. First, too many people forgot their chosen code, until shown a class list of codes, after which about 5% still could not identify their choice. Second, the procedure changes the way correlations with other factors can be approached. This resulted in unsatisfactory attempts to determine course grade and grade point average by request. The procedure may well have encouraged more honest responses as it definitely guaranteed protection, but that would have to be balanced by the potential loss to unmatched codes of significant numbers of participants' results. In situations where researchers wish to match other records, it would also be inappropriate.

Statistical Procedures

All statistics were produced on the University of Calgary Honeywell Multics computer system using Statistical Package for the Social Sciences software.

For descriptive purposes, means and standard deviations wwere obtained for all numerical data. For categorical data, frequencies were reported for each sub-group.

Relationships among the twelve separate factor scores (five from the entry instrument and seven from the exit instrument) were investigated first. It was anticipated that attitude scores on any one factor would reflect similarity with the scores on other factors. Pearson product-moment correlations were reported between each pairing of entry attitudes, and between each pairing of exit attitude factors. Also reported were correlations between each factor's entry scores and its corresponding exit scores.

No comparison between classes was attempted. Though significant differences in teaching procedure among the three instructors existed which could have provided interesting comparisons of effects, that was not the intent of the study. Also, without control of student placement, the bias due to streaming of students by teaching major would have diluted any claims that observed differences would be attributable to teaching differences. Further, the strong influence of common course curricula, labs, and final examinations would minimize otherwise observable differences.

Comparisons were made between the Experienced sub-group and the Novice group. For this purpose, those subjects not defined as members of either group were omitted. T-test comparisons between groups for each of the five entry measures and the seven exit measures of attitudes were made. The t-test provides the probability that a t-value at least as great as the obtained t-value would result from chance distribution. As prior research tends to suggest the direction of relationship, one-tailed values were reported.

Identical procedures were followed to compare male and female subgroups. A t-test compared female scores with male scores on each of the entry instrument's five attitudinal factors, and on each of the exit instrument's seven attitudinal factors. Because of inconclusive findings by earlier research, the t-values obtained were considered two-tailed.

Further to this, responses to the single sex-typing item were studied. However, because of the extremely skewed response (100 strongly disagree, 9 disagree, 9 neither, no agree or strongly agree), no statistical analysis was conducted.

To quantify change in attitude as a result of the experience of the course, scores provided by each participant in each of five attitude factors on the entry instrument were compared with each score from the exit instrument. Correlated t-tests, which compare two dependent variables subject by subject, were used to explore this hypothesis. Test results were obtained for the full sample, for novices, for experienced users, and for each sex. For these t-tests, obtained values were considered one-tailed, as a positive direction in the changes was expected.

Post Hoc Procedures

To explore the importance of one factor's strong correlation with exit motivation, a partial correlation (with the effects of the one factor removed) between exit motivation and the other factors was performed. This test corrects for the variance due to one factor before providing a correlation between two other factors.

Following in the next chapter are results for all data analyses described above. For purposes of interpretation within this study, statistical significance of correlations and t values was accepted if the probability that the obtained value was due to chance was less than .05. However, scores that approached that arbitrary significance value are mentioned, and exact probability values for all scores are reported in the tables, to allow the reader to decide upon a personally acceptable statistical significance level.

CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

In this chapter, six sets of tables are presented and explained. Results are described in the context of the research question to which they apply.

Entry Attitudes

Table 5A (page 43) shows basic descriptive statistics for entry attitudes, for the total sample. According to the four Kerber factors, computing was viewed as extremely precise (11.7 on a scale from 5 to 35, S.D = 3.81) and quite enjoyable (15.3, S.D. = 5.89), but scores on the Humanization / Dehumanization factor and Ease of Use / Difficult factor are intermediate (23.7, S.D. = 5.91; and 21.6, S.D. = 5.01, respectively). The Williams factor, General Evaluation, also shows a strongly positive score (12.0, S.D. = 5.27). The standard deviations of four of the five factors exceed one position per question on the seven-position scale used, suggesting considerable, but not extreme, variation within the sample.

Table 6A (page 44) shows correlations among the five entry factors. The relationships reflect extremely low probabilities that the observed corre-

Table 5

Descriptive Data, n = 118

A. Entry Semantic Differential Factors *

	Factor	Mean	Std. Dev.	Min, max.
1.	precision	11.7	3.81	5, 23
2.	humanization	23.7	5.91	11, 35
3.	enjoyment	15.3	5.89	5, 34
4.	ease of use	21.6	5.01	5, 35
5.	general evaluation	12.0	5.27	5, 32

B. Exit Semantic Differential Factors *

	Factor	Mean	Std. Dev.	Min, max.
1.	precision	11.7	4.78	5, 33
2.	humanization	20.9	5.90	9, 35
3.	enjoyment	13.7	5.87	5, 35
4.	ease of use	21.3	4.90	9, 34
5.	general evaluation	11.7	5.21	9, 34

C. Likert-type Scale Factors *

	Factor	Mean	Std. Dev.	Min, max.
1.	enjoyment	10.6	3.09	5, 19
2.	motivation	10.2	3.54	5, 24

D. Categorical Data Frequencies

Experience	Male	Female	Totals
novice	7	35	42
other	8	32	40
experienced	11	25	36
totals	26	92	118

* All scores have been inverted as necessary so that lower scores are generally indicative of positive attitudes. All factor scores are the sum of 5 items. Semantic differential scores have a theoretical range from 5 to 35. Likert-type scale scores have a theoretical range of 5 to 25.

Table 6

Correlations Among Attitude Factors

A. Entry Semantic Differential Factors

Factors	Factor 2	Factor 3	Factor 4	Factor 5
1. precision	.160 (.042)	.477	.165 (.037)	.551
2. humanization		.484	.391	.423
3. enjoyment			.346	.848
4. ease of use				.280 (.001)
5. general evaluation				

B. Exit Semantic Differential and Likert-type (L) Factors

Factors	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
1. precision	.316	.652	.238 (.005)	.694	.549	.452
2. humanization		.616	.332	.485	.483	.468
3. enjoyment			.346	.887	.759	.683
4. ease of use				.254 (.003)	.345	.291 (.001)
5. general evaluation					.704	.713
6. enjoyment (L)						.709
7. motivation (L)						

C. Entry and Exit Factor Correlations

1. precision	.441
2. humanization	.565
3. enjoyment	.581
4. ease of use	.596
5. general evaluation	.615

Probabilities are reported in brackets. For all correlations with no reported probability, $p < .005$

Table 7

Partial Correlations
Correlations of exit attitudes with exit motivation, controlling for semantic differential enjoyment factor

	Factors	Corr	Prob
1.	precision	.012	.447
2.	humanization	.083	.187
3.	enjoyment	---	---
4.	ease of use	.080	.196
5.	general eval.	.320	.000

lations were due to chance ($p < .0005$ for seven of ten correlations, with all probabilities less than .05). However, there is considerable range in size of correlations, with Enjoyment and General Evaluation correlating .848, meaning that variation in one factor accounts for 70% (.848 squared) of the variation in the other. Precision also correlates highly with General Evaluation (and thus with Enjoyment, naturally), with scores of .551 and .477.

Precision correlates relatively poorly with Humanization and with Ease of Use, ($r = .160$ and $r = .165$ respectively. Ease of Use correlates least of any of the four Kerber factors with General Evaluation ($r = .280$).

Exit Semantic Differential Factors

Table 5B shows basic descriptive statistics for the five semantic differential attitude factors upon completing the course for the whole sample of 118. According to the Kerber factors, computing was viewed as extremely precise ($\overline{x} = 11.7$) and enjoyable ($\overline{x} = 13.7$), with scores in the midrange on the other two factors ($\overline{x} = 20.9$ for Humanization and $\overline{x} = 21.3$ for Ease of Use). General Evaluation also was extremely positive ($\overline{x} = 11.7$).

From the correlations in Table 6B, again the dominant relationship between Enjoyment and General Evaluation is apparent (r = .887), with Precision again correlating highly with both (r = .652 with Enjoyment, r = .694 with General Evaluation). More complex patterns also imitate those of the entry attitude correlations. For example, although Both Humanization (r = .616) and Precision (r = .652) correlate highly with Enjoyment, they correlate only moderately with each other (r = .316). The Ease of Use factor appears least correlated with others of any of the five semantic differential factors.

Exit Factor Comparisons

Table 5C shows the means from Enjoyment (10.6, S.D. = 3.09) and Motivation (10.2, S.D. = 3.54) as measured by Likert-type statements. In a theoretical range from 5 to 25, both can be interpreted as strongly positive, with a translated meaning to the Likert-type scale of "Agree." With the standard deviations representing less than one position on each five-item score, some homogeneity of response is suggested.

Table 6B includes correlations among all exit attitude factors, including the Likert-type factors, which correlate with each other strongly ($r = .709$). The two Enjoyment factors correlate strongly ($r = .759$), as do semantic differential Enjoyment and Motivation ($r = .683$). Both Likert-type factors also correlate highly with General Evaluation ($r = .704$ and $r = .713$ for Enjoyment and Motivation respectively). Again Ease of Use provides the least correlations, .345 and .291 respectively.

Table 7A (page 45) shows the results of a post-hoc test to see the extensiveness of the Enjoyment factor's influence upon exit Motivation. By controlling for the influence of the semantic differential Enjoyment factor, partial correlations were computed for the other four semantic differential measures with Motivation. The correlations were significantly reduced, with only General Evaluation, which had strong correlations with both Enjoyment and Motivation as mentioned above, having a significant partial correlation remaining.

Subgroup Analyses

Table 5D provides a crossfrequency count for sex and entry experience grouping. Males form 17% of the novice group, compared to 30% of the experienced group. Experienced subjects make up 42% of the males, compared to 27% of the females. This suggests that any significant differences attributable to entry experience will be reflected to a degree in sex-related scores. In other words any sex-based difference will be observable to a degree as part of the variation in entry experience.

Viewing each classification separately, males comprise 21% of the total sample, compared to 79% female. Novices comprise 36%, while experienced comprise 30%.

Sex-based Differences

Table 8 (page 50) provides T-test comparisons between the attitude scores of males and of females. In neither entry attitude factors nor exit attitude factors are significant T values obtained. In entry data (Table 8A), females reported slightly more favorable attitudes in two of four Kerber factors. In exit data (Table 8B), females report slightly more favorable scores in all factors, with only the differences in Enjoyment (both semantic differential and Likert-type) and Motivation approaching significant probabilities.

Table 8

T-test Comparison of Male and Female Subgroups

A. Entry Semantic Differential Factors

	Factor	Male Mean	Female Mean	T Value	Prob
1.	precision	12.5	11.5	1.22	.226
2.	humanization	23.5	23.8	-0.19	.847
3.	enjoyment	16.5	15.0	1.17	.243
4.	ease of use	20.6	21.9	-1.17	.243
5.	general evaluation	13.2	11.6	1.36	.176

B. Exit Semantic Differential Factors

	Factor	Male Mean	Female Mean	T Value	Prob
1.	precision	12.5	11.4	1.00	.318
2.	humanization	21.8	20.7	0.81	.420
3.	enjoyment	15.2	13.3	1.40	.164
4.	ease of use	21.6	21.2	0.36	.716
5.	general evaluation	12.9	11.3	1.41	.160

C. Likert-type Scale Factors

	Factor	Male Mean	Female Mean	T Value	Prob
1.	enjoyment	11.5	10.4	1.57	.120
2.	motivation	10.7	10.1	0.74	.460

Scores for male sub-group based upon n = 26. Scores for females based upon n = 92. Total degrees of freedom = 116. Probabilities are two-tailed.

Table 9

T-test Comparison of Novice and Experienced Subgroups

A. Entry Semantic Differential Factors

	Factor	Novice Mean	Exper. Mean	T Value	Prob
1.	precision	12.6	10.6	2.25	.014
2.	humanization	24.2	21.5	2.00	.025
3.	enjoyment	15.4	15.0	0.29	.388
4.	ease of use	23.2	19.3	3.40	.001
5.	general evaluation	12.4	11.3	0.85	.199

B. Exit Semantic Differential Factors

	Factor	Novice Mean	Exper. Mean	T Value	Prob
1.	precision	12.6	11.3	1.15	.126
2.	humanization	22.1	20.0	1.44	.077
3.	enjoyment	14.7	14.3	0.29	.382
4.	ease of use	22.6	20.2	2.14	.018
5.	general evaluation	12.5	11.5	0.75	.229

C. Likert-type Scale Factors

	Factor	Novice Mean	Exper. Mean	T Value	Prob
1.	enjoyment	11.7	10.1	2.19	.016
2.	motivation	11.0	10.0	1.18	.121

Scores for novice sub-group based upon n = 42. Scores for experienced based upon n = 36. Total degrees of freedom = 76. Probabilities are one-tailed.

Table 10

T-test Comparisons Between Entry and Exit Attitudes

A. Full Sample, n = 118

	Factors	Entry Mean	Exit Mean	T Value	Prob
1.	precision	11.7	11.6	-0.16	.437
2.	humanization	23.7	20.9	-5.48	.000
3.	enjoyment	15.3	13.7	-3.17	.001
4.	ease of use	21.6	21.3	-0.79	.217
5.	general evaluation	12.0	11.7	-0.80	.213

B. Females Only, n = 92

	Factors	Entry Mean	Exit Mean	T Value	Prob
1.	precision	11.5	11.4	-0.16	.436
2.	humanization	23.8	20.7	-5.49	.000
3.	enjoyment	15.0	13.3	-2.75	.004
4.	ease of use	21.9	21.2	-1.50	.069
5.	general evaluation	11.6	11.3	-0.74	.230

C. Males Only, n = 26

	Factors	Entry Mean	Exit Mean	T Value	Prob
1.	precision	12.5	12.5	-0.04	.484
2.	humanization	23.5	21.8	-1.48	.075
3.	enjoyment	16.5	15.2	-1.65	.056
4.	ease of use	20.6	21.6	1.20	---
5.	general evaluation	13.2	12.9	-0.31	.379

D. Novices Only, n = 42

	Factors	Entry Mean	Exit Mean	T Value	Prob
1.	precision	12.6	12.6	0.03	---
2.	humanization	24.2	22.0	-2.16	.018
3.	enjoyment	15.4	14.7	-0.84	.202
4.	ease of use	23.2	22.6	-1.00	.162
5.	general evaluation	12.4	12.5	0.13	---

E. Experienced Users Only, n = 36

	Factors	Entry Mean	Exit Mean	T Value	Prob
1.	precision	10.6	11.3	1.04	.306
2.	humanization	21.5	20.0	-1.72	.094
3.	enjoyment	15.0	14.3	-1.01	.320
4.	ease of use	19.3	20.2	1.11	.275
5.	general evaluation	11.3	11.5	0.29	.771

Probabilities are one-tailed for categories A to D, and two-tailed for category E.

Experience-based Differences

Table 9 (page 51) provides T-test comparisons between the attitude scores of 42 novices and 36 experienced users. Entry factors in Table 9A show more favorable attitudes reported by experienced subjects, with Precision (difference of 2.0, $p = .014$), Humanization (difference of 2.7, $p = .025$) and Ease of Use (difference of 3.9, $p = .001$) all reporting significant probabilities.

Table 9B and 9C show exit attitude measures. Again, all factors have more favorable attitude scores for experienced users. The difference in scores of 1.6 ($p = .016$) for Likert-type Enjoyment and in Ease of Use (difference of 2.4, $p = .018$) have significant T-values, while others approach significance in varying degrees.

Comparisons of Exit and Entrance Attitudes

Standard deviations (Tables 5A and B) tended to show the same pattern in both the entry and exit measures, with the exception of Precision, which upon exit had a standard deviation of 4.78, compared to 3.81 on entry. No evidence can be drawn from the standard deviations to suggest that the common experience of the course created more homogeneous attitudes.

Another measure between entry and exit attitudes is in Table 6C, which shows correlations for each of the five semantic differential factors. All correlations are strong, with Precision the lowest at .441, and General Evaluation the highest at .615.

Table 10A (page 52) provides both entry and exit means for comparison, using all subjects. In all five factors a decrease in scores occurred, meaning improvement in attitudes generally, but only two had significant differences. Humanization means moved to the more positive position of 20.9 from 23.7, with a change of 2.8 ($p < .0005$), while Enjoyment changed 1.6 from 15.3 to 13.7 ($p = .001$).

Table 10B shows the same comparison between entry and exit attitudes as 10A, but uses the female subjects only. As can be expected with such a large subgroup, the results generally reflect Table 10A, with Humanization (change of 3.1, $p < .0005$) and Enjoyment (change of 1.7, $p = .004$) generating significant t values.

In Table 10C, the results of males only, we see a distinction in comparison to females: the same overall pattern, but with smaller differences, none of which are below a .05 significance.. Humanization and

Enjoyment, with changes of 1.7 (p = .075) and 1.3 (p = .056) respectively, come close to significance. While the difference in means is also slightly less for males, the limited number of subjects in this subgroup could partially account for the less significant probabilities. The one surprise is Ease of Use: males actually recorded less positive attitudes in this regard at the end of the course than at the beginning (20.6 compared to 21.6). It appears that the difference apparent at the beginning between male and female was corrected by the end.

The change in attitude scores of novices is displayed in Table 10D. Two factors recorded very little change (Precision and General Evaluation), while two more (Enjoyment and Ease of Use) show marginal improvement. Only Humanization, with a change of 2.2 in the direction of more positive attitudes, showed a significant t value (p = .018).

The experienced users' changes in attitude are more mixed, as Table 10E shows. Ease of Use shows a change toward less positive attitudes, as does precision. However, Humanization and Enjoyment changed toward more positve attitudes. General Evaluation changes very little. None of these changes were significant at the .05 level, although Humanization approached that level.

With varied results for the four subgroups, two kinds of measures, and both entry and exit scores, no simple pattern emerges. However, the presence of strong correlations among measures, and the existence of significant differences in some attitude scores for some subgroups and not others, provide clarification of the issues specified in the hypotheses. Most important may be the the amount of change in novice users from entering the course to exiting, in comparison to the amount of change reported by experienced users. These results are applied to the hypotheses in Chapter V.

CHAPTER V

CONCLUSIONS

In this chapter, conclusions are presented regarding each hypothesis as stated at the end of Chapter II. A discussion of the pertinence of this study upon the issue of dimensionality of computing attitudes is followed by some recommendations for further study.

Sex-based differences

The data this study generated generally supports the first hypothesis, that there will be no significant difference in the attitudes of male and female sub-groups. No significant differences were obtained among either the five different entry attitude measures or the seven exit measures, as reported in Table 8 (page 52).

The entry data in Table 8A shows females having more positive attitudes in three of five categories. One factor presented very little difference, while only Ease of Use showed a tendency toward slightly more positive scores among males. That no significant sex-based differences emerged (specifically that males did not demonstrate more positive attitudes) is punctuated by the significant difference in entry attitudes between novices and experienced users, and the overlapping membership of the male and experienced groups.

Nor were significant differences between sexes apparent among exit attitudes in Table 8B. However, two interesting patterns emerged worthy of comment. One is the swing in Ease of Use. This was the only entry factor where males scored more positively than females, and the only factor where males' scores failed to improve. Females' scores in this category recorded an almost significant improvement, to the point where females' exit score mean was more positive than males'. However, because neither difference was statistically significant, this could be a statistical anomaly, rather than an indication of differences of perception of computing tasks.

The second pattern is less tentative. Although differences in means did not achieve the chosen level of significance, with female means more positive than male means in all seven exit measures, there is a tendency that suggests that the course more positively impacted females' attitudes toward computing than males'. Such a suggestion contrasts directly with findings by Collis (1985), who found that participation in a computer literacy course by high school students improved only males' attitudes. In this study, Table 10B (page 52) shows that when female scores are analysed separately, exit means are significantly more positive than entry means for Humanization and Enjoyment.

Why did this course succeed in slightly improving females' attitudes as well as males', when the high school courses in Collis' sample did not? Conjecture about the significant factor in course design or implementation should centre upon the humanization and enjoyment factors in which significant differences were achieved. This might include the teacher-education context of the course, or the devotion of curriculum content to issues about computing, including sex bias itself. It may relate to the interaction and sharing of tasks incorporated into lab-time. Supporting such conjecture would be the conclusion by Winer and Strauss (1984) that in terms of the Holland typology, teachers generally are socially oriented. A simpler consideration could be the presence of a strong majority of females in most sections of the course, which may serve to counterbalance access considerations mentioned by

Lockheed and Frakt (1984) or motivation considerations suggested by Jackson and Yamanaka (1985). Regardless, the results contrast with Collis' results to suggest that positive impact upon female students' attitudes toward computing is possible.

Also promising and in contrast with Collis' findings is the overwhelming rejection of sex-linked bias, as demonstrated by the responses to the question "Computing is more for males than females." While these results are similar to those obtained with teachers by Vermette, Orr, and Hall (1986), caution is advised in basing conclusions upon this data. It is based only upon responses to one question. Further, if the sex bias issue was addressed as part of the course, the responses may be more an indication of content learned than of attitudes or beliefs internalized.

Experience-based differences

As expected by hypothesis two, the entry attitudes of experienced users were more positive than those of novices. Although the pattern of means is the same for novices and experienced students, all five means show more positive attitudes for experienced users. Scores for Precision, Humanization, and Ease of Use recorded significant levels of difference.

There exist two possible explanations for the difference in entry attitudes due to prior experience. One is that experience using computers generally creates more positive attitudes toward computing among those that partake. The second is that those in a population with more positive attitudes tend to engage in opportunities to use computers more than others. If the former is accepted, then compulsory computer literacy education would be a logical path toward eliminating computerphobia. Those resisting computer involvement would not choose such a course, but would benefit through more positive attitudes for being made to take it. However, the latter explanation would suggest that even before involvement with computers, people tend to know how they personally will respond to such experiences, and their various attitudes may not be changed by experience. If so, then justification for a compulsory computer literacy course would depend upon other considerations such as content, rather than attitude change.

Comparison of exit attitudes means between those with prior experience and novices provides grounds for choosing between the two explanations. The second half of hypothesis two suggests that novice and experienced students will have comparable exit attitudes. If so, then it could be concluded that the course experience overcame the deficit in entry attitudes of novices. If significant differences remain in the comparison based on prior experience, then experience alone cannot account for differences between novice and experienced subgroups.

The exit data in Table 9 (page 51) shows the same pattern of differences in mean scores for the semantic differential factors that existed upon entry. Further, the Likert-type exit measures recorded a significant difference in enjoyment and the difference in mean scores for motivation approached significance. In both cases, students who had had prior experience had more positive exit scores than the novice students. Thus the second half of hypothesis two is rejected: experienced users continued to have more positive attitudes toward computing than novice users even after the course was completed.

Hypothesis three also bears upon this issue. It suggested that experienced users would not experience significant attitude change as a result of the further experience gained in the course. As might be expected, the difference in means between the two groups was decreased over the duration of the course. However, in two categories (Precision and Ease of Use) the decrease in mean differences was more a result of change in experienced scores than of change in novice scores. The natural preconception that experienced users' attitudes would remain static while the experience of the course would change the novice means to match with experienced means does not hold up. Thus hypothesis three is rejected.

Are the entry attitudes of novices more vulnerable to change than the experienced users' attitudes? One would assume so, in that the impact of the course would be diminished by prior computing situations. Yet, from the t-values in Tables 10D and 10E we can see that the experienced users' means changed as much as or more than novice users, over the time of the course. Comparing Table 9B to 9A can show that the differences between experienced and novice users in all five measures have been reduced by participating in the course. Yet in all five, at least half of the original difference has been retained. This persistence of novice users' attitudes seems surprising in that their entry responses could not have been based upon personal experience.

Why would the impact of the course on attitudes generally appear balanced between novice and experienced users? It may be that the specific course, with its education-specific content such as learning theory, lesson design and curriculum-oriented software offered sufficient new experiences to provide experienced users with grounds to amend attitudes that were developed in other computing contexts. However, if this were a significant factor, it could suggest that the novices' attitudes would have grounds for even more extensive changes, and this did not occur.

Again we are led to the possibility that novices' entry attitudes approached the experienced users' attitudes in terms of sophistication: they were accurate predictors of personal exit attitudes and thus resisted change as well as experienced users' atttitudes. Supportive of such a possibility would be theories that computing experience is analogous to other experiences (learning to drive? learning math?) which novices can refer to in accurately predicting their attitudes experiencing the real thing for 60 hours. If so, then measures of attitudes toward computing would prove predictive in terms of voluntary involvement with computing situations.

How little was the overall change in attitudes? Of four subgroups and the full sample results, only Precision, which was strongly positive both before and after the course, showed little change consistently among the subgroups (Table 10, page 52). Only Ease of Use showed negative change, with males and experienced subgroups. However, it is the failure to achieve significance, and the differences between means where significance was achieved, that support the conclusion that there was little change.

Only two of five semantic differential factors measured significant change from course beginning to end in the full sample. Humanization changed from 23.7 to 20.9, a difference of 2.8. Enjoyment changed from 15.3 to 13.7, a difference of 1.8. Among the subgroup measures, only one other factor obtained a difference that approached significance: Ease of Use with females recorded a change from 21.9 to 21.2, which was only significant in comparison to males who recorded an opposite change. The magnitude of these significant changes can be given perspective by reference to the measuring procedure. Each factor was composed of five items. Thus the factor changes of about 2.5 which achieved significance amount to an average movement of half a position on a seven-position scale per single item.

Possible explanations vary. Fortunately, the presence of a wide range of entry attitude means eliminates the ceiling effect, where entry measures are so high that expecting improvement is unrealistic. The ability of the scales to distinguish factors and to differentiate patterns of change among subgroups in some of those factors prohibit rejecting the results as instrument failure. Conjectural explanations could include that attitudinal change requires aging like wine, and exit measures as used by this study would fail to obtain indications of attitudes compared to delayed measures. However, any attempts to measure delayed attitude changes would be vulnerable to influences upon attitudes of subject experiences after the course.

It appears more likely that the limit in change due to the course can be attributable to sophistication in the subjects upon entry. Assuming that novices' attitudes as well as experienced users' responses reflect sophistication suggests that the subjects' entry attitudes have sufficient foundation to be persistent as experience is gained. Though the findings of this study support such a conclusion, it offers no clues as to what transferrable personal experiences would enable novices to predict their attitudes toward computing before their first experience. To the extent that it suggests naivity, the term 'naive user' does not apply.

Before accepting as previously outlined the explanation that novices' entry attitudes are persistent in resisting change and are accurate predictors of exit attitude, it is necessary to deal with an alternate explanation. Could it be that the course simply failed to have impact? This is unlikely: its length, considerable hands-on time, variety of lab activities, and considerable content all suggest that ammple opportunity for attitude change was presented. Further, other forms of evaluation of content learned and student satisfaction with the course (Black, 1985) suggest the course was successful in other areas. If novices' attitudes underwent little change, it is more logically attributable to the accuracy of each individuals' entry attitudes as predictors of exit attitudes.

Two more specific results also deserve discussion, distinct from the issue of attitude persistence. Changes in scores as a result of the course tended to follow similar patterns for novice and experienced subjects. One exception stands clear. On the Ease of Use factor, both males and experienced users registered less positive attitudes at course end, with scores approaching statistical significance in a two-tailed context. In contrast, both female and novice sub-groups registered an improvement of attitude. Because sex and entry attitude were correlated, the pairs of sub-groups is not surprising, but no explanation for the contrasting change on the one variable is apparent.

Another difference, one of degree rather than direction, relates to one aspect of theory and prior research. This is in the category of Humanization, where females and novices (remember that these groups have significant overlap) recorded extremely significant differences between entry and exit. With both experienced and male subgroups the same tendency exists, but failed to achieve statistical significance. That this factor, seemingly linked as it is to socialization differences, is of more importance to females than males (Lockheed and Frakt, 1984:17) lends importance to the difference. An improvement in the perception of females (or novices) that computing is less impersonal or isolating could be a significant contributor to exit measures of motivation and pleasure.

Attitudes and Motivation

Among the many strong relationships between factors shown by the correlations in Table 6 (page 44), the measures of enjoyment are involved in the strongest. Of the exit correlations in Table 6B, that between the two kinds of enjoyment measures is highest. Both correlate very strongly with General Evaluation. Most important, both correlate highly with the exit measure of motivation toward computing.

The correlation of the two enjoyment factors provide valuable support for a contention implicit in the instrument design. The Likert-type scales, with their full-sentence stimulus design, could specify an affective or personal interpretation of the question. However, because those stimuli referred to personal responses to experiences with computing, they were not suitable for use with novice subjects. With other research situations, they could not be suitable for use where variations in subjects' experiential contexts could control the responses more than individual differences in attitudes. On the other hand, the semantic differential design is more context-free, because its stimulus is so limited and structured. The high correlation between the two supports a conclusion that both Likert-type and semantic differential questions can tap a personal aspect of attitudes with comparable success.

The correlation of the two enjoyment factors with General Evaluation in both instruments poses a pair of possible interpretations. If the labelling of the factor as General Evaluation is challenged, then the factor may simply replicate the kind of response given to items from Enjoyment. On the other hand, if the category's labelling is accepted, then Enjoyment is overwhelmingly important, above Ease of Use or Humanization, in determining students' evaluation of the subject matter.

The face validity of the five items comprising the General Evaluation factor does not provide one clear interpretation. Two of the five items (interesting / boring, fun / uninteresting) clearly relate to enjoyment. Another, organized / disorganized, might best be considered a measure of precision. Good / bad and important / unimportant are more generally oriented. Thus some correlation between Enjoyment and General Evaluation could be expected, but certainly two items out of five do not fully explain a correlation as high as .848 upon entry.

The importance of enjoyment in determining overall impressions of computers is again evident among the exit correlations. (Table 6B) The two enjoyment factors and General Evaluation, all highly correlated together, correlate strongly with exit Motivation. To the extent that positive motivations toward computing are deemed an indication of success for an introductory computing course, it appears that enjoyment of content matter is the primary attitudinal determinant of such success. Thus, hypothesis four is accepted.

It is in the comparative sense that the importance of enjoyment must be established. Although it seems common sense that enjoyment be a large factor in exit motivation, similar common-sense support could be expressed for Ease of Use or Humanization, had either of those factors emerged as dominant. They did not: the strength in correlations of .683 and .709 which the two Enjoyment measures recorded with Motivation is demonstrated more clearly in the post-hoc partial correlation reported in Table 10A, showing that little is left of the correlations between Motivation and the other factors when variation shared with Enjoyment is removed.

Dimensionality of attitudes toward computing

As the literature review in Chapter II described, public attitudes toward computing do not always appear as multidimensional, despite expectations generally that this be the case. Whichever position one accepts changes the interpretation of enjoyment's impact upon motivation discussed in the previous section. If computing attitudes are considered unidimensional, then Enjoyment items emerge as the most predictive attitude measures of motivation, while under a multidimensional paradigm, enjoyment would be viewed as the strongly dominant dimension. There is support for both positions in this study.

Among the four semantic differential factors selected from Kerber, the wide range in means in Table 5A (page 43) is suggestive of distinction by the factors. The lowest, 11.7, and the highest, 23.7, differ by an amount that is twice as great as the greatest standard deviation among the four.

On the other hand, the strong correlations among Kerber's entry factors in Table 6A (page 44) suggest that either there is considerable overlap among factors in a multidimensional field, or that the separate factors simply measured a unidimensional attitude with varying degrees of success. In general, the exit attitudes in Table 6B are even more closely correlated, with the Likert-type items both correlating highly with each other and with General Evaluation and Enjoyment among the semantic differential factors.

Unfortunately we cannot resolve this issue by comparing correlations between factors with correlations of each factor with itself between measures. Normally, if factors' distinctiveness is important, their correlations with themselves between measures will exceed correlations between different factors. In this case, if we compare correlations of each factor with itself over time (Table 6C) to correlations of each factor with others at a set time (Tables 6A and 6B), the correlations with themselves tend to be exceeded by the correlations with the enjoyment factors, lending comparative credence to the idea of a single dimension. Yet, such evidence is unacceptable in that weakening of factors' correlations with themselves between measures should be expected, due to the influence of the course itself.

If attitudes toward computing are not multi-dimensional, then the differences in the means in Table 5A could be explained as equivalent responses marked by a shift along the seven-position scale in the semantic differential items. However, the complexity of relationships in the correlation tables confounds this simpler alternative somewhat. For example, the two factors with the most extreme means, Precision and Humanization, correlate relatively poorly with each other, relatively highly with Enjoyment , and differently (Precision poorly and Humanization well) with Ease of Use. (Table 6A) Among the Kerber factors at course end in Table 6B, Precision, whose mean most closely matches Motivation, ranks third in correlating with Motivation. The two lowest correlations occurred with Precision, which had the lowest mean, matched with both Humanization and Ease of Use, which had the highest means. This would support a suggestion that the different means represent a distinction among attitudes rather than a shift on the scale.

Assuming the existence of four separate factors also allowed indications of changes specific to one factor and not others to emerge. For example, significant improvement in scores in the full sample occurred in two dimensions, Enjoyment and Humanization, but not in the others. (Table 9A, page 51) In contrast, the General Evaluation factor, which Williams et al. considered dominant as a single factor, failed to measure a statistically significant change. Sex-based differences, to be discussed in full below, also appeared only in certain factors. For example, while females registered an improvement in all attitude categories, males registered an unexpected decline of 1.0 in mean attitude regarding ease of use. Such distinctions likely would not have emerged from instruments based upon a unidimensional model.

All things considered, although the data analysis does not confirm irrefutably the prior decision to analyse attitudes toward computing as being multi-dimensional, neither does it contradict such a decision. More significant, there appear practical grounds for such an analysis, in that evidence regarding the chosen hypotheses was generated.

Recommendations for further study

This study was limited to attitudinal concerns. As a result, it did not examine the interplay between attitudes toward computing and other indicators of course influence. Comparisons with other forms of course evaluation would provide perspective for the influence of attitudinal data. Questions suggesting themselves include: What is the relationship between academic success and attitude toward the subject matter? Do students differentiate in evaluating the usefulness of subject matter and the usefulness of the course?

The limits of this course to one environment also suggests further data gathering. Compulsory computing literacy situations are becoming more common in schools, and a full mixture of entry experience levels could be anticipated. Are school-age students as able to accurately predict their attitudes toward computing without experience? Would the findings of this study be similar with courses that were not a specific part of a job-training program? Does enjoyment diminish as a determinant of motivation when training is for job-specific contexts as in individual business environments?

Regarding the concept of persistence or sophistication of novices' entry attitudes, guesses abound as to what experiences subjects would hold comparable to computing, in determining their attitudes. A second possible factor in this regard is the role of others' experience -- to what extent can second-hand experience influence a novice's own perceptions of computing?

In any of these suggested investigations, the results of this study suggest that attitudes toward computing can be successfully measured, inasmuch as success refers to tapping the basis for motivation toward subject matter.

Educational implications

The specific findings of this study can be transferred to other audiences or programs only by conjecture. The sample, because of the compulsory nature of the group, was assumed to be representative of a full range of students in Education, but such a population cannot be considered innately representative of any larger group such as teachers in general. Furthermore, the course around which the study operated was not typical of most computer literacy programs: other than its compulsory nature, it also differed in its considerable length and its education-specific content. Lastly, it can be assumed that time changes public perception and involvement, and therefore public attitudes, toward computing, and thus transferability should be assumed to have time-sensitivity as well. While any such comparisons would be interesting to make, they were beyond the scope of this study.

As an experiment in gathering, analyzing and determining judgements from attitudinal data, the study demonstrated a degree of success. The high correlation between semantic differential and Likert-type items for the same factor demonstrated the comparability of the two techniques, despite (or perhaps after consideration of) their different stimulus structure. The range in average factor scores and the complexity of the relationships of factors with various subgroups provided support, depending upon interpretation, for both a unidimensional and a multidimensional approach toward computing attitudes, although the multidimensional alternative demonstrated some distinctions within subgroups.

The failure to obtain statistically significant differences between sexes appears important in current debate. Women in this sample entered the course with fewer experienced users in their number than men. Yet, the exit attitudes of women as a group were at least as positive toward computing as men's. The study provided evidence that the course positively influenced women's view of computing as less depersonalizing and more enjoyable. Further, the sex-typing of computing as an activity appeared as minimal, suggesting that this course may have been successful in treating and/or preventing that counter-productive attitude as reported by others.

The importance of subject enjoyment was strongly evident. Its role in influencing overall evaluation of computing, as well as its relationship with motivation toward computing, stand in strong support of the conclusion of Jackson and Yamanaka (1985), that enjoyment was the single strongest factor in women's technical goals, and broaden its intended reference.

Most importantly, the entry attitudes of novices, while found to be statistically distinct from experienced users, demonstrated persistence as strong as that of experienced users. The suggestion that computing novices' attitudes are not naive, nor easily influenced, should influence the way courses are designed and implemented. If adults tend to be able to predict without experience what their attitudes toward computing will be after compulsory experience, then attitude change fades as justification for making such a course compulsory. The prospective student can make a sophisticated decision about his personal involvement, despite a lack of personal experience upon which to base such a decision. The hypothetical computer anxiety discussed in Chapter 2 is not caused simply by lack of exposure nor corrected generally by computer literacy education.

With the strong correlations between entry and exit attitudes, computer literacy education may have to rethink its premise that positive attitudes accrue from computing experience. With strong and persistent entry attitudes apparent regardless of experience, computer literacy programs must decide how to deal with such a wide range of persistent entry orientations. To the extent that attitudinal change or establishment of positive attitudes is a goal of a computer literacy program, the achievement of that goal can not be assumed, in the face of persistent entry attitudes of both experienced and novice users.

The success of this study to base educational decisions upon attitudinal data alone suggests one specific direction for further research. How do attitudinal factors regarding computing relate to other educational factors? Certainly course success, and student perception of success, influences motivation. Yet this study did not incorporate such factors, nor compare such factors with attitudinal ones in terms of influence upon each other. Comparison with other forms of course evaluation would provide perspective for the usefulness of attitudinal data: Do students distinguish between course and content attitudinally?

This study demonstrated successfully the use of both semantic differential and Likert-type items to determine attitudes closely related to student motivation. As a result, the author hopes that attitudinal measurement will be perceived more functionally, especially in courses such as computer literacy where attitudinal outcomes are major goals.

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APPENDICES

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STUDENTS IN COMPUTER COURSES
ENTRY QUESTIONNAIRE EDTS 425

I. A range of seven positions is given between terms. MARK THE BOX THAT BEST INDICATES YOUR OPINION OF COMPUTING.

		1	2	3	4	5	6	7	
a	precise	[]	[]	[]	[]	[]	[]	[]	inexact
b	personalizing	[]	[]	[]	[]	[]	[]	[]	depersonalizing
c	stimulating	[]	[]	[]	[]	[]	[]	[]	dull
d	difficult	[]	[]	[]	[]	[]	[]	[]	easy
		1	2	3	4	5	6	7	
e	dependable	[]	[]	[]	[]	[]	[]	[]	undependable
f	flexible	[]	[]	[]	[]	[]	[]	[]	rigid
g	fun	[]	[]	[]	[]	[]	[]	[]	dreary
h	demanding	[]	[]	[]	[]	[]	[]	[]	obliging
		1	2	3	4	5	6	7	
i	reliable	[]	[]	[]	[]	[]	[]	[]	unreliable
j	personal	[]	[]	[]	[]	[]	[]	[]	impersonal
k	desirable	[]	[]	[]	[]	[]	[]	[]	undesirable
l	frustrating	[]	[]	[]	[]	[]	[]	[]	satisfying
		1	2	3	4	5	6	7	
m	effective	[]	[]	[]	[]	[]	[]	[]	ineffective
n	warm	[]	[]	[]	[]	[]	[]	[]	cold
o	pleasing	[]	[]	[]	[]	[]	[]	[]	disgusting
p	bossy	[]	[]	[]	[]	[]	[]	[]	obedient
		1	2	3	4	5	6	7	
q	efficient	[]	[]	[]	[]	[]	[]	[]	inefficient
r	humanizing	[]	[]	[]	[]	[]	[]	[]	dehumanizing
s	enjoyable	[]	[]	[]	[]	[]	[]	[]	unpleasant
t	dominant	[]	[]	[]	[]	[]	[]	[]	submissive
		1	2	3	4	5	6	7	
u	good	[]	[]	[]	[]	[]	[]	[]	bad
v	interesting	[]	[]	[]	[]	[]	[]	[]	boring
w	organized	[]	[]	[]	[]	[]	[]	[]	disorganized
x	important	[]	[]	[]	[]	[]	[]	[]	unimportant
y	fun	[]	[]	[]	[]	[]	[]	[]	uninteresting
		1	2	3	4	5	6	7	

II. Which experiences with computers have you had? For each item in the list below, check each box that applies. Column one is for experience AT WORK. Column two is for experience IN SCHOOL. Column three is for experience IN OTHER SITUATIONS. Check as many boxes as apply.

		WORK	SCHOOL	OTHER
a	prepared a written document	[]	[]	[]
b	performed mathematical calculations	[]	[]	[]
c	searched for information	[]	[]	[]
d	entered data	[]	[]	[]
e	communicated with another computer	[]	[]	[]
f	written a program	[]	[]	[]
g	used a program you wrote	[]	[]	[]
h	used someone else's program	[]	[]	[]
i	played a game	[]	[]	[]

III. How many hours have you spent on computers at work?

- [] none
- [] 1 to 10
- [] 11 to 100
- [] more than 100 hours

How many hours have you spent on computers at school?

- [] none
- [] 1 to 10
- [] 11 to 100
- [] more than 100 hours

How many hours have you spent on computers, other than at work and at school?

- [] none
- [] 1 to 10
- [] 11 to 100
- [] more than 100 hours

IV. Describe your ability in these areas, by marking one box for each.

VW = VERY WEAK
W = WEAK
A = AVERAGE
S = STRONG
VS = VERY STRONG

	VW	W	A	S	VS
a typing ability	[]	[]	[]	[]	[]
b math ability	[]	[]	[]	[]	[]
c academic ability	[]	[]	[]	[]	[]
d problem-solving ability	[]	[]	[]	[]	[]

V. Try to list five consumer situations where you can encounter computers, directly or indirectly.

(1)____________________

(2)____________________

(3)____________________

(4)____________________

(5)____________________

VI. Why are you taking this course? You may give more than one reason if you wish.

____

____

____

____

How worried are you about your performance in this course?
[] much more than other courses
[] a little more than other courses
[] no different from other courses
[] a little less than other courses
[] much less than other courses

What is your grade point average?
[] 3.5 or higher
[] 3.0 to 3.4
[] 2.5 to 2.9
[] 2.0 to 2.4
[] 1.5 to 1.9
[] 1.4 or lower

Please describe your program (eg.elementary mathematics--fifth year of B ED after)

____

Are you male or female? [] male [] female

VII. I do not want to know who you are, but I will be giving you a second questionnaire at the end of the course. To help me match the two parts, please put your initials, or else the last three digits of your phone number, in the blanks here. I will ask you to put the same code on the second questionnaire.

___ ___ ___

I know your time is valuable. I am grateful for your cooperation. Best wishes in the course to come.

STUDENTS IN COMPUTER COURSES
FINAL QUESTIONNAIRE EDTS 425

I. A range of seven positions is given between each pair of terms. MARK THE BOX THAT BEST INDICATES YOUR OPINION OF COMPUTING. Remember, I am NOT asking for your opinion about the course.

		1	2	3	4	5	6	7	
a	precise	[]	[]	[]	[]	[]	[]	[]	inexact
b	personalizing	[]	[]	[]	[]	[]	[]	[]	depersonalizing
c	stimulating	[]	[]	[]	[]	[]	[]	[]	dull
d	difficult	[]	[]	[]	[]	[]	[]	[]	easy
		1	2	3	4	5	6	7	
e	dependable	[]	[]	[]	[]	[]	[]	[]	undependable
f	flexible	[]	[]	[]	[]	[]	[]	[]	rigid
g	fun	[]	[]	[]	[]	[]	[]	[]	dreary
h	demanding	[]	[]	[]	[]	[]	[]	[]	obliging
		1	2	3	4	5	6	7	
i	reliable	[]	[]	[]	[]	[]	[]	[]	unreliable
j	personal	[]	[]	[]	[]	[]	[]	[]	impersonal
k	desirable	[]	[]	[]	[]	[]	[]	[]	undesirable
l	frustrating	[]	[]	[]	[]	[]	[]	[]	satisfying
		1	2	3	4	5	6	7	
m	effective	[]	[]	[]	[]	[]	[]	[]	ineffective
n	warm	[]	[]	[]	[]	[]	[]	[]	cold
o	pleasing	[]	[]	[]	[]	[]	[]	[]	disgusting
p	bossy	[]	[]	[]	[]	[]	[]	[]	obedient
		1	2	3	4	5	6	7	
q	efficient	[]	[]	[]	[]	[]	[]	[]	inefficient
r	humanizing	[]	[]	[]	[]	[]	[]	[]	dehumanizing
s	enjoyable	[]	[]	[]	[]	[]	[]	[]	unpleasant
t	dominant	[]	[]	[]	[]	[]	[]	[]	submissive
		1	2	3	4	5	6	7	
u	good	[]	[]	[]	[]	[]	[]	[]	bad
v	interesting	[]	[]	[]	[]	[]	[]	[]	boring
w	organized	[]	[]	[]	[]	[]	[]	[]	disorganized
x	important	[]	[]	[]	[]	[]	[]	[]	unimportant
y	fun	[]	[]	[]	[]	[]	[]	[]	uninteresting
		1	2	3	4	5	6	7	

II. How much would the following characteristics affect future students in this course?

SD = STRONG DISADVANTAGE
MD = MILD DISADVANTAGE
N = NOT OF MUCH INFLUENCE AT ALL

		SD	MD	N
a	poor typing ability	[]	[]	[]
b	poor math ability	[]	[]	[]
c	poor academic ability	[]	[]	[]
d	poor at problem-solving	[]	[]	[]

III. I realize you do not have all your results, but I would like to know what you expect to receive in this course. Mark just one choice.

[] A
[] B
[] C
[] D
[] F

IV. For each opinion below, indicate your feeling by marking one of the five boxes.

SA = STRONGLY AGREE
MA = MILDLY AGREE
N = NEITHER AGREE OR DISAGREE
MD = MILDLY DISAGREE
SD = STRONGLY DISAGREE

	SA	MA	N	MD	SD
a I feel good when I complete a computing task alone.	[]	[]	[]	[]	[]
b I am willing to work hard to do well in computing.	[]	[]	[]	[]	[]
c I usually do well in computing class and like it very much.	[]	[]	[]	[]	[]
d Most of computing has practicalvalue.	[]	[]	[]	[]	[]

	SA	MA	N	MD	SD
e I enjoy computing.	[]	[]	[]	[]	[]
f It is important to know computing in order to get a good job.	[]	[]	[]	[]	[]
g I am good at computing.	[]	[]	[]	[]	[]
h I would like to take more computing.	[]	[]	[]	[]	[]

	SA	MA	N	MD	SD
i Learning computing is mostlymemorizing.	[]	[]	[]	[]	[]
j I am taking computing only because I have to.	[]	[]	[]	[]	[]
k Computing is more for males than females	[]	[]	[]	[]	[]

V. To help me match this with the first questionnaire, please put your initials, or the last three digits of your phone number, whatever you used the first time, in the blanks here.

___ ___ ___

I know your time is valuable. I am grateful for your cooperation. When I become rich and famous, you can tell everyone you helped me get started!

Ralph Mason

January, 1985

Fellow students:

As a part of my thesis at the university, I must gather some information on students in computing courses. I ask for your cooperation in filling out the questionnaire. Actually, I hope you find the questionnaire interesting.

Please bear in mind that I am not interested in individual results, so your answers will not be released to anyone until they are compiled into a large group, at which time all individual records will be destroyed. I do not want to know your name or any other tracable identification. Your anonymity will be guaranteed.

You need not feel obliged to cooperate; also, you may freely stop cooperating at any time, if you choose. For example, when filling out the questionnaire you can always leave blank any questions you consider improper.

Procedures regarding any university research suggest that I inform you in these matters and obtain written indication that you agree to participate, so I ask that you sign this letter below.

I thank you for your assistance. It is greatly appreciated.

Ralph Mason

Educational Policy and Administration

University of Calgary

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