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ABSTRACT

This study examined the relationship between the learning style profile of students enrolled in the service module courses offered by the Computer Science department at Calvin College (Michigan) and their general attitudes toward computers. Data were gathered using the VARK (Visual, Aural, Read/write, and Kinesthetic) learning style inventory and the General Attitudes Toward Computers questionnaire. Results are reported for each of the following research questions: (1) What is the learning style profile of students who enrolled in service module courses? (2) How do students who enrolled in service module courses feel about computers? (3) What is the relationship between learning styles and attitudes toward computers? and (4) What is the relationship between selected academic (year in school, major) and demographic (age, gender) variables and attitudes toward computers? Recommendations for future studies are included. (Contains 30 references.) (MES)

Calvin College

Research Field Study

Learning Styles and General Attitudes Toward Computers:

An Analysis of Students Enrolled in Computer Science Modules at Calvin College

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December 2000

Learning Styles and General Attitudes Toward Computers:

An Analysis of Students Enrolled in Computer Science Modules at Calvin College

CHAPTER I

Introduction

Several theories have been proposed over the last thirty years in which learning styles have been categorized, defined, and analyzed. While these models vary in methodology, they all agree on the diversity of learners and the need to address that diversity in classroom instruction in an effort to improve student performance. But, which theory is the "right" one? The answer may very well be all of them, as each model touches on a different aspect of the whole learner (Armstrong 1994). The human mind is a complex organ. In our effort to understand the way the mind works, we must approach it from all dimensions -- the cognitive, the affective, and the perceptual -- the multimedia of the mind.

Calvin College, located in Grand Rapids, Michigan, is a private institution of higher learning and is accredited by the Commission on Institutions of Higher Education of the North Central Association of Colleges and Schools. The College is a member of the American Council on Education, the Association of Independent Colleges and Universities of Michigan, the National Association of Independent Colleges and Universities, the American Association of Colleges for Teacher Education, the Mathematical Association of America, the Michigan Academy of Sciences, Arts, and Letters, and the American Mathematical Society. It is also a member of the Christian College Coalition, Michigan Campus Compact and is an affiliate member of the American Society of Engineering Education.

Calvin College is a comprehensive liberal arts college in the Reformed tradition of historic Christianity. Its primary purpose is to engage in vigorous liberal arts education that promotes lifelong Christian service; develops knowledge, understanding, and critical inquiry; encourages insightful and creative participation in society; and fosters thoughtful, passionate Christian commitments. Its curriculum emphasizes the natural, cultural, societal, and spiritual contexts of

society. Its teaching respects diverse levels, gifts, and styles of learning.

Statement of Need

In order to provide our students with the best possible educational experience, we must carefully consider both content and context in curriculum development. Another important consideration too often overlooked is the diversity of learners and the implications for instructional design. Far too often, the emphasis is placed on the assessment of learning disabilities rather than that of learning abilities.

Extensive research over the past four decades has shown that student motivation and performance improves when instruction is adapted to the learning preferences of students. In light of such evidence, educators have a responsibility to understand the diversity of their students and to present information in a variety of ways in order to accommodate all learners' preferences.

A study of the factors necessary for a student to be successful should include an analysis of learning styles, general

attitudes related to specific disciplines, as well as various academic and demographic variables that may influence them.

Purpose Statement

The purpose of this study is to determine the relationship between the learning style profile of students enrolled in the service module courses offered by the Computer Science department at Calvin College and their general attitudes toward computers. The results of the study will be used to improve curriculum design, instructional delivery, and student performance.

Research Questions

1. What is the learning style profile of students who enrolled in service module courses?
2. How do students who enrolled in service module courses feel about computers?
3. What is the relationship between learning style and attitudes toward computers?
4. What is the relationship between selected academic (year in school, major) and demographic (gender) variables and attitudes toward computers?

Definition of Terms

The following terms are defined to clarify their use in the context of the study:

- Service module courses - one-credit hour courses in basic computer concepts and applications that "serve" the student body at large, regardless of major or discipline
- VARK Learning Styles Inventory - hereinafter referred to as VARK or VARK Inventory (see Appendix A)
- General Attitudes Toward Computers Questionnaire - hereinafter referred to as Attitudes Questionnaire (see Appendix B)

Scope and Delimitations of the Study

The population for this study was limited to students enrolled in the service module courses offered by the Computer Science department at Calvin College. The convenience sampling of subjects should yield a representative sample of the larger student population, which may in turn approximate the behavior of all college students possessing similar characteristics to the subjects in this sample.

Assumptions

The following assumptions were made with respect to this study:

- Participation in the study was voluntary.
- Students completed the surveys without the influence of others.
- The responses were immediately captured and stored in digital form and remain unchanged.

Report Outline

HAPTER II

Literature Review

Educational researchers have proposed several learning styles theories since the 1970s, the most familiar of which is probably Howard Gardner's Theory of Multiple Intelligences (MI). In his book, Frames of Mind: The Theory of Multiple Intelligences, Gardner describes seven separate intelligences, including linguistic, logical-mathematical, spatial, bodily-kinesthetic, musical, interpersonal, and intrapersonal (see Appendix C). MI theory is a cognitive model, at the core of which is the belief that (1) each person possesses all seven intelligences, (2) most people can develop each intelligence to an adequate level of competency, (3) intelligences usually work together in complex ways, and (4) there are many ways to be intelligent within each category (Armstrong 1994). In Gardner's own words, the essence of the theory is "to respect the many differences among people, the multiple variations in the ways that they learn, the several modes by which they can be assessed, and the almost infinite number of ways in which they can leave a mark on the world" (Armstrong 1994, p. vii).

Another well-known learning styles model is the Myers-Briggs Type Indicator (MBTI), which measures the affective dimension of learning and is based on the work of Carl Jung. Bettina Lankard Brown (1996) states that "personality sets the stage for how one acquires and integrates information. It reflects genetic influences as well as the influences of culture, environment, and experiences" (p. 4). The MBTI categorizes individuals into 16 different types of personalities, or archetypes, based on the way they view their environment, make decisions, focus on the inner world of ideas and concepts or the outer world of people and things, and respond to situations with acceptance or judgmental attitude (Wilson 1998). The MBTI test is intended for adults and has been in use for more than fifty years. A second model emphasizing personality is Herman Witkin's Bipolar Construct of Field Dependence and Field Independence, which measures the extent to which the learner is influenced by a surrounding field (Brown 1996). Asselin and Mooney (1996) use brain hemisphericity to differentiate between right brain (global) and left brain (analytic) learners. In general, "those who are field dependent or 'global' perceive things as a whole, make broad general distinctions among concepts. Are people-

oriented, and learn material in a social context. Those who are field independent or 'analytic' perceive things in parts rather than as a whole, impose structure or restrictions on information and concepts, see little overlap, and have an impersonal relationship to the world" (Wilson 1998, p. 4).

The Visual-Auditory-Kinesthetic (Modality Preference) Model focuses on the modes or senses through which people take in and process information (Willis 1999). It is a perceptual, instructional preference model that categorizes learning by sensory preferences. Bettina Lankard Brown (1996) states that "learning styles research shows that most people prefer learning by experiencing and doing (kinesthetic elements), especially when reinforced through touching and movement (tactile elements)" (p. 3). A study done by Specific Diagnostic Studies concludes that 29% of elementary and high school students learn best through the visual mode (pictures), 34% through the auditory mode (sound or music), and 37% through the tactile/kinesthetic mode (moving, touching, doing) (Willis 1999). Swanson (1995) reports that "sensory preferences are also distinguishable among different cultural groups" (p. 10). An

instrument used to assess sensory preferences is the Multi-Modal Paired Associates Learning Test (MMPALT).

The Modality Strengths Model introduced by Walter Barbe, Michael Milone, and Raymond Swassing attests that "observable modality strengths (the superior functioning of visual, auditory, and kinesthetic channels of learning) are more important in planning instruction than learners' modality preferences, which may or may not match their strengths" (Wilson 1998, p. 9). This perceptual model suggests that modality strengths are not fixed, changing over time. Mariaemma Willis, author of Discover Your Child's Learning Style, states that "there are different ways to express each modality ... each person's set of modality strengths is unique, and may even differ with the situation or learning activity" (Willis 1999, p. 144). Barbe, Milone, and Swassing believe that matching students with teachers of similar modality strengths enhances motivation and achievement (Wilson 1998). "Their research, completed in the late 1970s, showed that students vary in respect to their modality strengths, with about 30% visual, 30% mixed, 25% auditory, and 15% kinesthetic ... They found no difference between the races or sexes on modality

strength" (Wilson 1998, p. 9). Other studies have found that "students whose styles are matched with those of their teachers report greater ease of learning (Packer and Bain 1978) and higher satisfaction (Renninger and Synder 1983) than those whose styles are mismatched" (Wilson 1998, p. 3).

The Learning Styles Inventory developed by Rita Dunn is the most widely used learning styles instrument in elementary and secondary schools (Wilson 1998). The LSI encompasses four areas: (1) instructional environment, (2) emotionality, (3) social preferences, and (4) physiological uniqueness (perceptual preferences ... auditory, visual, tactile, and kinesthetic) (see Appendix D).

CHAPTER III

Methodology

This descriptive, non-experimental correlational study measured the degree of relationship between learning styles and general attitudes toward computers, as well as selected academic and demographic variables, of students enrolled in the service module courses offered by the Computer Science department at Calvin College.

Research Design

A multiple correlation design was used to predict the relationship between learning styles and general attitudes toward computers, as well as selected academic (year in school, major) and demographic (gender) variables. Multiple regressions were used to isolate and predict the various relationships. The study was conducted over a 14-week period in order to provide the most accurate results possible (with more time, other variables can be introduced which makes determining relationships more difficult).

Pilot Studies

Students enrolled in service module courses offered by the Computer Science department at Calvin College during the first half of the fall 2000 semester were asked to voluntarily review the instruments for this study. Participation was optional. Three professionals, including an educational researcher, a faculty member, and a data entry person also reviewed the instruments.

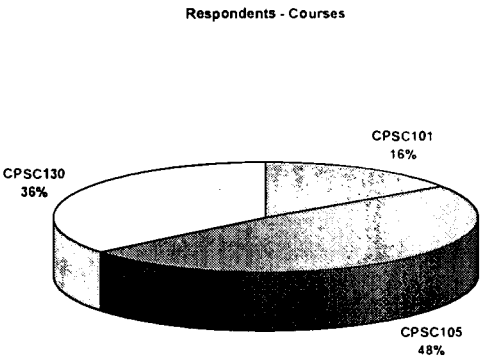
After completing the surveys, participants of the pilot test were asked to comment about the overall clarity of the surveys as

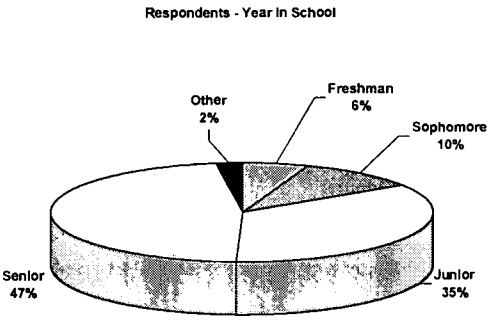
well as individual items, ease of completion, and time required completing each instrument. Student response was overwhelming positive, both in terms of the number of students responding and in their critique of the surveys. All participants expressed appreciation for the web-based format, as both instruments were interactive forms accessible on the Internet. Some students reported difficulties when they initially tried to submit the Attitudes Questionnaire. However, they went back a second time and were able to submit their responses successfully!

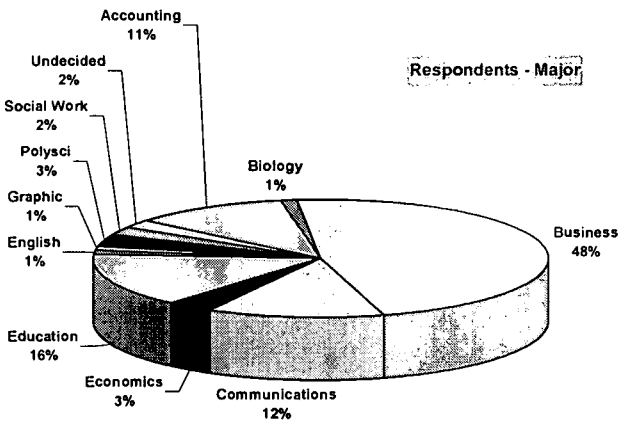
Selection of Subjects

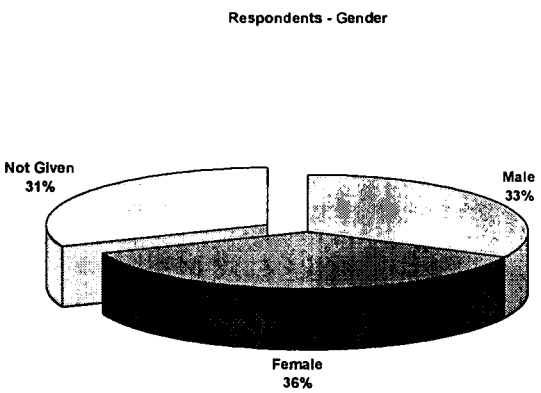
All students enrolled in the various service module courses offered by the Computer Science department at Calvin College during the fall 2000 semester were asked to participate in this study. The service modules are one-credit hour courses in basic computer concepts and applications that serve the student body at large, regardless of major or discipline. The 82 students who responded to both instruments were the subjects of this study. The convenience sampling of subjects should yield a representative sample of the larger student population, which may in turn approximate the behavior

of all college students possessing similar characteristics to the subjects in this sample.









The 82 respondents were distributed as follows:

- 16% enrolled in CPSC-101, 36% in CPSC-130, and 48% in CPSC-105
- 6% freshmen, 10% sophomores, 35% juniors, 47% seniors, and 2% other
- 33% male, 36% female, and 31% no response
- 48% Business majors, 16% Education, 12% Communications, 11% Accounting, 12% Various (less than 3% each)

Instrumentation and Classroom Procedures

Two instruments were used to gather data on the variables being investigated. The VARK learning style inventory was administered first. The survey was presented as an interactive web-based form and was made available to students online. The General Attitudes Toward Computers questionnaire was also made available to students online and was completed approximately one month after the VARK inventory.

The VARK Learning Style Inventory provides a perceptual learning style profile for each student. The acronym VARK stands for the Visual, Aural, Read/write, and Kinesthetic sensory modalities used in learning. The VARK Inventory was developed in 1987 by Neil Fleming, Lincoln University, New Zealand. It differs from most learning styles instruments in that it's primary purpose is to be advisory rather than diagnostic and predictive. Fleming added a fourth category, read-write, to the visual, aural and kinesthetic characteristics used by most researchers to define perceptual learning styles by subdividing the visual mode into symbols (visual) and text (read-write). The inventory has "received high acclaim from

students and professors for its powerful simplicity, its ability to spark discussion about learning and the fact that it makes intuitive good sense" (www.active-learning-site.com). Fleming defines the categories as follows.

Visual (V): This preference includes the depiction of information in charts, graphs, flow charts, and all the symbolic arrows, circles, hierarchies and other devices that instructors use to represent what could have been presented in words. Note: this definition does not include the use of television, videos and films. These media are primarily Aural (A) and Kinesthetic (K) because of their presentation of sound and reality (usually). They rarely use graphics.

Aural (A): This perceptual mode describes a preference for information that is "spoken or heard." Students with this modality report that they learn best from lectures, tutorials, and talking to other students.

Read/write (R): This preference is for information displayed as words. Not surprisingly, many academics have a strong preference for this modality.

Kinesthetic (K): By definition, this modality refers to the perceptual preference related to the use of experience and practice (simulated or real). Although such an experience may invoke other modalities, the key is that the individual is connected to reality, either through experience, example, practice or simulation.

The VARK Inventory consists of 13 questions in multiple-choice format. Each question requires the student to draw upon practical experience to indicate how he or she would respond in everyday life

situations. Multiple selections are encouraged when the respondent is equally comfortable with the alternatives presented. "The sum of the alternative answers for each modal preference slightly favors the R mode (Visual, 12; Aural, 12; Read/Write, 13; Kinesthetic, 11)" (Fleming and Mills 1992, p. 3). The inventory includes questions that deal with both the processing and presentation of information, as well as cognitive processing for decision making.

The self-developed Attitudes questionnaire measures the perceived benefits and negative effects of computer use in education. The questionnaire consists of 20 items in Likert scale format (Strongly Agree, Agree, No Opinion, Disagree, Strongly Disagree) that deal with general attitudes toward computers, computer application knowledge, and factors that facilitate or inhibit the use of technology. The majority of the items appearing on this inventory were drawn from questionnaires developed by professional educational researchers and/or those distributed by the Milken Exchange on Education Technology.

Data Collection and Recording

Both instruments were made available online in order to minimize inconvenience to students, and thus maximize response, and to avoid the problem of absenteeism inherent in real-time administration. Students were provided with the Internet address, or URL, for the VARK Inventory during the first week of class, and were also made aware that a hyperlink to the survey was available on the class website for their convenience. The instructor gave a brief demonstration on accessing the survey, and asked that students complete it before the next class meeting. The students also received an e-mail message from the instructor reminding them to complete the VARK Inventory, which also included a direct hyperlink to the form. This process was repeated during the fifth week of class for the Attitudes Questionnaire. Both instruments are interactive web-based forms, with the data being collected electronically and stored in a database. The database was later imported into a spreadsheet program for statistical analysis.

Data Processing and Analysis

A variety of statistical tools were used to analyze the data, including means, analysis of variance (ANOVA), and frequencies.

CHAPTER IV

Introduction

The purpose of this study was to determine the relationship between the learning style profile of students enrolled in the service module courses offered by the Computer Science department at Calvin College and their general attitudes toward computers. The study was based on the VARK Learning Styles Inventory and a self-developed General Attitudes Towards Computers questionnaire. Both instruments were presented as interactive web-based forms and made available to students online. The responses were immediately captured and stored in digital form and later imported into MS Excel for analysis.

Analysis Procedures Used

A variety of statistical tools were used to analyze the data, including means, analysis of variance (ANOVA) and frequencies. McMillan and Schumacher (1997) describe the use of descriptive and inferential statistics in Research in Education: A Conceptual Introduction:

There are many research situations in which a mean from one group is compared with a mean from another group to determine the probability that the corresponding population means are different. The t-test is a formula that is used to determine the probability level of rejecting the null hypothesis. The sample means, standard deviations, and the size of the samples are used in the t-test equation. The standard error of the difference between the means can be conceived of as a measure of the amount of error in estimating the population mean from a sample mean. As the distance between two means gets larger, the error involved in estimating the means gets smaller and the t statistic is greater. To determine the level of significance, the researcher compares this number with theoretical *t* values in a table (see Appendix E).

ANOVA (one-way analysis of variance) is an extension of the t-test. Rather than the researcher's using multiple t-tests to compare all possible pairs of means in a study of two or more groups, ANOVA allows the researcher to test the differences between all groups and make more accurate probability statements than when using a series of separate t-tests. ANOVA calculates an F statistic, which is analogous to the t. It is a three- or four-digit number that is used in a distribution of F table (see Appendix F) to find the level of significance that the researcher uses to reject or not reject the null. ANOVA addresses the question: Is there significance between any two population means. If the F value that is calculated is large enough

(greater than .05) then the null hypothesis (no difference between the groups) can be rejected. The null hypothesis being tested is that the means are equal (different only by sampling and measurement error). The researcher can then conclude that the means are different, and that this conclusion will be right 95 times out of 100.

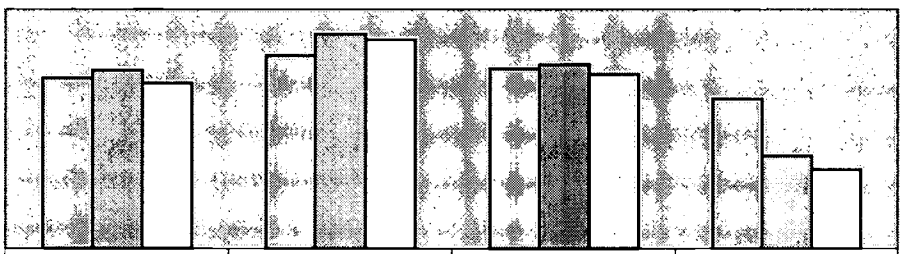
Frequency distributions indicate quickly the most and least frequently occurring scores, the general shape of the distribution, and whether any scores are isolated from the others.

An analysis of the data follows, categorized by research question and reported in chart and graph form. Responses from the VARK Learning Styles Inventory (research questions 1 and 3) are reported as mean modal preference scores. The sum of the alternative answers for each modal preference slightly favors the R mode (Visual, 12; Aural, 12; Read/Write, 13; Kinesthetic, 11)" (Fleming and Mills 1992, p. 3). Responses from the Attitude Toward Computers Inventory (research questions 2, 3, and 4) are reported as average total points. Students were asked to respond to 20 items using a Likert scale (Strongly Agree = 5 points, Agree = 4 points, Neutral = 3 points, Disagree = 2 points, Strongly Disagree = 1 point). Total scores for the Attitudes survey were interpreted as follows: 80+ points = Very Positive, 60-79 points = Positive, 40-59 points = Neutral, 20-39 points = Negative, and 0-19 points = Very Negative. Correlations are reported at the .05 level of significance.

Results of Analysis of Research Questions

1. What is the learning style profile of students who enrolled in service module courses?

Learning Style Preference by Course Code
Mean Preference Score

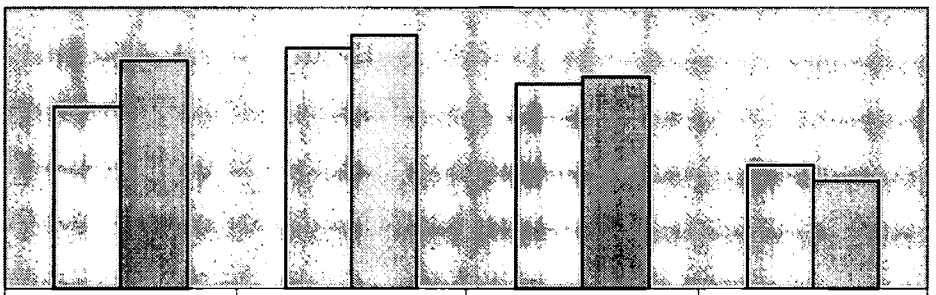


	Visual	Kinesthetic	Aural	Read-Write
CPSC101	4.3	4.8	4.5	3.8
CPSC105	4.5	5.4	4.6	2.3
CPSC130	4.1	5.2	4.4	2.0

Figure 1: *A significant correlation exists (.030 at the .05 level of significance) between the Read-Write modal preference and course code.*

The VARK Learning Styles Inventory was used to determine the learning style profile of the respondents. Individual student responses were categorized and combined by course code, the results of which are displayed in Figure 1. The combined results indicate a strong Kinesthetic modal preference in all courses, followed by Aural, Visual, and Read-Write. This is consistent with the findings of a study conducted by Specific Diagnostic Studies, as reported on page 9.

Learning Style Preference by Gender
Mean Preference Score



	Visual	Kinesthetic	Aural	Read-Write
Male	3.9	5.1	4.4	2.6
Female	4.9	5.4	4.5	2.3

Figure 2: *A significant correlation exists (.007 at the .05 level of significance) between the Visual modal preference and gender.*

Individual student responses were categorized and combined by gender, the results of which are displayed in Figure 2. The combined results indicate a strong Kinesthetic modal preference in both sexes. The profile of male respondents is consistent with the course code findings reported in Figure 1 (Kinesthetic, Aural, Visual, Read-Write), however, females indicated a slight preference for the Visual over the Aural mode.

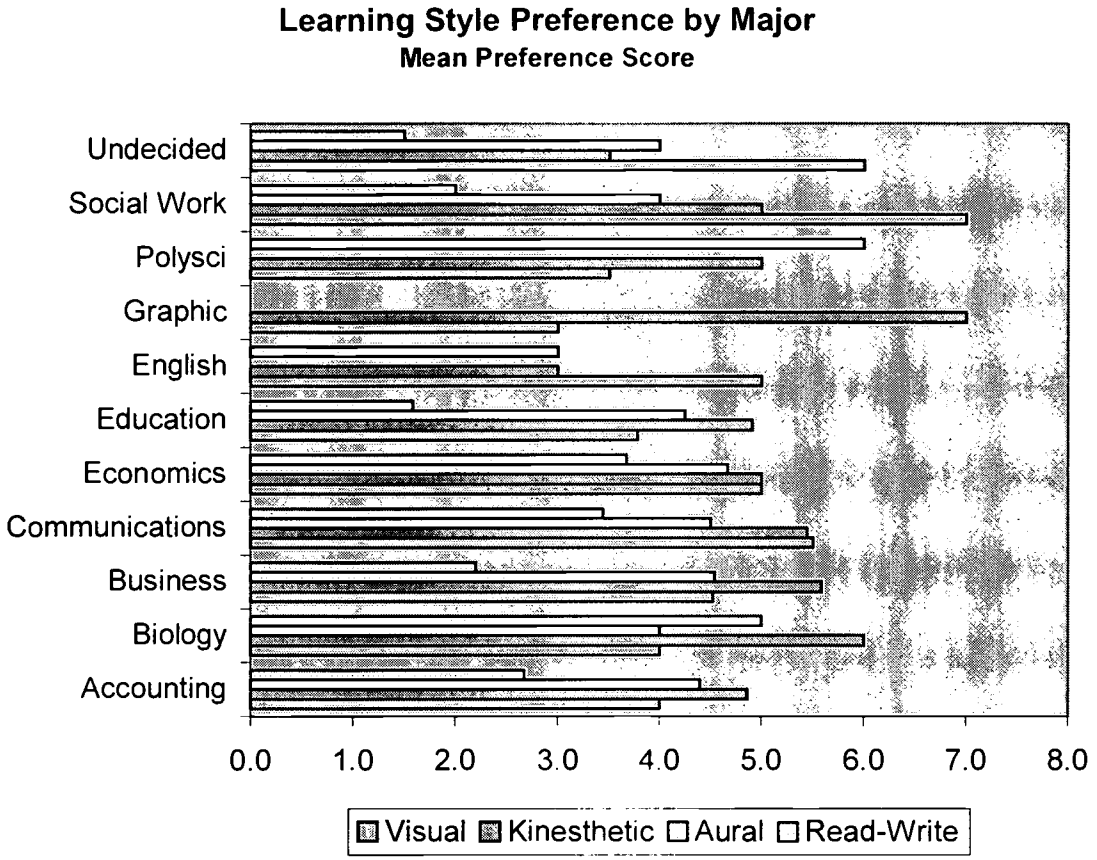
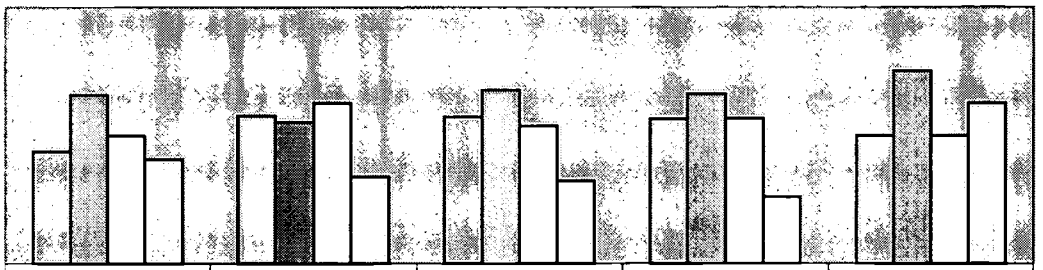


Figure 3: *A significant correlation exists (.022 at the .05 level of significance) between the Visual modal preference and major.*

Individual student responses were categorized and combined by major, the results of which are displayed in Figure 3. A Kinesthetic modal preference was dominant in the Accounting, Biology, Business, Economics (tied with Visual), Education, and Graphic fields. Communications, English, and Social Work majors prefer the Visual mode.

Learning Style Preference and Year in School
Mean Preference Score



	Freshman	Sophomore	Junior	Senior	Other
Visual	3.5	4.6	4.6	4.5	4.0
Kinesthetic	5.3	4.4	5.4	5.3	6.0
Aural	4.0	5.0	4.3	4.5	4.0
Read-Write	3.3	2.7	2.6	2.1	5.0

Figure 4: *No significant correlation exists between modal preference and year in school.*

Individual student responses were categorized and combined by year-in-school, the results of which are displayed in Figure 4. The Kinesthetic-Aural-Visual-Read/Write pattern apparent in the course code and gender (male) analyses was repeated in the year-in-school analysis (freshman, senior and other). Juniors also preferred the Kinesthetic mode, but indicated a slight preference for the Visual over the Aural mode (similar to the results of females in the gender analysis). Surprisingly, the sophomore group indicated a strong preference for the Aural and Visual modes over the Kinesthetic.

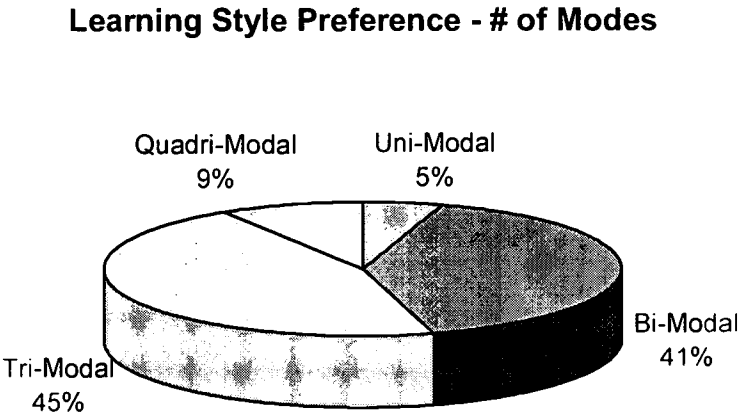


Figure 5

Individual student responses were categorized and combined by modal preference, the results of which are displayed in Figure 5. The majority of respondents were tri-modal (46%), with 41% bi-modal, 9% quadri-modal, and 5% uni-modal.

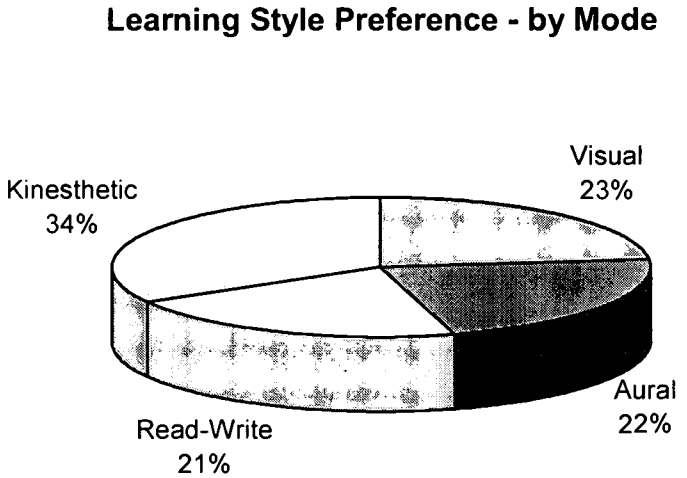


Figure 6

Individual student responses were categorized and combined by modal preference, the results of which are displayed in Figure 6. The modal preference occurring most frequently was Kinesthetic (33%), followed by Visual (23%), Aural (22%), and Read-Write (21%).

2. How do students who enrolled in service module courses feel about computers?

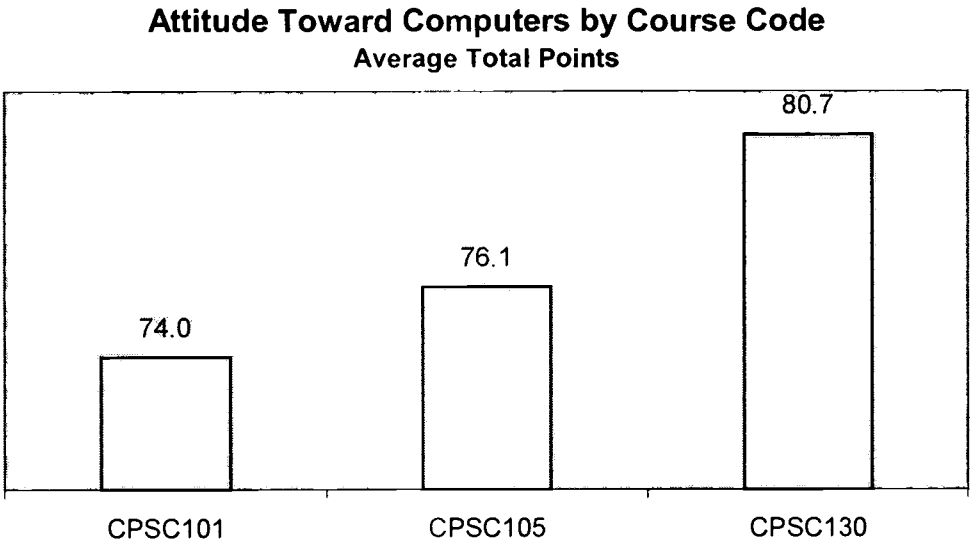
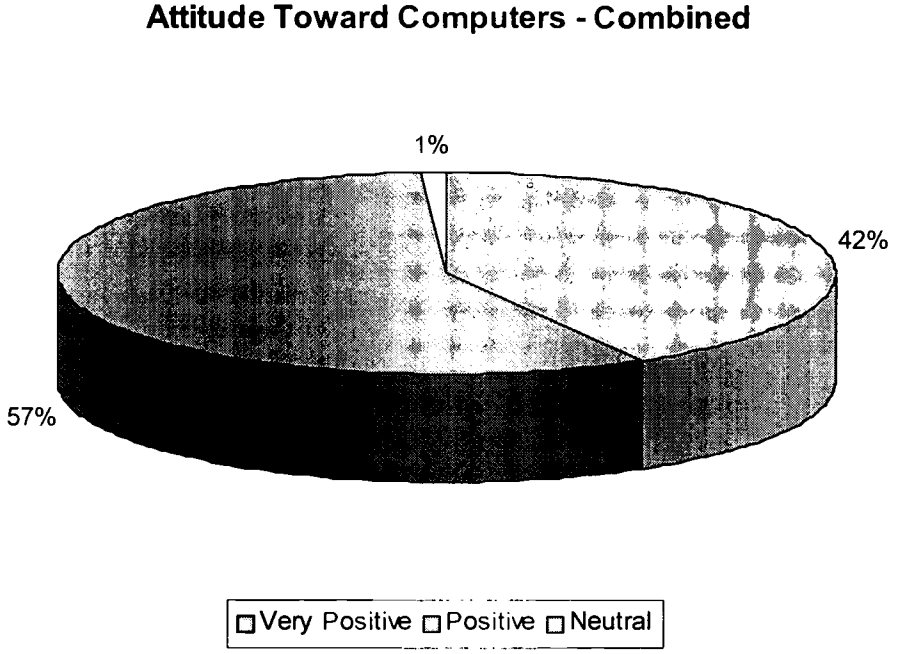


Figure 7: *A significant correlation exists (.002 at the .05 level of significance) between attitude toward computers and course code.*

Individual student responses were categorized and combined by course code, the results of which are displayed in Figure 7. Students in the concepts course (CPSC101) scored lower than those in the application courses (CPSC105 and CPSC130), with CPSC101 and CPSC105 falling into the Positive category and CPSC130 in the Very Positive category. The lower score in the CPSC101 course is likely attributable to the content of the class (concepts versus applied software), as well as the students' level of experience with computers.



Very Positive	80+
Positive	60-79
Neutral	40-59
Negative	20-39
Very Negative	0-19

Figure 8

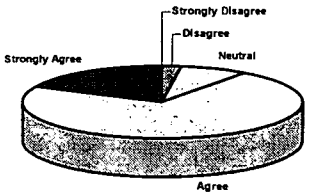
Student responses to individual questions on the Attitudes survey were combined and are displayed in Figure 8. The majority of students (57%) fell into the Positive category, 42% in the Very Positive category, and 1% in the Neutral category. The students' positive attitude toward computers is likely a result of the rapid rate of technological growth over the past decade and steadily increasing exposure to computers in all aspects of life.

Student responses to individual questions on the Attitudes survey are displayed in Figure 9 (questions 1-8), Figure 10 (9-16), and Figure 11 (17-20). The following abbreviations are used to describe students' responses: Strongly Agree = SA, Agree = A, Neutral = N, Disagree = D, Strongly Disagree = SD.

Figure 9 displays individual charts for questions 1 through 8 of the Attitudes survey. The majority of students agreed with questions 1-4 and 6-8, and disagreed with question 5.

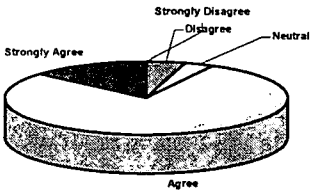
- Q1: Computers make school interesting (SA 18%, A 72%)
- Q2: I feel Calvin College is using computers effectively (SA, 14%; A, 78.7%)
- Q3: Calvin College offers enough computer classes (SA, 11%; A, 51%)
- Q4: There is too much emphasis on computers in the classroom (SA, 16%; A 54%)
- Q5: I would like to take classes over the Internet (D, 35%; SD, 23%)
- Q6: I find the Internet very useful for schoolwork (SA, 48%; A, 43%)
- Q7: All Calvin graduates should be able to operate a computer (SA, 82%; A, 18%)
- Q8: I like learning in front of a computer (SA, 16%; A, 43%)

Question 1: Computers make school interesting.

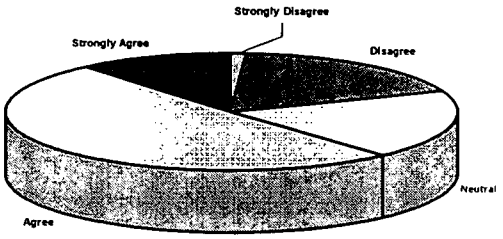


Question 2: I feel Calvin College is using computers effectively.

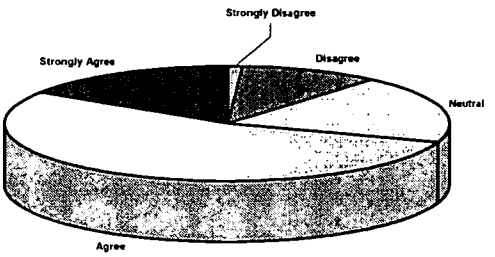
Figure 9



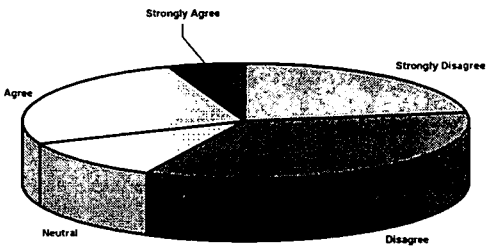
Question 3: Calvin College offers enough computer classes.



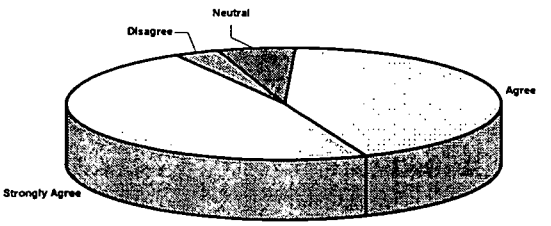
Question 4: There is too much emphasis on computers in the classroom.



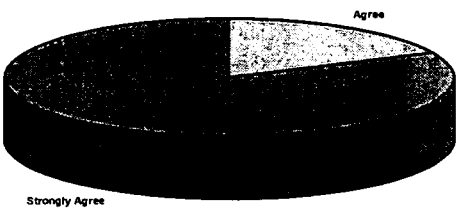
Question 5: I would like to take classes over the Internet.



Question 6: I find the Internet very useful for schoolwork.



Question 7: All Calvin graduates should be able to operate a computer.



Question 8: I like learning in front of a computer.

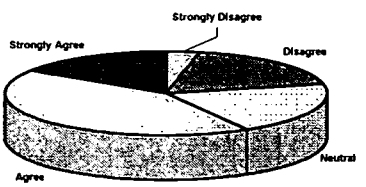
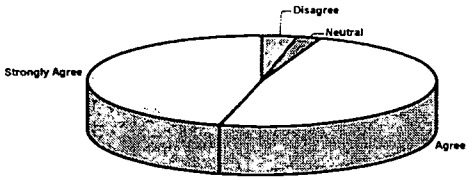


Figure 10 displays individual charts for questions 9 through 16 of the Attitudes survey. The majority of students agreed with each of these questions.

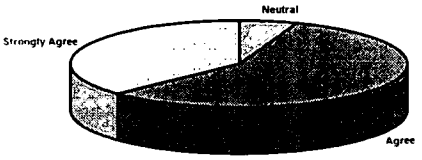
- Q9: I use computers regularly and effectively (SA, 46%; A, 48%)
- Q10: Computers add to the educational process (SA, 37%; A, 57%)
- Q11: Job seekers that possess computers skills are likely to be more successful than job seekers without those skills (SA, 52%; A, 43%)
- Q12: I would like to have course materials available on the school's web page (SA, 36%; A, 48%)
- Q13: I want to know how computers work (SA, 23%; A, 43%)
- Q14: Calvin professors encourage students to learn with computers (SA, 9%; A, 57%)
- Q15: Professors rarely assign work that requires a computer (SA, 19%; A, 53%)
- Q16: I have sufficient access to computers to complete assignments and projects (SA, 43%; A, 49%)

Question 9: I use computers regularly and effectively.

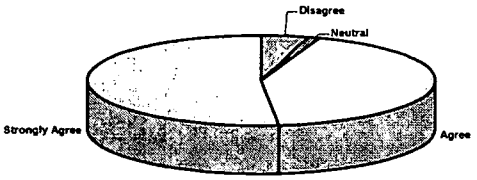


Question 10: Computers add to the educational process.

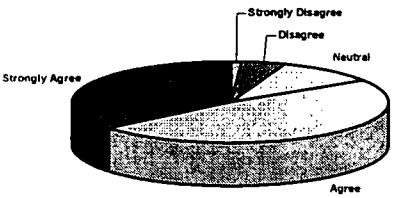
Figure 10



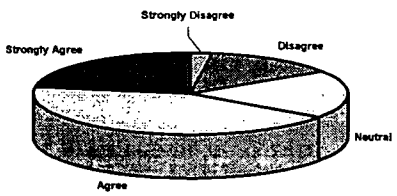
Question 11: Job seekers that possess computers skills are likely to be more successful than job seekers without those skills.



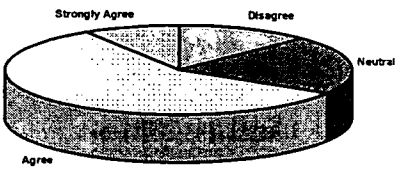
Question 12: I would like to have course materials available on the school's web page.



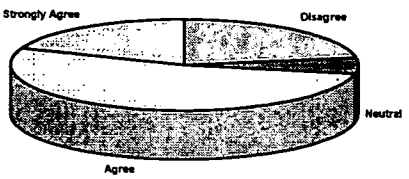
Question 13: I want to know how computers work.



Question 14: Calvin professors encourage students to learn with computers.



Question 15: Professors rarely assign work that requires a computer.



Question 16: I have sufficient access to computers to complete assignments and projects.

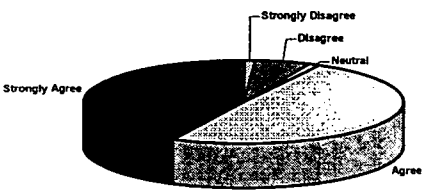
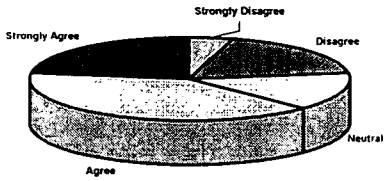


Figure 11 displays individual charts for questions 17 through 20 of the Attitudes survey. The majority of students agreed with questions 17 and 19-20, and were neutral toward question 18.

- Q17: I feel comfortable teaching myself new programs on the computer (SA, 23%; A, 40%)
- Q18: When I have a computer question, most professors are able to answer them (A, 28%; N, 44%; D, 25%)
- Q19: I believe computers are an important part of my education (SA, 34%; A, 59%)
- Q20: Students who own a computer have an advantage over those who do not (SA, 30%; A, 48%)

tion 17: I feel comfortable teaching myself new programs on the computer.



Question 18: When I have a computer question, most professors are able to answer them.

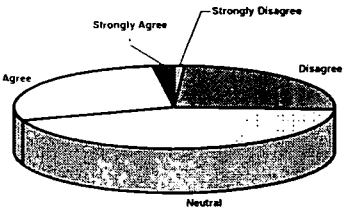
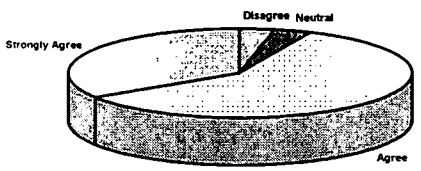
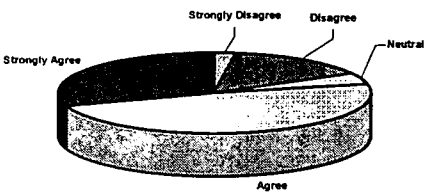


Figure 11

Question 19: I believe computers are an important part of my education.



Question 20: Students who own a computer have an advantage over those who do not.



As stated earlier, the students' positive attitude toward computers is likely a result of the rapid rate of technological growth over the past decade and steadily increasing exposure to computers in all aspects of life. In reviewing the results, the following notable observations (and apparent contradictions) were made:

- The response to question 3 indicates that 38% of students feel that Calvin College could offer more computer courses.
- A majority of students (70%) felt that there is too much emphasis on computers in the classroom (Q4). This belief seems to be contradicted in the positive response to questions 10 (computers add to the educational process) and 19 (computers are an important part of my education).
- The response to question 5 indicates that 57% of students do not want to take courses over the Internet. This seems to be contradicted in the positive response to questions 8 (I like learning in front of a computer) and 12 (I would like to have course materials available on the school's web page).
- The response to question 14 indicates that the majority of students (66%) agree that professors encourage learning with computers. This seems to be contradicted in the negative response to question 15 (professors rarely assign work requiring a computer).
- The response to question 18 indicates that 25% of students disagree with the statement that professors are able to answer their computer related questions, while 44% were neutral.

An analysis of variance (ANOVA) indicates a significant correlation at the .05 level of significance between the means of the

following questions and course code (CPSC101, 105, 130). The conclusion is that the same relationship will exist in future studies 95 times out of 100.

- Q1: Computers make school interesting (.014)
- Q5: I would like to take classes over the Internet (.015)
- Q6: I find the Internet very useful for schoolwork (.037)
- Q8: I like learning in front of a computer (.009)
- Q11: Job seekers that possess computers skills are likely to be more successful than job seekers without those skills (.049)
- Q13: I want to know how computers work (.018)
- Q19: I believe computers are an important part of my education (.002)

An analysis of variance (ANOVA) indicates a significant correlation at the .05 level of significance between the means of the following questions and gender. The conclusion is that the same relationship will exist in future studies 95 times out of 100.

- Q14: Calvin professors encourage students to learn with computers (.028)
- Q16: I have sufficient access to computers to complete assignments and projects (.013)

An analysis of variance (ANOVA) indicates a significant correlation at the .05 level of significance between the means of the following questions and major. The conclusion is that the same relationship will exist in future studies 95 times out of 100.

- Q2: I feel Calvin College is using computers effectively (0.00)
- Q4:There is too much emphasis on computers in the classroom (.027)

An analysis of variance (ANOVA) indicates a significant correlation at the .05 level of significance between the means of the following questions and year-in-school. The conclusion is that the same relationship will exist in future studies 95 times out of 100.

- Q8: I like learning in front of a computer (.001)
- Q15: Professors rarely assign work that requires a computer (.038)
- Q17: I feel comfortable teaching myself new programs on the computer (.024)

A chart combining all questions on the Attitudes survey is displayed in Figure 12.

Respondents - Attitude Toward Computers

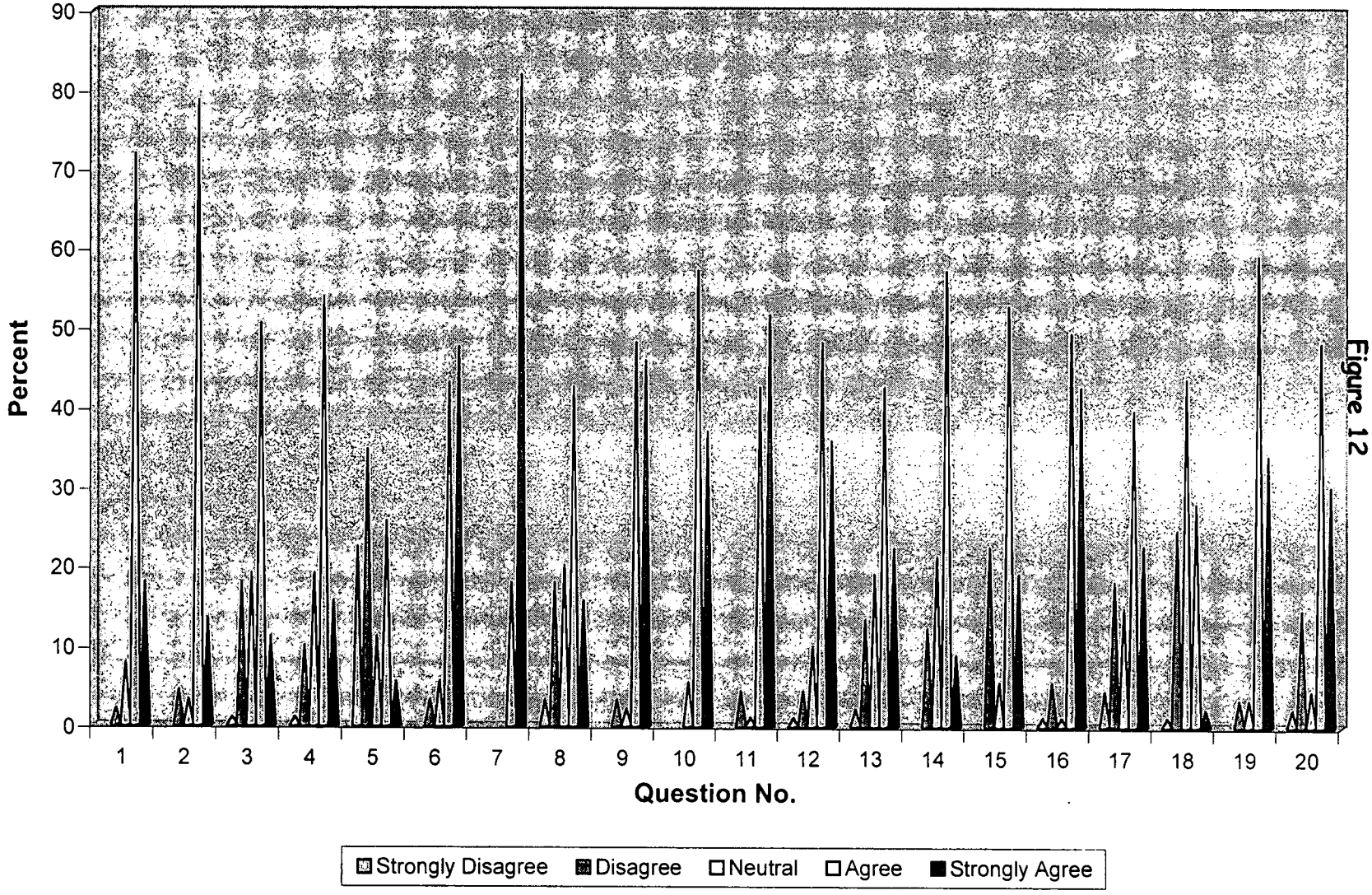


Figure 12

3. What is the relationship between learning style and attitudes toward computers?

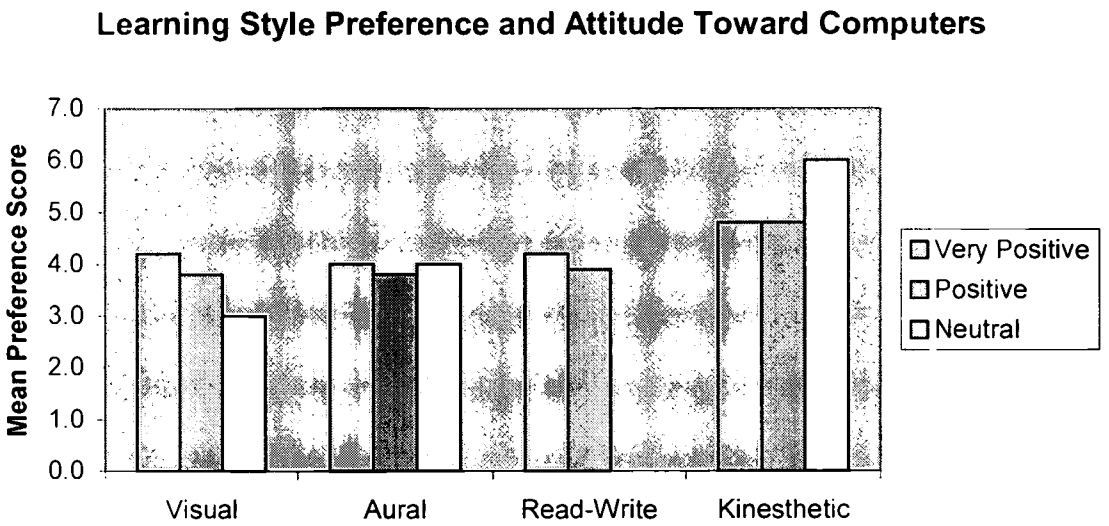


Figure 13: *No significant correlation exists between modality preference and attitude toward computers.*

Student responses on the VARK Learning Styles Inventory, without consideration of attitudinal influences, were combined and categorized by modal preference and previously displayed in Figures 5-6. The majority of respondents were tri-modal (46%), with 41% bi-modal, 9% quadri-modal, and 5% uni-modal. The modal preference occurring most frequently was Kinesthetic (33%), followed by Visual (23%), Aural (22%), and Read-Write (21%).

Student responses to individual questions on the Attitudes survey, without consideration of modal preference influences, were combined and previously displayed in Figure 8. The majority of students (57%) fell into the Positive category, 42% in the Very Positive category, and 1% in the Neutral category.

Individual student responses on the VARK inventory were subsequently categorized and combined by general attitude toward computers, the results of which are displayed in Figure 13. The results suggest that students' attitude toward computers are consistently positive regardless of modal preference. An analysis of variance shows no significant correlation between modality preference and attitude toward computers.

4. What is the relationship between selected academic (year in school, major) and demographic (gender) variables and attitudes toward computers?

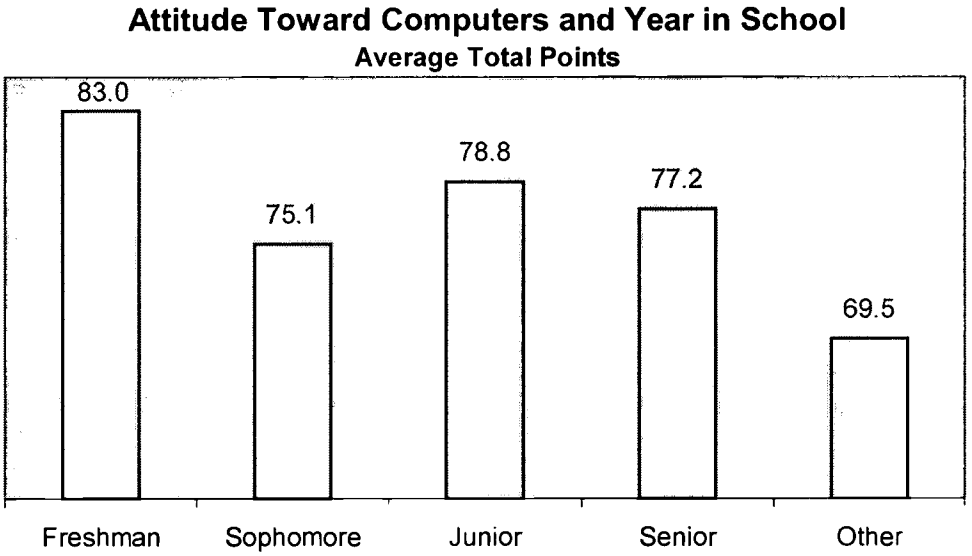


Figure 14: *A significant correlation exists (.049 at the .05 level of significance) between attitude toward computers and year in school.*

Student responses to individual questions on the Attitudes survey were combined and categorized by year-in-school, the results of which are displayed in Figure 14. This chart suggests that younger students are slightly more comfortable with technology than older students.

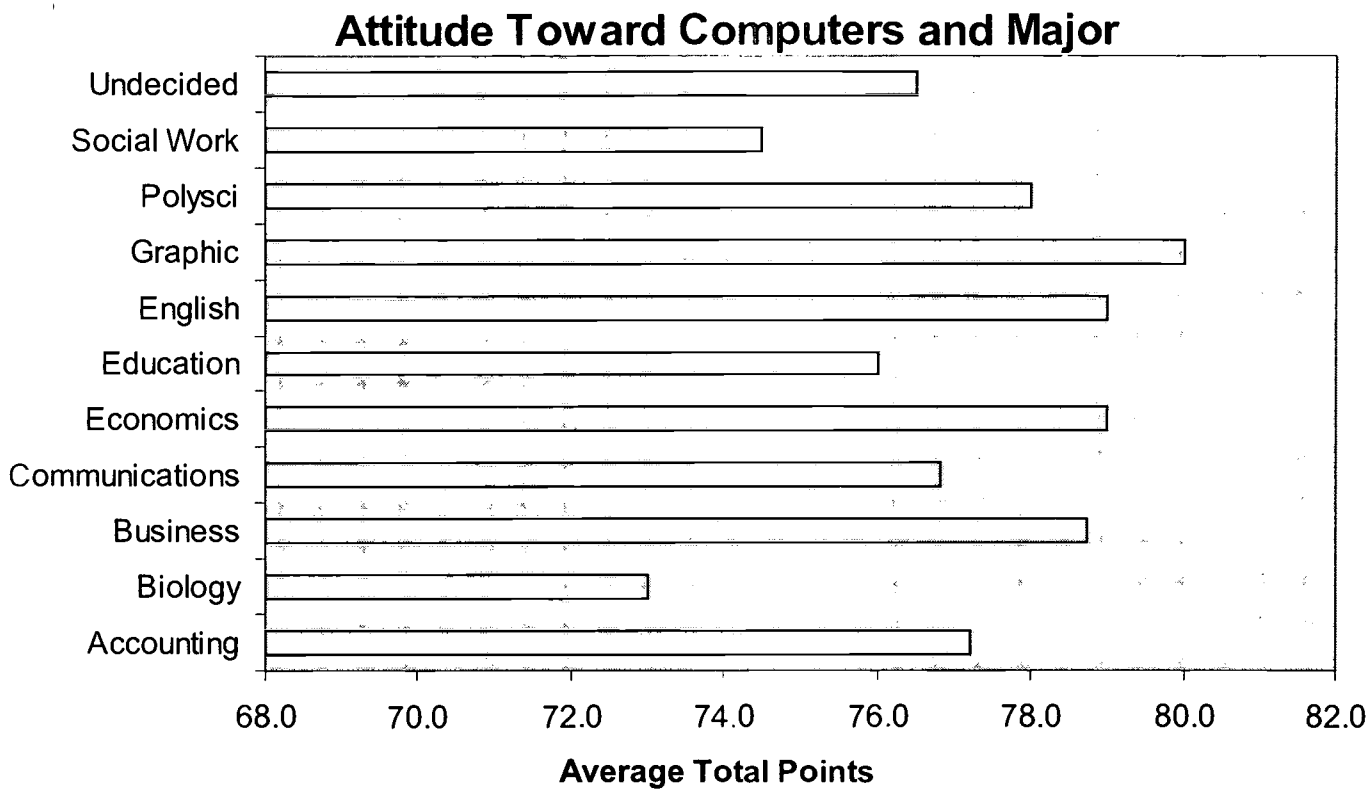


Figure 15: *No significant correlation exists between attitude toward computers and major.*

Student responses to individual questions on the Attitudes survey were combined and categorized by major, the results of which are displayed in Figure 15. This chart suggests that Graphics, English, Economics and Business majors have a more positive attitude toward computers (average total points 78+) than students in other fields.

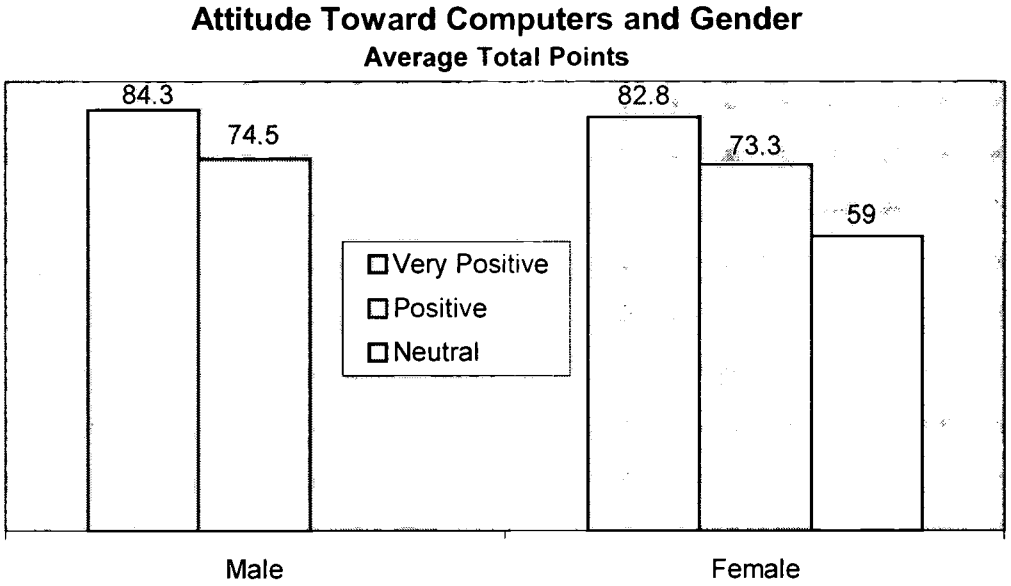


Figure 16: *No significant correlation exists between attitude toward computers and gender.*

Student responses to individual questions on the Attitudes survey were combined and categorized by gender, the results of which are displayed in Figure 16. This chart suggests that males have a slightly more positive attitude than females toward computers.

Summary

1. What is the learning style profile of students who enrolled in service module courses?

The results of the VARK Learning Styles survey indicate that most of the respondents are either bi-modal (41%) or tri-modal (46%), with Kinesthetic being the modal preference occurring most frequently (33%), followed by Visual (23%), Aural (22%), and Read-Write (21%). An analysis of modal preferences by course code indicates a strong Kinesthetic modal preference in all courses, followed by Aural, Visual, and Read-Write. This is consistent with the findings of a study conducted by Specific Diagnostic Studies, as reported on page 9. An analysis of modal preferences by gender indicates a strong Kinesthetic modal preference in both sexes. The profile of male respondents is consistent with the course code findings (Kinesthetic, Aural, Visual, Read-Write), however, females indicated a slight preference for the Visual over the Aural mode. In an analysis of modal preferences and major, a Kinesthetic modal preference was dominant in the Accounting, Biology, Business, Economics (tied with Visual), Education, and Graphic fields.

Communications, English, and Social Work majors prefer the Visual mode. The Kinesthetic-Aural-Visual-Read/Write pattern apparent in the course code and gender (male) analyses was repeated in the year-in-school analysis (freshman, senior and other). Juniors also preferred the Kinesthetic mode, but indicated a slight preference for the Visual over the Aural mode (similar to the results of females in the gender analysis). Surprisingly, the sophomore group indicated a strong preference for the Aural and Visual modes over the Kinesthetic.

2. How do students who enrolled in service module courses feel about computers?

The results of the Attitude survey indicate that the majority of students (57%) feel Positive about computers, 42% feel Very Positive, and 1% are Neutral. The students' positive attitude toward computers is likely a result of the rapid rate of technological growth over the past decade and steadily increasing exposure to computers in all aspects of life. Students in the introductory concepts course (CPSC101) scored lower than the subsequent application courses (CPSC105 and CPSC130) on the Attitudes survey, with CPSC101 and CPSC105 falling into the Positive category and CPSC130 in the Very

Positive category. The lower score in the CPSC101 course compared to the CPSC105 and 130 courses is likely attributable to the content of the class (concepts versus applied software), as well as the students' level of experience with computers.

In reviewing the results of individual questions, the following notable observations (and apparent contradictions) were made:

- The response to question 3 indicates that 38% of students feel that Calvin College could offer more computer courses.
- A majority of students (70%) felt that there is too much emphasis on computers in the classroom (Q4). This belief seems to be contradicted in the positive response to questions 10 (computers add to the educational process) and 19 (computers are an important part of my education).
- The response to question 5 indicates that 57% of students do not want to take courses over the Internet. This seems to be contradicted in the positive response to questions 8 (I like learning in front of a computer) and 12 (I would like to have course materials available on the school's web page).
- The response to question 14 indicates that the majority of students (66%) agree that professors encourage learning with computers. This seems to be contradicted in the negative response to question 15 (professors rarely assign work requiring a computer).
- The response to question 18 indicates that 25% of students disagree with the statement that professors are able to answer their computer related questions, while 44% were neutral.

An analysis of variance (ANOVA) indicates a significant correlation at the .05 level of significance between the means of the following questions and course code (CPSC101, 105, 130). The conclusion is that the same relationship will exist in future studies 95 times out of 100.

- Q1: Computers make school interesting (.014)
- Q5: I would like to take classes over the Internet (.015)
- Q6: I find the Internet very useful for schoolwork (.037)
- Q8: I like learning in front of a computer (.009)
- Q11: Job seekers that possess computers skills are likely to be more successful than job seekers without those skills (.049)
- Q13: I want to know how computers work (.018)
- Q19: I believe computers are an important part of my education (.002)

An analysis of variance (ANOVA) indicates a significant correlation at the .05 level of significance between the means of the following questions and gender. The conclusion is that the same relationship will exist in future studies 95 times out of 100.

- Q14: Calvin professors encourage students to learn with computers (.028)

- Q16: I have sufficient access to computers to complete assignments and projects (.013)

An analysis of variance (ANOVA) indicates a significant correlation at the .05 level of significance between the means of the following questions and major. The conclusion is that the same relationship will exist in future studies 95 times out of 100.

- Q2: I feel Calvin College is using computers effectively (0.00)
- Q4: There is too much emphasis on computers in the classroom (.027)

An analysis of variance (ANOVA) indicates a significant correlation at the .05 level of significance between the means of the following questions and year-in-school. The conclusion is that the same relationship will exist in future studies 95 times out of 100.

- Q8: I like learning in front of a computer (.001)
- Q15: Professors rarely assign work that requires a computer (.038)
- Q17: I feel comfortable teaching myself new programs on the computer (.024)

3. What is the relationship between learning style and attitudes toward computers?

The results of the VARK Learning Styles survey indicate that most of the respondents are either bi-modal (41%) or tri-modal (46%), with Kinesthetic being the modal preference occurring most frequently (33%), followed by Visual (23%), Aural (22%), and Read-Write (21%). An analysis of modal preferences by course code indicates a strong Kinesthetic modal preference in all courses, followed by Aural, Visual, and Read-Write. The results of the Attitude survey indicate that the majority of students (57%) feel Positive about computers, 42% feel Very Positive, and 1% are Neutral. An analysis of student responses on the VARK, categorized and combined by general attitude toward computers, suggests that students' attitude toward computers are consistently positive regardless of modal preference. An analysis of variance shows no significant correlation between modality preference and attitude toward computers.

4. What is the relationship between selected academic (year in school, major) and demographic (gender) variables and attitudes toward computers?

The results of the Attitude survey indicate that younger students are slightly more comfortable with technology than older students. Graphics, English, Economics and Business majors have a more positive attitude toward computers (average total points 78+) than students in other fields. Males have a slightly more positive attitude than females toward computers.

Link to Literature Review

Several theories have been proposed over the last thirty years in which learning styles have been categorized, defined, and analyzed. While these models vary in methodology, they all agree on the diversity of learners and the need to address that diversity in classroom instruction in an effort to improve student performance. As outlined in Chapter IV, the VARK Learning Style Inventory provides a perceptual learning style profile for each student. The acronym VARK stands for the Visual, Aural, Read/write, and Kinesthetic sensory modalities used in learning.

CHAPTER V

Restatement of the Problem

The purpose of this study was to determine the relationship between the learning style profile of students enrolled in the service module courses offered by the Computer Science department at Calvin College and their general attitudes toward computers. The results of the study will be used to improve curriculum design, instructional delivery, and student performance.

Methodology

Two instruments were used to gather data on the variables being investigated. The VARK learning style inventory was administered first. The survey was presented as an interactive web-based form and was made available to students online. The General Attitudes Toward Computers questionnaire was also made available to students online and was completed approximately one month after the VARK inventory.

Conclusions Based on Findings

The data from the VARK Learning Styles inventory and the Attitudes survey were analyzed to determine the relationship between modal preferences and general attitudes toward computers. Four research questions were presented in Chapter I, and the results were reported in Chapter IV. In summary:

1. What is the learning style profile of students who enrolled in service module courses?

The results of the VARK Learning Styles survey indicate that most of the respondents are either bi-modal (41%) or tri-modal (46%), with Kinesthetic being the modal preference occurring most frequently (33%), followed by Visual (23%), Aural (22%), and Read-Write (21%). An analysis of modal preferences by course code indicates a strong Kinesthetic modal preference in all courses, followed by Aural, Visual, and Read-Write. This is consistent with the findings of a study conducted by Specific Diagnostic Studies, as reported on page 9. An analysis of modal preferences by gender indicates a strong Kinesthetic modal preference in both sexes. The profile of male respondents is consistent with the course code

findings (Kinesthetic, Aural, Visual, Read-Write), however, females indicated a slight preference for the Visual over the Aural mode. In an analysis of modal preferences and major, a Kinesthetic modal preference was dominant in the Accounting, Biology, Business, Economics (tied with Visual), Education, and Graphic fields. Communications, English, and Social Work majors prefer the Visual mode. The Kinesthetic-Aural-Visual-Read/Write pattern apparent in the course code and gender (male) analyses was repeated in the year-in-school analysis (freshman, senior and other). Juniors also preferred the Kinesthetic mode, but indicated a slight preference for the Visual over the Aural mode (similar to the results of females in the gender analysis). Surprisingly, the sophomore group indicated a strong preference for the Aural and Visual modes over the Kinesthetic.

2. How do students who enrolled in service module courses feel about computers?

The results of the Attitude survey indicate that the majority of students (57%) feel Positive about computers, 42% feel Very Positive, and 1% are Neutral. The students' positive attitude toward computers is likely a result of the rapid rate of technological growth

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In reviewing the results of individual questions, the following notable observations (and apparent contradictions) were made:

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An analysis of variance (ANOVA) indicates a significant correlation at the .05 level of significance between the means of the following questions and gender. The conclusion is that the same relationship will exist in future studies 95 times out of 100.

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- Q4: There is too much emphasis on computers in the classroom (.027)

An analysis of variance (ANOVA) indicates a significant correlation at the .05 level of significance between the means of the following questions and year-in-school. The conclusion is that the same relationship will exist in future studies 95 times out of 100.

- Q8: I like learning in front of a computer (.001)
- Q15: Professors rarely assign work that requires a computer (.038)
- Q17: I feel comfortable teaching myself new programs on the computer (.024)

3. What is the relationship between learning style and attitudes toward computers?

The results of the VARK Learning Styles survey indicate that most of the respondents are either bi-modal (41%) or tri-modal (46%), with Kinesthetic being the modal preference occurring most frequently (33%), followed by Visual (23%), Aural (22%), and Read-Write (21%). An analysis of modal preferences by course code indicates a strong Kinesthetic modal preference in all courses, followed by Aural, Visual, and Read-Write. The results of the Attitude survey indicate that the majority of students (57%) feel Positive about computers, 42% feel Very Positive, and 1% are Neutral. An analysis of student responses on the VARK, categorized and

combined by general attitude toward computers, suggests that students' attitude toward computers are consistently positive regardless of modal preference. An analysis of variance shows no significant correlation between modality preference and attitude toward computers.

4. What is the relationship between selected academic (year in school, major) and demographic (gender) variables and attitudes toward computers?

The results of the Attitude survey indicate that younger students are slightly more comfortable with technology than older students. Graphics, English, Economics and Business majors have a more positive attitude toward computers (average total points 78+) than students in other fields. Males have a slightly more positive attitude than females toward computers.

Methodological Limitations

The population for this study was limited to students enrolled in the service module courses offered by the Computer Science department at Calvin College. The sample size was small (82).

Recommendations for Future Studies

Future studies should include:

- other institutions
- a larger sample size
- an expanded list of academic and demographic variables
- an analysis of students with strong uni-modal preferences as compared to those with multi-modal preferences
- an analysis of the effects of learning styles-based instruction on student performance
- an analysis of faculty modal preferences and student modal preferences
- an analysis of the effects of matching student and faculty modal preferences on student performance

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