# A Comparison of Students in Introductory (General Education) Computer Science Courses and Students in the First Computer Science Major Course.

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## Abstract

Students in the first course in the Computer Science major (CS 1) and students in the Computer Science service courses were surveyed to determine if there were differences between them in four areas: computer usage; skills and experience in office productivity tools including email, Internet use, and programming; use of the computer; and perceptions of the importance of the computer in their careers.

There were differences between students in the service course and CS 1 students in a number of the four enumerated areas. Both the CS 1 students and the Computer Science service course used the computer extensively in high school. However, when considering the skills and experience in office productivity the CS 1 students rated themselves as being more proficient and having more experience than there 'Intro' counterparts. This prevalence of the CS1 students over the 'Intro' students was consistent throughout the other three areas.

## Introduction

Since the Spring Semester 2001 students in the Computer Science services courses (Introduction to Computer Science and Introduction to Microcomputer – a College of Business core course) and students enrolled in the Computer Science 1 major course have been surveyed to determine their experience and perceived skill levels in programming, the office suites of products - e.g. word processing, spreadsheets, databases and presentation software, e-mail and use of the internet. In addition they were asked questions about access to a computer and previous use of a computer in high school and who helped them learn about computers.

There were 356 students in the CS 1 class and 2,089 in the COMS100 and 101 classes combined. This disparity in numbers makes comparison by numbers alone difficult and meaningless. In analyzing the results, percentages are used because they offer a better measure in comparing the two groups.

The students in both groups were very similar except for gender. The average age for both groups was 20 and most graduated from high school within the last three years. As a result most consider themselves freshman. As CS 1 is the first computer science major course there were very few seniors taking the course, but more juniors and seniors taking the basic introduction courses. Because the Introduction to Microcomputers is a College of Business required course, this course does have a larger number of upper classmen taking the course especially as they get closer to graduation or the need this a prerequisite for another required course.

The gender difference in the courses was interesting. In the CS 1 course the ratio was 86% male and 14% female. In the general introductory courses, the ratio was 60% male and 40% female. Anecdotally at Minnesota State University, Mankato the percentage of females in the CS 1 course is higher than the percentage of those that actually finish the CS major.

The first questions in the survey asked students about their uses of computer, the brand of computer, did friends or relatives help them learn how to use a computer and did they use the computer in at least one high school course.

## Computer Usage

Computer usage in high school and home was very prevalent for both groups. For the CS 1 students, 93.1% used a computer in high school, 97.8% use a computer at home and 87.8% had at least one high school class that required the use of a computer. For the other group of students, 94.8% used a computer in high school, 95.6% use a computer at home and 85.8% had a high school course requiring the use of a computer.

Since most of the students have used or are using a computer, students were then asked if they were going to bring their own computer to the Minnesota State University, Mankato

and if so what brand and type (laptop or desktop). For the CS 1 students, 73.1% were bringing their own. Most of these students were bringing desktops from different manufacturers. Of all of the possible choices available to students, Dell was the company most frequently identified although not overwhelmingly (19.4%). 'Homemade' was the next largest category at 18.6%. Only 12.7% of the CS 1 students were bringing laptops to the University.

For the students in the 'Intro' courses, 60.5% were bringing their own computers and they also were bringing desktop computers from different manufacturers. Dell again was the most frequently identified but only 1.6% were 'homemade' and only 11.8% were bringing laptops. Since the College of Business requires laptops of all junior and senior students many in the Intro to Microcomputer course may be deferring the purchase of a computer until their junior or senior year.

The students who were in the CS 1 course appeared to be more self educated in learning how to use a computer. Of these students 37.4% replied that their friends or parents did not help them learn to use a computer (62.6% indicated they did receive help). For the 'Intro' students, 22.3% replied that they received no help in learning how to use the computer.

Table 1 illustrates the use of the computer by students in the CS 1 course and the service courses ('Intro'). The CS 1 students have used the computer in greater numbers for most of the activities enumerated. The only activity where this isn't true was in the use of a computer in a 'business or accounting' course.

This table also illustrates the decline in use of programming languages popular in the past. COBOL, FORTRAN, Pascal and assembly language are not used as extensively as they once were. However, it appears that BASIC, which in this case implies Visual BASIC, continues to be a popular programming language.

Table 1 Computer Usage

| Dichotomy label | Name | Pct of responses | | Pct of cases | |
|---|---|---|---|---|---|
| | | CS 1 | 100 & 101 | CS 1 | 100 & 101 |
| in course for computer | Q7 | 7.9 | 4.9 | 53.7 | 24.5 |
| course about computer | Q8 | 11.2 | 10.6 | 76.6 | 53.1 |
| in a math course. | Q9 | 7.3 | 6.8 | 50 | 34.3 |
| in an English course | Q10 | 12.6 | 16.6 | 85.6 | 83.2 |
| in a science course. | Q11 | 8.7 | 8.9 | 59 | 44.5 |
| to write a BASIC program | Q12 | 6.2 | 3.6 | 42.1 | 17.9 |
| to write a COBOL program | Q13 | 0.5 | 0.2 | 3.7 | 0.9 |
| to write Pascal program | Q14 | 1.0 | 0.3 | 7.1 | 1.7 |
| to write a FORTRAN program | Q15 | 0.3 | 0.1 | 2.0 | 0.3 |
| to write an assembly program | Q16 | 1.4 | 0.3 | 9.6 | 1.4 |
| write graphics routine | Q17 | 3.3 | 2.2 | 22.6 | 10.8 |

| | | | | | |
|---|---|---|---|---|---|
| for word processing | Q18 | 14.2 | 18.9 | 96.6 | 94.7 |
| to create and use spreadsheet | Q19 | 13.1 | 14.2 | 89 | 71.2 |
| for desktop publishing | Q20 | 7.3 | 5.6 | 49.4 | 28.2 |
| in a business or accounting | Q21 | 5.0 | 6.8 | 33.9 | 34.3 |
| | | ------------- | | ------------ | |
| Total responses | | | | | |
| | | 100 | 100 | 680.8 | 501 |

When students were asked to rate themselves on their programming skills, use of an office suite of products, internet and email, they could choose from the following responses 'expert', 'good', 'fair' and 'little or no experience'. When asked about their amount of experience they had in the above areas they could choose from the following responses 'a lot', 'more than average', 'some' and 'little or no' experience. Programming was the first topic addressed. There were no precise definitions given for the response categories. The students self-rated themselves base on their own subjectivity. Their answers were relative to the student's knowledge and experience.

## Programming

Students were asked to rate their programming skills and the amount of experience they had in programming. For those students who were in the first course in the Computer and Information Sciences major, you would expect they would rate themselves higher and have more experience than the 'Intro' students. This is true, but there were a high number of CS 1 students who rated themselves as 'poor' with 'little or no' experience.

When programming skills are compared, the CS 1 students rate themselves 'good' (15.9%) and 'expert' (3.7%) more than the 'Intro' students (8.2% and .5% respectively). On the other hand there are fewer of them (the CS 1 students) that rate themselves as having 'poor or no' (45%) programming skills than the 'Intro' students (62.7%). When the response 'fair' is considered, it can be seen that more of the CS 1 students (15.9%) consider themselves having 'fair' programming skills than the 'Intro' students (8.2%). Perhaps this is due to the CS 1 students having more knowledge of programming and its complexities and therefore they rate themselves accordingly.

When considering the amount of experience in programming, the CS 1 students have more programming experience than the 'Intro' students. When comparing the CS 1 students' self rating on their skill to the categories in the amount of experience, there were more students (8.2%) who said they have 'a lot' of experience programming, but only 3.7% felt they were expert programmers. Of the CS 1 students there were 47.9% who had 'little or no' experience, while 74.1% of the 'Intro' students had 'little or no' experience in programming. For the student not going into computer science skills and experience are unimportant or because these students do not have any experience then they aren't considering computer science as a major.

## Office Application Programs

In today's society people are expected to known how to use a computer and those applications which contribute to personal and office productivity. This implies that anyone who will be working in an office or for that matter any business should know how to do word processing, have a working knowledge of a spreadsheet, familiarity with a database and some knowledge of presentation software. Most of these applications are found in the Microsoft Office Suite of products. Microsoft Office has become the de facto standard in education, business and industry. It doesn't matter what the student's majors is they should have some kind of experience with this suite of products and a basic knowledge of how a generic application works e.g. word processing, use of spreadsheet and database, etc..

**Word Processing**

All students in this sample were asked about their skills and experience using a word processor. More of the CS 1 students rated themselves as experts (35.3%) than did the Intro students (20.3%) and only 1.4% rated of the CS 1 students rated themselves as having 'poor or no' skills in word processing. For the 'Intro' students 3.1% fell into this category. Over 50% in each group rated themselves as being 'good' at word processing.

Is being 'good' associated with 'a lot' or 'more than average' in the amount of experience students have in word processing? When considering the amount of experience more CS 1 students (66.1%) have 'a lot' more than experience than their 'Intro' counterparts (41.9%), but more of the Intro students (39.8%) consider themselves to have 'more than average' experience than the CS 1 students (33.9%). Only .8% of the CS 1 students had 'little or no' experience with word processing while 2.2% of the 'Intro' students had 'little or no' experience.

Word processing is one of the office suite of products that people are most familiar with as is evidenced in the survey, using a spreadsheet is another. Most of the students in this survey had experience with using a word processor and the majority of them felt their skills were at least 'fair' or above does this trend continue?

**Using Spreadsheet**

Working with spreadsheets shows the same types of responses as was reported in programming and word processing, but there is an increase in those who rated themselves as 'poor' or with 'no' skills in working with a spreadsheet for both groups of students. There were 19.5% of the 'Intro' students who rated themselves as having 'poor' or 'no' skills in using a spreadsheet as compared to 7.6% of the CS 1 students. More of the CS 1 students (14.2%) rated themselves as 'expert' and 50.1% as 'good' compared to 4.8% and 34.0%, respectively, of the 'Intro' students. How does this self-rating compare to the amount of experience expressed by both groups of students?

The differences apparent in the preceding discussion are also apparent in the responses to the amount of experience in using a spreadsheet. For those who answered 'a lot' 27.2%

were CS 1 students and 10.3% were 'Intro' students. For the response 'little or none' 20.8% of the 'Intro' students answered with this response while only 7.1% of the CS 1 students were in this response group. The majority of both groups, over 60% in the CS 1 and 'Intro', felt that they had 'more than average' or 'some' experience in using a spreadsheet.

Most of the students in the survey have used a word processor and rate themselves accordingly, fewer of the students have used a spreadsheet and fewer rate themselves as being an 'expert' or 'good'. This trend does hold true for using a database, in particular the Access database.

**Use of a Database**

As Microsoft owns over 90% (Thibodeau, 2002) of the office productivity (Word and Excel) software market and as Access is one of those applications in the Microsoft Office suite of products, students were asked to rate themselves on their database skill level and the amount of experience they have had with Access. It could be argued that database skill level is something other than skill with Access. This may be true but for purposes of this discussion it is assumed to be a rating of their (the students) Access skills.

Fewer of the students in either group rated themselves as 'expert' while many more rated themselves as either 'fair' or 'poor or no' skill. For the CS 1 students, only 5.4% rated themselves as 'expert' and only 1.7% of the 'Intro' students did. For those who rated themselves as either 'fair' or 'poor or none', there were 64.1% CS 1 students in this category and 82.6% 'Intro' students. All of the students in this sample don't feel their skill levels are that strong. This is probably due to their lack of experience in using Access.

You cannot gain in skill level unless you use the application. The students in this survey indicated that they don't have 'a lot' of experience with Access. Only 5.7% of the CS 1 students indicated that they had 'a lot' of experience with Access and only 2.4% of the 'Intro' students indicated that they had. The majority of the students in both groups had 'some' or 'little or no' experience. In this category were 77.9% CS 1 and 89.3% of the 'Intro' students. These students do not have much experience using Access and this is reflected in their self rating in their database skills, i.e. Access skills.

**Using Presentation Software**

Most students have had some exposure to presentation software and in particular to PowerPoint, another one of the applications in the Microsoft Office suite of products. This is reflected in their self-ratings. Again more of the CS 1 students (18.1%) rated themselves as 'expert' than the 'Intro' (5.7%) students.

The trends seen previously were also present for those with 'poor' or 'no' skills in presentation software. Only 11.0% of the CS 1 students rated themselves as having 'little or no' skills in presentation software while there were 32.9% 'Intro' students who answered with this response. The amount of experience reflects these self-ratings.

More of the CS 1 students had 'a lot' more experience than the 'Intro' students and had fewer students with the 'little or no' experience than the 'Intro' students. There were 18.1% with 'a lot' of experience for the CS 1 students and there were only 5.7% who had 'a lot' of experience. On the other hand 39.7% of the 'Intro' students had 'little or no' experience while there were only 16.1% of the CS 1 students in this category.

As the applications grow in complexity and power (the ability to program and perform many complex functions) especially with Excel and Access, the less familiarity and experience the students have and, as a result, the less confidence they have in their abilities which is also related to their amount of experience with each skill area.

However this isn't true when considering the use of e-mail and the Internet.


## E-mail and Internet Usage

### E-mail Usage

It is not surprising that most of the students in the survey rated themselves as 'expert' or as 'good' in their skill level. In this combined category 'expert' or 'good', there were 96.4% of the CS 1 students and 87.8% of the 'Intro' students. Very few (1.1% for CS 1 and 1.9% of the 'Intro') of the students in either group responded that they had 'poor or no' experience in using E-mail to send and receive message. This is not surprising considering the extensive use of e-mail by students in this survey. Since many of the students consider themselves as either 'expert' or 'good' is this commensurate with the amount experience they exhibit.

The majority of the students in both groups have 'a lot' or 'more than average' experience with sending and receiving messages. Again the CS 1 students (96.1%) had more experience than did the 'Intro' students (84.4%). There weren't any CS 1 students who reported that they had 'little or no' experience. There were 1.9% of the 'Intro' students who had 'little or no' experience. These findings are also duplicated in Internet usage.


### Internet Usage

Internet usage is a nebulous term. Every student uses the internet to register for classes, get their tuition invoice, get their grades, etc. Many of the courses use a course management program to manage course resources. Students also use the Internet to research topics for their papers, download music, order tickets, make reservations, buy

airline tickets, etc. As a result Internet usage encompasses all of these activities plus others not enumerated. Regardless as to how the Internet is used, how do students rate themselves on their skill level and the amount of experience they have in Internet usage?

As can be expected a very large number of the students in the survey considered themselves as either 'expert' or 'good'. Again the numbers favor the CS 1 students, there were 90.4% who said they were either 'expert' or 'good' in Internet usage. Of the 'Intro' students 87.1% were in this category. For both groups there were very few (1+ %) who had 'poor or no' skill in using the Internet. These ratings reflect the amount of experience exhibited by either group of students.

When combining the respondents to the 'a lot' and 'more than average' response, over 80% of the students (87.4% for CS 1 and 85.2% for the 'Intro' students) in both groups fall into this category and only 1.2% of the 'Intro' students had 'little or no' experience in using the Internet. There were no CS 1 students who said they had 'little or 'no' experience with Internet usage.

## Importance of the Computer in Academic and Occupational Career

Students in both groups recognize the importance of computer skills in the job market. Students were asked about the impact of using computers in: a. making it easier to get a job; b. increasing their earning power; and c. in helping them to do a better job once they get that job.

The students were asked questions that required them to indicate their agreement or disagreement with the statement. The responses available went from strongly agree, agree, disagree and strongly disagree.

There was very strong agreement for students in both groups that knowing how to use a computer will make it easier to get a job. Over 96% of the students in both groups agreed with that statement and of this 96% - over 54% strongly agreed with the statement. There were some who disagreed but no one strongly disagreed

This sentiment was also true when asked about increasing earning power by knowing how to use a computer. Over 92% of the respondents agreed with this statement and of these over 47% were in strong agreement. However, .4% of the 'Intro' students strongly disagreed with this statement but none of the CS 1 students did strongly disagree with this statement.

Students in both groups were in overwhelming agreement with the statement that 'once I got a job, knowing how to use a computer will help to do the job better'. Students answered affirmatively in response to this question – over 95% in agreement and of those over 51% were in strong agreement.

Is it 'cool' knowing how to use a computer? Over 91% agreed that knowing how to use a computer was cool and over 51% thought strongly about it. However, there were a few CS 1 students (5%) who disagreed and 8% of the Intro students who did.

## Role of Computer Equipment and Resources

Students in the sample were asked a number of questions concerning the role of computer equipment in their academic studies. Were they expecting to use computers for most of their courses at MSU, M? Is it important to have my own computer and who will buy it? If computing resources are important to my success in college, did the on campus computing facilities influence my decision to come to Minnesota State University, Mankato.

Students in both courses expected to use computers in most of their courses. Over 90% of the students in both groups were in agreement with the statement and of those over 45% strongly agreed. It is not surprising that only 5% of the CS 1 students (CS Majors) disagreed with this statement while 10% of the Intro students did. Although many of the courses at any University benefit from the use of a computer, it is possible to take some courses where use of the computer would be very limited.

Is it more important to have my own computer rather than go to the computer labs? For CS 1 students 85% felt it was more important to own a computer and of these, 46% thought it was very important (strongly agree). For the intro students 79% agreed with the statement and of those 36% were in strong agreement. There were more 'Intro' students (19.8 %) who were in disagreement than CS 1 students (13.8%) about the importance of computer ownership.

If having a computer is important who is willing to buy it? For CS 1 students 89% were willing to buy a computer and 44% indicated that their parents were willing to purchase a computer for them. For the Intro students 81.5% were willing to buy (agreed with the statement) a computer for their own use and 49.5% indicated their agreement with the statement that their parents were willing to purchase the computer.

As can be seen students in both groups appreciate the importance of the computer in their academic careers. As such either they or their parents are willing to buy a computer for use in the students' course work. So then what role did computing facilities at Minnesota State University, Mankato play in influencing their (the student's) decision to come to the University?

Very little it turns out for the ''Intro' but it was a consideration for the CS 1 students. For CS 1 students 38.4% indicated that the computer facilities influenced their decision as opposed to 23.4% of the Intro students. Most CS 1 students are taking this course because they either want to major or minor in Computer Science and as such they realize the importance of computer facilities that are not limited to just the general computer labs. For them there are other computer facilities they need to consider like the wireless labs,

the client server labs, the robotic labs - labs that require expensive and sophisticated equipment. Computer Science is a laboratory science and as such needs dedicated and specialized laboratories as much as the other laboratory sciences, i.e. chemistry, biology, physics, etc.

## Summary

This research has implications for course content, for computing facilities and resources at the institution. In the future the Introduction to Computer Science courses may want to eliminate some topics and devote additional time to other topics. Students are exhibiting a familiarity with some of the most basic office productivity and electronic communication skills and a familiarity with the internet. As such more advance topics may be addressed and added to the curriculum

For example, since most of the students in the service ('Intro') courses are familiar with the internet, using email, using Word and PowerPoint, we could either drop the subjects or introduce more advanced topics. When teaching e-mail, faculty could talk about creating SPAM filters/rules in Microsoft OUTLOOK or any other e-mail client. Faculty could also highlight the importance of security in using e-mail, e.g. awareness of e-mail fraud, the different forms of virus delivery, etc. In Word some advanced topics which could be introduced are creating newsletters, creating indices or table of contents plus how to use a database (Access) with the mail merge functions of Word, etc. Lectures on the Internet could address digital literacy and evaluation of the site content.

Students in the CS 1 course are also familiar with the above topics, but their familiarity will not grow because their skill levels will not be advanced because they are not required to take courses that will enhance their knowledge and use of a spreadsheet (Excel) and a database application like Access. Students in the 'Intro' courses are expected to learn advance functions in Excel, but this is not true for the CS 1 students. There is no further exposure to Excel in the Computer Science major curriculum. Students in the 'Intro' courses are exposed to Access and get a familiarity with it and the construction of a database. Unless our CS 1 Students (CS majors) take a system design course which includes a three week introduction at the beginning of the semester to Access, majors in Computer Science may never learn to use this all important tool. If Computer Science majors took the 'Intro' course, faculty wouldn't have to spend the first few weeks teaching students the basic elements of Access. Faculty could devote the time to an in-depth discussion of database basics or other topics relevant to the course.

This study indicates that there is a need for an 'Intro' or service course. There will always be students attending our colleges and universities, especially those international students from third world countries, who don't have any computer experience. These students need to get some formal training in this area if they expect to be successful in their academic careers. Perhaps remediation is an alternative if the service course drops topics like e-mail, Internet usage, and Word processing.

For international students getting a familiarity with the computer, learning to how to use e-mail, the Internet and word processing is as important as is having the computing resources available i.e. hardware, but to what extent. Most of the CS 1 students have indicated the importance of having their own computer as did many of the 'Intro' students. This would suggest that in the future there might not be a need to expand the on-campus access to hardware. With the cost of desktops and laptops approaching commodity pricing levels, the need for on-campus hardware is diminishing but not disappearing.

Many more colleges and universities are exploring the feasibility of requiring new students to have a laptop. Instead of spending money on computers the universities will now be spending this money on ancillary hardware like printers, wireless networking, blue tooth enabled devices and additional power outlets (laptop batteries have a long life, but not an infinite life). One would expect to see in the future charging stations (for charging laptop batteries) or labs with few if any computers but with printers and workstations with electrical outlets. The computers labs of today will become the 'study halls' of the future – spaces not dedicated to a specific use.

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