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THE DIGITAL DIVIDE IN WORCESTER

An Interactive Qualifying Project Report

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by

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ABSTRACT:

This IQP focuses on a review of the technology gap that is growing between various socioeconomic groups throughout the world, the United States, and locally in Worcester County. Certain people, the technology "haves," possess the best information technology that society has to offer. This opens to them a wealth of information. The technology "have-nots" lack these resources, and as such, lack the resources to succeed in the new information-based economy. The result has been dubbed the "digital divide."

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Chapter 1: INTRODUCTION

Before steps can be taken to bridge a technology gap, the community must be informed. Our goal is to gain a good understanding of technology access and benefits in the city of Worcester in order to determine the possible existence of a local digital divide of the full scope of a divide. Recent research conducted by corporations and independent organizations nationally has yielded data showing that certain groups of Americans have greater levels of computer ownership and Internet access then other groups. These studies haves shown that the group with lower access to technology is generally made up of certain minorities, those with lower incomes and education levels, and those in rural areas or central cities. Over the past decade this research has helped establish the concept of an evolving digital divide. Through interaction with local residents and schools, we hope to provide similar data on the level of technology access in Worcester.

Various studies have shown technology gaps are linked to such factors as age, race, income, education, and geography. From the information we have gathered from background research, case studies, and past projects we are confident that a divide does exist in Worcester. Taking these previous studies into consideration we have conducted a statistically valid study. The data for this study was generated by gathering surveys from local residents and schools. By seeking out existing correlations between the aforementioned demographics and the level of access to information technologies in Worcester, we are able to provide evidence of a digital divide.

Our research can then be used to increase awareness of a digital divide in the local community and school systems. In addition, there are many public and private agencies that could benefit from this information. The Worcester public schools, board of

education, pubic libraries, and community centers could use these results to plan out future strategies for dealing with the divide. This research could also be used as a basis for further studies, investigations, and projects on the digital divide conducted by WPI students and faculty. We feel this study is a suitable IQP due to the fact that it faces many important societal issues that directly relate to technology.

We believe the digital divide cannot be ignored. Americans are continually becoming more dependent upon information technologies. Without access to these tools it will be increasingly harder for citizens to play a full role in society. These citizens are left at a disadvantage when seeking better education, searching for better jobs, or taking an active role in their communities. There has not been a great deal of research completed on the state of technology access in Worcester. Although national studies indicate that the digital divide is a national trend, we feel that speculation is not enough. The digital divide cannot be summed up in a single definition since the factors that contribute to its formation are as diverse as the locations in which it exists. This project is being conducted in order to present initial data on the status of Worcester's digital divide.

Chapter 2: BACKGROUND

2.1. Introduction to the Digital Divide

With the arrival of the information age and the advent of the Internet, society has been transformed. The world's economy, and our nation's, is becoming more and more dependant on information technology. The digital economy affects every citizen's well-being, from job opportunities to education. In order to assure the livelihood of America's people, we must ensure that all Americans have the tools, technologies, and skills of the information age.

Sadly, those who are in an underprivileged economic situation are falling behind. Lloyd Morrisett, the former president of the Markle Foundation, coined the term "digital divide" to describe the separation between the technology "haves" and "have-nots." The technology "haves" typically shown to consist of Whites, Asians/Pacific Islanders, those with higher incomes, those more educated, and households with dual-parent. This group of citizens generally posses greater access to technology then the "have-nots", which consist of certain minorities, those with lower incomes and education levels, and those in rural areas or central cities [2]. This digital divide threatens to leave those who lack information access or skills behind.

The divide has many causes but no simple solutions. On a world scale societies are simply not yet ready for computers and the Internet. Approximately 33% on the world's population has no electricity, and another 33% does not have reliable electricity. The United States has more computers than the rest of the world combined, and more computers per capita than any other country. Phone lines are a first logical step before Internet access; yet phone lines do not reach 80% of the world's population. [4]

Within some countries the lack of technology or phone access is not the problem, but rather the present political situation. For instance, in Cuba where there is no freedom of speech the government controls the Internet like it controls other media in the country. In Iran, the Internet is censored for content including "sexuality, religion, criticism of the Islamic Republic, any mention of Israel, and the United States." [5]

According to Professor Jennifer L. Hochschild of Princeton University, Americans expect equality in what she has dubbed the "socializing domain," which includes education, health care, and basic political rights. However, we as a society do not seem to have a problem with much larger differences in the "economic domain" [3]. Internet access still exists with the idea that it is an economic privilege instead of a necessity. However, every day Internet and information technology skills are becoming more essential. According to Larry Irving, Assistant Secretary of Commerce for Communications and Information, 60 percent of jobs today require skills with technology. The Office of Management and Budget states that 75 percent of all transactions between the government and individuals, including Social Security, food stamps, and Medicaid, take place electronically. This puts the individual who does not have information technology skills or access at a considerable disadvantage.

The implications of the digital divide do not stop there. There is a direct correlation between education and job wages. Between the years 1979 and 1995, "real wages dropped 23 percent for people with less than a high school education and 12 percent for those with only a high school diploma, while wages rose 4 percent for college graduates and 12 percent for people with advanced degrees." A joint study in 1997 between economists David Autor of Harvard and Alan Krueger of Princeton found that as

much as half of the increase in the demand for skilled workers can be linked to the spread of information technology [3]. This means that those without information technology skills are automatically less likely to prosper in today's economy.

The website of the Department of Housing and Urban Development states that "fewer and fewer Americans will be able to fully participate in our nation's economic, social, civic, and government life." Many government bodies, businesses, and organizations are moving their operations to the Internet. Those who are under-represented on the Internet stand to be excluded from any economic benefits that the net may provide.

In recent years, much evidence has been compiled by various studies that show that the digital divide exists. Politicians have not overlooked the problems inherent with such a gap. In the past few years the government has set up committees, held forums, and sponsored programs and initiatives that have helped to combat the technology gap on a national and local level. The Telecommunications Act of 1996 introduced a program known as "e-rate." The e-rate program is intended to provide cheap Internet access to schools. The program is designed to award the largest breaks to the most disadvantaged schools. The government has started other initiatives as well. The Telecommunications Act of 1996 also established the Telecommunications Development Fund. The fund will operate as a non-profit organization and was set up to provide loans to small businesses in order to promote competition in telecommunications and stimulate the development of new technology. The Department of Housing and Urban Development (HUD) has created the Neighborhood Networks Initiative to provide training and access for HUD-financed areas. There are 340 of these centers are currently open, and 1060 more are planned.

Government planning and intervention is a crucial and necessary step to bridge the Digital Divide in America.

2.2 The Global Divide

The expansion of technology and the continually rapid pace of globalization present a very interesting situation worldwide. The evolution of information technology has given rise to new markets, new rules, and new players throughout the world. According to the Human Development Report for 1999 these alterations are leading to three distinct changes in global relations. These changes are the shrinking of space, the shrinking of time, and the extinction of borders.

The shrinking of space occurs as peoples jobs, income, and lifestyles are now being affected by events taken place on the other side of the world. Markets and technologies are changing faster then they ever have before resulting in a shrinking of time. Furthermore, national borders are becoming more faded as culture norms and values become integrated with the global exchange of information. The present is a new and exciting time for all of these reasons, but only for the few of us who can take advantage of and use these new technologies. "The well-connected have an overpowering advantage over the unconnected poor, whose voices and concerns are being left out of the global conversation," says the 1999 Human Development Report, produced by the UN Development Program. Recent studies by the UN uncover some demographics about web users. The description of the average Internet subscriber is an under 35, urban-based, English-speaking man with a college education and a high income. This depiction of the average Internet user describes a relatively small percent of the world [1].

The technological infrastructure that has been created throughout the world is thus far very unevenly distributed. The hardware needed for information exchange is just not in place for most developing countries. The availability of technology in these countries, in comparison with that of the industrialized world, is disconcerting. According to the Human Development Report for 1999, 75 percent of South African schools and many hospitals do not have a single telephone connecting them to the outside world. This is a very grim fact considering that South Africa is the most well connected country in Africa. South Africa, like many other third world countries, has trouble meeting pre-conditions that are necessary to support a modern technological infrastructure. There are three pre-conditions for using the Internet:

1) A phone connection
2) A computer and a modem and
3) Electricity.

Such prerequisites are the exception rather than the norm in the Third World. The United States has a ratio of 640 phone lines per 100 people. In South Africa, this ratio drops to only 100 phone lines per thousand. The continent of Africa as a whole is lagging behind in information technologies. With 739 million people, the continent carries only 14 million phone lines. In the country of Burkina Faso, there exist only 3 phone lines per thousand people. The average for all developing countries is 38.7 phone lines, while Industrial countries average 413.5 lines per thousand people. With such a limited amount of hardwiring it is difficult, costly, and in some cases impossible for many people to connect and communicate with the rest of the world. Developing in today's worldwide market would be nearly impossible unless you have sufficient

communication equipment such as phone lines and personal computers. In Canada, 254 out of every thousand people own a Personal Computer. Not one country that is labeled with a low human development ranking reaches 8 computers per thousand people. In fact the majority of these countries do not have enough computers to form any relevant statistics. Many of these statistics are not surprising considering that roughly 80 percent of the world has never heard a dial tone [8]. In 1995 the number of Internet users per 1000 people in the United States was about 35. When compared to the Industrial average of 17.9, the US ranks quite high worldwide. The technological divide exists mainly between Industrial and Agricultural societies. Industrialized countries, which hold only 15 percent of the world's population, make up 88 percent of all Internet users. These statistics show how unevenly the world's information technologies are distributed.

Information technologies are a great resource for anyone who has the ability to use them. Although, many countries have a vast number of issues and priorities to consider before they can begin to deal with the widening of the technology gap. A Lack of formal education, technological infrastructure, and basic needs are all issues that inhibit much of the world from taken part in globalization. Before technologies can be beneficial to these countries they must first deal with these other more pressing issues.

2.3 The Divide in the United States

The United States is the greatest user of information technologies in the world. America has more computers than the rest of the world combined, and more computers per capita than any other country. Yet the access to these tools is not spread equally among the United States' population.

In 1997, a report was released by Katz and Aspen that stated the Internet users were generally wealthier and more highly educated. The same year it was found that Whites were markedly more likely than African Americans to have a computer in their household and have a higher probability of having access to a personal computer at work. Additionally, when examining students it was found that there was no difference between the World Wide Web usage of white students and African American students among those who owned a computer. However, among students who did not have a computer at home, white students were much more likely to have used the web. This usage was also more likely to have taken place outside the home. The conclusion reached was that on a race level "access translates into usage."

If indeed, access does translate into usage, it is important to know where Americans are accessing the Internet. A study in 1999 showed that 22.2% currently use the Internet at home, 32.7% use it somewhere, while 67.3% do not use it at all. Approximately two-thirds of Americans do not use the Internet at all. Out of those who access the Internet outside their home, 56.3 percent log on at work. A person with a college or higher degree is ten times more likely to use the Internet at work than someone with only a high school education. Public libraries account for only 8.2 percent of those who access the Internet outside the home; community centers account for only 0.6 percent. [2]

As of 1997, nearly 70 percent of schools in the United States had at least one computer connected to the Internet, but less that 15 percent of classrooms had Internet access. The distribution of this access correlates with higher income and education [1]. Data from 1998 reveals that "urban households with income of $75,000 and higher are

twenty times more likely to have Internet access than rural households at the lowest income levels." Blacks and Hispanics are less likely to have Internet access from home than Whites living in any location. [2]

In an effort to provide widespread access to the Internet, and therefore greater usage, the program commonly known as "E-Rate" was introduced in 1996. The Universal Service Fund for Schools and Libraries, or E-Rate, was passed into law as part of the Telecommunications Act of 1996 in order to make telecommunications services and equipment affordable for public and private schools and libraries. The institutions receive 20 to 90 percent discounts depending on their particular economic situation and location. As of 2000, 75% of all public school districts have applied for E-Rate funding, as have 50% of all public libraries and 15% of private schools. Greater funding is distributed to school districts that are the most impoverished. Likewise, large districts and urban districts typically receive higher awards. The majority of E-Rate funds, 58 percent, are used by institutions for internal connections and equipment. Telecommunications series accounts for 34 percent of the money, and only 8 percent is used to pay for Internet access.

Chapter 3: PROCEDURE

3.1 Survey Introduction

3.1.1 General Background

Surveys are an effective means of gathering data. Through a set of questions administered to a large number of people, important information pertaining to demographics, opinions, and many other areas can easily be collected. Whenever a survey is conducted, it is in relation to a specific population. Although very rarely used, a census survey is one that everybody belonging to the population has to fill out. This method defeats the purpose of surveying because it is very time consuming and hard to implement. Sample surveys on the other hand allow for a much more condensed respondent set with almost as valid results. Major corporations use complicated and hard to utilize methods to ensure that the data they gather is accurate. This is not necessary for all intents because the sampling design relies on a very basic principle: "Surveys can be used in a scientific way to realize the great benefits of interviewing a representative sample instead of the whole population" [9]. By correct application of the surveying process, valid results can be attained with much ease.

There are many aspects to the surveying process, many of which must be considered when planning any study. There are multiple kinds of surveys that can be used depending on the purpose and resources of a project. The three main types of surveys conducted are mail, telephone, and face-to-face. These different surveys all have their advantages and disadvantages, as will be presented in sections to follow. There is the question of how many people need to be sampled in order to produce results that will be considered valid. For smaller populations, it is essential to choose whether or not to

use the sampling scheme in the first place. If so, there is the question of choosing a sampling appropriately and representative of the population being modeled. A concern that arises in all types of surveying studies, independent of the type, is response rate. This factor not only determines the size of the sample being used but also influences the validity of the data being produced, as will be explored in more detail in a further section. Lastly, there is the question of accuracy of the final data being gathered. There are many things that can go wrong that will cause inaccurate data to be generated, and it is a primary concern of anybody conducting a study to avoid, or at least minimize, the effects of such mishaps.

One criticism that surrounds the whole study and analysis of surveys is that no generalization can gather results about a population as diverse as human beings. It is true that all humans are unique and have very specific and individual characteristics, emotions, and beliefs. However, when conducting a survey, it is not these specific characteristics that we are trying to analyze. There are usually very specific results that are being sought and it can usually be safely assumed that the distribution of any given one characteristic is fairly even within a population. There are several issues that arise when considering this distribution of characteristics, one of them being the change in necessary sampling size that accompanies the shift in distribution. A key factor in the validity of surveys is randomness. We cannot emphasize enough how important randomness is to the development of a statistically valid sampling scheme. We should note that it is by no means the only important factor, many others of which we will discuss in more detail in later sections.

Although there are many things that go into a survey, there are four things that are considered essential to make a survey work.

- First, the sampling must be large enough. We have already mentioned this, and will leave further discussion for later sections.
- Secondly, it is very important that the selections are actually random. This means that any eligible resident in the population has either an equal or known probability of being selected for questioning. Nonconforming to this principle leads to biases and inconsistencies that can ruin an otherwise good and valid survey.
- Third, it is necessary to produce questions that will encourage willing and accurate responses from the respondents. With the wrong questions, the validity of the results can once again become compromised.
- The fourth criteria is that people who do not respond to the survey, but were part of the sampling, are similar to those that did respond willingly.

Again we note that these are not "necessary and sufficient" conditions for a good survey but rather the four cornerstones on which a valid study can be built.

Before a survey is even planned, it is important to give some consideration to the alternatives to surveying. There may be means by which the same result can be reached through much less work, resources, time, and money. The first alternative is using existing and secondary data for gathering similar results. If one does not ask the question "Is any of the data I am looking to collect new?" then a survey project might be completed on a topic for which all the data already exists in easy to access places such as the Internet. The second choice is to conduct an in-depth case study on the same topic as the survey. This technique may produce important initial results that can be used to plan

a more complete and diverse study at a later time. The problem with a case study is that the results are very specific to the case and are not extendable to other scenarios. However, the case study method is very effective in gathering a list of the factors that contribute to the problem being studied. The third alternative is to conduct content analysis of publications and other literature that relates directly to the study. Typically, content of newspapers, letters, proposals, television programs, and community bulletins are the most analyzed as they provide data that is directly reflective of a given community or neighborhood. The fourth common alternative to surveying is to hold non-random interviews with people chosen for specific characteristics that they possess. This is often a good strategy to use if you wish to gather a good idea of the problem from experts or a focus group before proceeding to any kind of complicated study. Although the results of such interviews in no way reflect the views of the general public, it is often the case that the population considered in the study specifically possesses the desired character traits. If these alternatives are discarded and the survey is the preferred method of performing the project, we can proceed to talk about further issues with surveying and sampling.

In the scientific community there is high regard for studies conducted not only in a statistically valid manner, but also in an ethical one. Interestingly enough, unethical surveying is not only morally wrong, but can actually strongly influence the results. It is important to encourage the participation of people in the study, but it is wrong to pressure them into performing an act that they would not willingly commit on their own. By pressuring respondents, the answers they give may become skewed, whether from their attitude toward the surveyor or from a lack of concern on their part. One major way that

pressure can be reduced is through anonymity. It is good practice to report all results in the aggregate. This means that individual responses do not appear in any publicized form, and only data tabulated from all the surveys is conveyed to the audience of the study. A promise of confidentiality encourages people to respond more honestly to the questions they are given and also sets a degree of ethics for the project.

Taking many of the factors into account, we have compiled the following list of steps and considerations necessary for a successful study involving surveying.

- Accuracy and error analysis
- Is information being sought new?
- Surveying method
- Sampling design
- Questions that provide useful information
- Good questionnaire
- A good analysis of the data

3.1.2 Introduction to Accuracy and Error Analysis

As we mentioned in the previous section, accuracy is the main goal of any survey project. As Donald Dillman points out, "Accuracy has a special meaning in survey research: It describes results that are close to the true population value" [9]. This implies that any data that is used to predict the behavior or state of a whole population has to be accurate. In order to achieve a good level of accuracy, researchers much avoid four types of errors. These types of errors correspond directly to the four essential characteristics that we presented in the previous section that are required to make a survey work. First

there is sampling error, which corresponds to the number of people chosen to participate in the study. Next we have coverage error that results from the sampling population differing significantly from the actual population. Measurement error is the inaccuracy that is due to a lack of good questions in the actual questionnaire. Alternatively, measurement error can come from several other places as well. Lastly, non-response error results from lack of responses from the sample population and the presence of significant character differences between the responding and non-responding parties. All four of these errors can have largely detrimental effects on a study if they are not properly accounted for.

3.1.2.1 Sampling Error

Sampling error is the most unavoidable type of error. Sampling error is defined as the error that occurs when researchers survey only a subset or sample of all people in the population instead of conducting a census. Since a census is almost impossible to obtain, this error is inherent in the surveying process. On the good side, it is easily quantifiable with tables available in most statistics textbooks. If a project is found to have too high a sampling error, then the issue can be easily resolved by simply increasing the number of questionnaires collected. This allows researchers to easily take care of this error and concentrate on reducing the other three.

3.1.2.2 Coverage Error

Coverage error "occurs when the list, or frame, from which a sample is drawn does not include all elements of the population that researchers wish to study" [9]. For

example, conducting a survey on the issues that plague New York State residents and actually collecting surveys in only Buffalo and New York City will cause very large coverage error. Since in reality Buffalo and NYC only contain a portion of all NYS residents, it would not be fair to conjecture on the whole state, which is mostly rural, based on the results of two of the biggest cities in the state.

3.1.2.3 Measurement Error

The third type, measurement error, is a result of responses to questions that do not convey the necessary information to the conductor of the survey. In Salant's book, she refers to measurement error occurring "when a respondent's answer to a given question is inaccurate, imprecise, or cannot be compared in any useful way to other respondents' answers [9]. There are four common sources of measurement errors: the survey method, the questionnaire, the interviewer, and the respondent. In all four cases, these errors can invalidate much of our data and render our instruments useless for any further analysis.

3.1.2.3.1 The Survey Method

As a direct result of the method of surveying used, responses to certain questions may change and can be strongly influenced. In a mail survey, a respondent may take the time to look through all the questions before answering. This will defeat the purpose of lead-in questions and may severely bias the responses received on part of the survey. In telephone interviews, the surveyor has more control over the flow of the survey and has the power to clarify any misunderstandings that may occur. However, through these clarifications, they may influence the way the responder decides to answer the questions.

Face-to-face surveys also provide the interviewer with more power. These interviews allow for any misconceptions to be cleared up right on the spot, but may still bias the responses received. Often people will answer in a manner they feel would be either appropriate or acceptable as opposed to their true viewpoints. Researchers have found that the same question asked by mail, telephone, and face-to-face sometimes yields very different answers. This influence that the method of surveying has on the results is called the method effect. Although it is not possible to choose one method that is the best, it is clear that measurement error is a "more significant problem on some types of questions, such as those that deal with abstract ideas or sensitive issues" [9].

3.1.2.3.2 Questionnaires

The way questions are composed and the way the questionnaire is laid out can often introduce errors into the study and result analysis. If answer choices are not clearly written they may cause confusion with the responder and incorrect data may be provided. The structure of the question may be confusing as well. If there does not seem to be one fitting response or the answers just are not mutually exclusive, the results of the surveys may not be comparable to each other and can be deemed a waste of time.

3.1.2.3.3 Interviewer

As we mentioned in part 3.1.2.3.1, the interviewer may sometimes have a big impact on the results of the surveys. In simple terms, the interviewer may either lead or mislead the responder into an incorrect answer. By incorrect we refer to answers that were not the best match for the person taking the survey.

3.1.2.3.4 Respondent

The hardest measuring error to protect against is that due to the respondent. Initially, the respondent must be willing and able to provide correct answers to the posed questions. Also, some people may either inadvertently or deliberately answer some questions incorrectly. For example, if we were to ask for age then there might be older people who would lie about this for no good reason.

3.1.2.4 Non-Response Error

Non-response is the last type of error that we consider in our error analysis. This error occurs when "a significant number of people in the survey sample do not respond to the questionnaire and are different from those who do in a way that is important to the study" [9]. If this occurs, then the response to the survey is more likely to represent certain characteristics that have no real correlation with the general populace.

The latter four types of errors are very rarely considered together in a study. Certain people have a tendency to concentrate on specific ones as opposed to others. Dillman proposes that "statisticians with their grounding in mathematical theories and concepts deal best with sampling error and ... coverage error. In contrast, psychologists and sociologists are more oriented toward human behavior... [They] focus on measurement error and how it is influenced by respondents, interviewers, and question working. They are also concerned with non-response error" [9]. A perfect survey however, if one existed, would account for and minimize all the above error types.

3.2 Determining Needed Information

The first step to determining the needed information is to formulate the problem concisely and figure out what information it is you are trying to gather and whether or not the information needs to be gathered at all. The problem we are addressing, as discussed earlier in the report, is the digital divide that we speculate may have formed in Worcester. Since no previous studies have been done on a local level on this topic, the data that we intend to gather is pertinent, new, and important. What we are trying to find is evidence in favor of or against the existence of the divide within Worcester. We do not know ahead of time where the gap may exist, so we consider many factors. Information pertaining to both the demographic qualifications and technological/information literacy of the target population is necessary. The target population for this study is split up into two groups: Worcester family households for the residential portion of the study; students that attend school in the Worcester Public School System, grades 6 through 12, for the educational investigation. The initial list of information that we came up with that is needed for this pilot study is provided in table 3.1.

Table 3.1: Initial Overview of Information Pertinent to our Study of the Digital Divide

RESIDENTIAL	SCHOOL CHILDREN
o Socio-Economic Demographics Race, Age, Income, Education, Sex o Household Demographics Children, Marriage o Geographic Location o Knowledge of Technology o Access to Technology In the Home, Other possible locations, type of access o Benefits from Technology Technology enhanced activities, types of benefit o Opinion Technology attitudes, Ease of use, Willingness to adapt	o Demographics Race, Age/Grade level, Sex o Geographic Location Residentially, School attended o Knowledge of Technology Software/Hardware Awareness o Access to Technology Home, School (per class), other locations and tasks performed o Benefits from Technology Educational influence, Performance enhancement o Opinion Societal/Communal influence of technology,

One very important property that collected information should have is not being vague. Vague information will lead to vague questions and then the data that will be collected will not reflect the issues for which the survey was intended. In our project, we narrowed down the "technology" information to specific facts that we would like to collect. There are several key factors that we will consider in our study in the realm of

demographic distributions for the residents. Ethnicity, age, income, race, education level, household type, and the geography/location of the subject are all possibly relevant variables when talking about the technology gap. Through past studies on the state, national, and global level, the preceding categories have been identified as the ones along which evidence of the divide is strongest. These will later become the variables for which we seek evidence of correlation with some measure of information literacy.

We intend to gather a very similar information set through our interaction with the public schools. The demographic section would be the same, since possible existing gaps most likely lie along these lines. We would of course also add grade level and perhaps some other minor adjustments. For the measurement of information literacy we concentrated on access at school, instead of at home or in the community.

It is also important to avoid collection of biased and non-critical information. Biased information collection can result from predisposed opinions. Non-critical information will crowd the eventual survey and not contribute anything to the survey content. In our project, we avoided at all costs assuming that we would find a technology gap and went about the project searching for evidence either way. We also eliminated much non-critical data that we felt was not serving its purpose. The rationales for converting the needed information into questions that follow the necessary guidelines are presented in section 3.5, *Creating good questions and questionnaires*. The final format of the surveys may be viewed in Appendices G and H.

3.3 Survey Method

3.3.1 Survey Method Background

Once the information that needs to be collected has been determined, it is necessary to choose a survey method to use to administer the survey. The possible commonly administered survey types are mail, telephone, face-to-face, drop-off, and Internet. Each of these survey models caters to different needs and available resources. When choosing the model for our particular study we considered such factors as cost, manpower, time, bias, coverage, and response rates. What follows is an analysis of the five possible survey types and a discussion of their possible application to our Interactive Qualifying Project.

3.3.1.1 Mail

Mail surveys are conducted when a complete address list of the target population is available to the researcher. In this model, surveys are sent directly to the sample population in hopes of having them fill out the surveys and send them back. Mail surveys are highly anonymous and therefore provide a sense of privacy for the responder, making them more likely to truthfully answer questions. This model requires the least investment and manpower, making it best suited for projects in which qualified help and money is scarce. This surveying model also allows an easy way to minimize sampling error at lower overhead costs, since it does not cost much money to mail surveys to people and wait for the responses [10].

However, all these advantages come at a cost. The greatest weakness of mail surveys is that they are prone to non-coverage error. The lists that the samples are chosen from rarely accurately reflect the actual population. The mail model is also strongly

prone to non-response error. People may respond only if they feel their voice needs to be heard, making a very biased result frame. With mailed surveys it is also impossible to lead up to a question by a certain chain of questions since the readers can simply look over all the questions before responding. Another flaw of this model is that the surveyor has no control over who actually fills out the survey and cannot assure if the respondents are in the target population.

3.3.1.2 Telephone

When a great deal of the population owns a telephone a surveyor may wish to implore the use of the telephone survey model. The surveyor obtains a recent list of a population, and conducts each survey over the phone. This gives the surveyor a great deal of control, ensuring that the intended person will fill out the survey in the correct manor. The responses obtained from the telephone model are quick and allow the surveyor to quickly move through the target populace. When dealing with the issue of manpower this approach is dynamic, being suitable for use by both large and small-scale operations.

There are several factors that add to the cost of conducting a telephone survey. Since the respondents must have a telephone you are excluding the population of people who do not own a telephone, which may be an important factor in some surveys. Another drawback of this model is the inconsistencies associated with many phone lists. Such lists are continually changing and in many cases are both incomplete and out of date. Telephone surveys are also prone to bias, in which case the interviewer may lead the respondents to certain answers.

3.3.1.3 Face-to-Face

The Face-to-Face survey model is usually chosen when the surveyors do not have a list of the target population, or the target population is unlikely to respond to a less personal survey. Surveyors chose a population and usually conduct the interviews in a door-to-door manor. The response rates of these types of surveys are usually higher, due to the fact that the surveyor can convince the respondent of the importance of the study and guarantee them confidentiality. This increased control also allows the surveyor to assure the identity of the respondent as well as the quality of the responses. The face-to-face model is very useful for surveys that rely heavily on credibility and quality control.

The face-to-face survey model's largest downfall is the relatively high cost that is associated with it. A great deal of time and personal interaction is needed to conduct this survey on any size population. The results of this type of survey rely highly on the quality of the surveyors, so in order for the data to be considered statistically valid the surveyors should be trained beforehand. The high level of interaction can also result in the interviewer leading the respondent to a biased answer.

3.3.1.4 Drop-off

Surveyors will introduce the use of a drop-off survey if the target population is not spread out and reside in a small community. The implementation of this survey consists of a person delivering the questionnaire to respondents either individually or to a large group. The questionnaires are then either mailed back or left somewhere to be picked up upon completion. This model can be used by studies that require low

manpower, and need a relatively high turnaround rate. The drop-off method also allows for more personal contact, which generally helps raise the rate of response. This model should be used if manpower is low and the sampling of the target population is adequately large.

When instituting the drop-off model, surveyors must be sure to keep the questions simple and to the point. Although there is an element of personal interaction, in the end the surveys will be filled out without assistance. This may lead to inaccurate and incomplete surveys. The time taken to complete this survey will differ greatly with each study, depending on the response time of the different groups.

3.3.1.5 Internet

Internet surveys are well suited for large populations that are significantly spread out over sizeable geographical locations. This approach can be used to cut overhead dramatically. The cost of manpower is very low due to the fact that the surveys can be instituted and collected electronically. The data can even be filtered and analyzed using databases and statistical software. The survey is available 24 hours a day, and can be submitted instantly resulting in lower time cost. Measures can also be taken to ensure that all surveys will be completely filled out.

Most of the disadvantages of an Internet survey model lie in its lack of personal contact. Traditionally these types of surveys have much lower response rates then those in which personal contact is made. Furthermore, these surveys limit response control, which can lead to incorrect responses throughout the survey. The questions will also have to be left short and simple in order to ensure correct responses. Finally, this survey

should not be implored by researches that depend on a quick turnaround. As with any other type of non-personal survey, there is no way to ensure a timely completion of the questionnaire.

3.3.2 Rationale for Choosing Surveying Model for our Project

When considering which survey model would best suit our study, many factors had to be taken into consideration. To accurately depict a digital divide in Worcester a target population that represents the entire city must be used. In choosing a model we had to take into consideration our position on factors such as cost, response-rate, response-time, bias, manpower, and coverage. After weighing the advantages and disadvantages of each of these aspects separately, we were able to choose the model that suited us best.

When considering our available manpower, we need to choose a model that will carry the lowest possible cost due to our limited resources in this area. The surveying techniques that have the fewest manpower requirements are Internet, mail, and telephone surveys. These surveys are also well suited for our purpose due to their potential to survey large populations. However, there are inherent characteristics of these models that make them unusable for our survey. First of all there are no available telephone number or address listings of the target population at our disposal; this makes both the mail and telephone models impossible to use. In addition, our survey deals directly with the respondents' level of technology access. Both the Internet and telephone surveys require that the sampling population possess both of these technologies respectively. By choosing either of these models we would be excluding and important sub-group of our target

population that is needed in order to show a divide in access to technology. Excluding these subgroups would introduce a sampling bias and render our study invalid.

After excluding the Internet, Telephone, and Mail survey models we are only left with the face-to-face and drop-off models to consider. Once again we must keep in mind the amount of manpower at our disposal. The drop-off model undeniably holds the lower cost in this area, and also provides accurate results for large populations. Though this model traditionally offers lower response control and less personal contact then the face-to-face approach. Due to the relatively small size of our sampling population we need to ensure the accurate and complete answering of each survey. These factors are usually ensured best through a face-to-face model. In the end we chose a hybrid model, using methods of both the face-to-face and drop off models. Since the way we implement each surveying model directly relates to the sampling technique, the application of the chosen surveying models to the target populations of residents and students is discussed further in the following section.

3.4 Selecting a Sample and Sampling Design

When it comes to surveying, the sample refers to the set of people chosen from the target population. The sampling technique is used to generate information about a large populace using a small number of elements of the population. The choice of whether or not to sample should be based on various criteria including, but not limited to, the survey method, the population size, the variation expected in respondents' characteristics, and the need for precision in the study. The factors all play an important role in sampling and it in not okay to ignore one to concentrate on another.

3.4.1 Sampling Sizes

The simplest and probably most important question when it comes to sampling is the size of the sample population that is needed to produce statistically valid results. This issue may bring up cause for concern regarding coverage error. If the sample is too small, then there is no guarantee that the sample will be representative of the entire population. Necessary sample sizes are provided in Table 3.2 for given populations at three margins of measurement error.

Table 3.2: Necessary sampling sizes for various populations [9]

	+- 3% sampling error		+- 5% sampling error		+- 10% sampling error	
Population Size	50/50 split	80/20 split	50/50 split	80/20 split	50/50 split	80/20 split
100	92	87	80	71	49	38
250	203	183	152	124	70	49
500	341	289	217	165	81	55
750	441	358	254	185	85	57
1,000	516	406	278	198	88	58
2,500	748	537	333	224	93	60
5,000	880	601	357	234	94	61
10,000	964	639	370	240	95	61
25,000	1023	665	378	234	96	61
50,000	1045	674	381	245	96	61
100,000	1056	678	383	245	96	61
1,000,000	1066	682	384	246	96	61
100,000,000	1067	683	384	246	96	61

It is important to note that the values provided in the Table 3.2 refer to the actual response size, not to the size of the population sample. Since Worcester has a population between 100,000 and 1,000,000, we need a response size of roughly 245 people for the residential portion of the study in order to attain a 5% sampling error. The number of students in the Worcester Public Schools is about 30,000, so we need a response size of 234 students to attain a similar sampling error range. Both of the above approximations are based on an assumption of an 80/20 split in the characteristics of the populace. By 80/20 split, we mean that approximately 80% of the populace's answer will answer in one characteristic way, while the other 20% will answer another. We are predicting that

there will be an 80%-20% difference in characteristics related to the study of the digital divide.

As with any study, if there is a chance that non-response error will occur in the study, the sample size needs to be significantly increased in order for the response size to meet the validity cutoffs. For our study, we had to ensure that we would meet these standards in order for our results to be considered statistically valid. We did not know what kind of response rate we would get from Worcester residents and could not determine the necessary sampling size. We therefore employed a slightly different strategy: Randomly selecting survey participants from the target population until the necessary response size was met.

With the Worcester schools, we implemented the surveying model as a self-administered group survey. We decided to come into the schools, briefly talk to the students, and then administer the surveys in our attendance. This way we are sure that the entire sample population completes the surveys. We can then accordingly adjust the number of classrooms surveyed to attain the necessary response sizes.

3.4.2 Sampling method

There are several common sampling methods that are often used. For clarity's sake we will split them up into three categories: Non-Probabilistic, Probabilistic, and Ultra-Probabilistic. Ultra-Probabilistic is the term we use to describe sampling methods of a very complicated nature. Although there are applications for all three types, it is primarily the two probabilistic algorithms that we are interested in for usual surveying

needs. This is important because both of the probabilistic methods employ elements of randomness that are necessary for successful surveying.

3.4.2.1 Non-Probabilistic

Non-Probabilistic sampling schemes are those in which it is either impossible to predict the chances of any given person to be selected for the sample or these probabilities are highly variant. "Nonprobability sampling depends on subjective judgment" [9]. Selecting a sample because of convenience, preconceived notions, or special interests results in highly biased results that have little correlation to the actual target population. Any new information that is gathered from such a scheme is considered relevant only to the sample population. These types of samples can be appropriate for focus groups and pilot studies in which the results are meant as only an indication of how to conduct a larger study.

3.4.2.2 Probabilistic

In a probabilistic sampling technique each member of the target population is given an equal probablity of being chosen. The entire target population is know ahead of time and is represented through some sort of list. The sample population is then selected from this list using one of three methods. The first method requires each individual sample to be "picked from a hat", the second utilizes a random number table, and the third implores the use of a computer-generated random number list. If the list of the target population is very large the surveyor may wish to use a systematic sampling over a simple random sample. In this case the randomized method of selection is only used in

the first sampling. The rest of the population is chosen systematically using the first element. An example of this would be a one-in-five sample in which the first random sample is chosen from the range of one through five, and every fifth element after this in the target population is chosen to be sampled [9].

3.4.2.3 Ultra-Probabilistic

Ultra-Probabilistic sampling techniques are implemented when there is no list that completely covers the target population. In such a case, a more complicated sampling design is called for. This is also true if "small subgroups within the target population are important to the research project" [9]. A common approach used in these types of designs is called "area frame" sampling. For this approach, the population is divided into geographical segments and random parts of these segments are chosen for the sample. Within each of these geographical slices, people are chosen at random for questioning. Another approach is to separate the population into groups with similar characteristics for which the distribution is known. Corresponding sample sizes can then be randomly chosen to fairly represent the complete populace. This is knows as a Randomized Complete Block Design (RCBD).

3.4.3 Three Steps to Sampling

Keeping the sample sizes and the various sampling methods in mind, there are three steps in sampling that must be completed in order to come up with a useful and applicable sampling and surveying scheme. First, it is necessary to carefully identify the target population. Then, a list needs to be constructed that represents the entire

population. Lastly, the actual sample for the study needs to be chosen based on some criteria. We consider these steps in accordance to our study and develop the sampling schemes that will be used for both the residential and school surveying.

3.4.3.1 Identify the Target Population

Before the sampling design can be chosen, it is important to clearly identify the target population. The target population for the residential portion of the study is comprised of every citizen of Worcester. Due to the nature of our study, the actual populace that we consider is composed only of adults over the age of 18. It is important to note that such groups as elderly people in special homes, the homeless, and those that live in other group housing projects are excluded due to the impracticality of fairly representing their contribution to the total population.

For the school portion of our study, the target population is comprised of all middle school and high school students who currently attend the Worcester Public Schools. Elementary and Pre-School students are excluded because the effects of the digital divide which we are studying have been shown to have the most impact on secondary school students as opposed to grammar school [4].

3.4.3.2 Constructing a List

The list that must be constructed is called the list frame, from which the sample will later be drawn. As we have previously mentioned, it is impossible to construct a list that will fairly represent the target population that we are after. In our case, we consider districts within Worcester and therefore need a sampling design that will reflect this fact.

We therefore turn to ultra-probabilistic methods of sampling to construct a sample that is both large enough and statistically representative of the population. For the schools, the list originally contains all the middle and high schools in Worcester from which the actual student samples are taken.

3.4.3.3 Choosing Actual Sample

3.4.3.3.1 Residents

The sampling plan that is proposed for a study needs to take into account the focus of the study and the hypothesis that is to be proved/disproved. One important feature of our project that immediately comes into play is the comparison of districts within the city among themselves. In order to have accurate data, we need to ensure equal consideration for residents of these districts. We therefore propose to use a RCBD (Randomized Complete Block Design). The way this design works is it takes certain groups in the target population within which the responses may be more homogenous and considers them as blocks. There is then an equal sampling from within each block. Since we plan to draw comparisons among the districts, or school quadrants, we shall designate them as our blocks for the design. Within each of the blocks, a randomized sampling is ideally conducted. Once again, since we have no lists even at this level of surveying, we apply another method from the ultra-probabilistic techniques. Within each district, we conduct an area frame sampling by choosing random parts of the districts, random streets from those parts, and random people who live on those streets.

3.4.3.3.2 Schools

Within the schools, we needed a simple way to implement the surveying model while conducting a valid study. The very structure of our educational system lends itself nicely to our type of sampling. The students are already divided into convenient groups in classrooms. Since there are classes that are required for all students, these classrooms are also an effective means to survey a sample that is as diverse as the entire target population. Since every student has an equal chance of taking the class at any given time, this method qualifies as a probabilistic sampling technique.

3.5 Creating Good Questions and Questionnaires

3.5.1 Background

There are many strategies employed in order to minimize the measurement error from surveys. Avoiding emotional and biased words is good practice due to how the nature of these words can significantly affect the respondents' answers to certain questions. According to experts [9], four other issues to consider are:

- How specific the questions should be;
- Whether the questions will produce credible information;
- Whether respondents are able to answer the questions; and
- Whether respondents will be willing to provide the information.

This brings us to a process known to scientists as operationalizing. This process consists of setting up categories of events or phenomena that can be observed and measured. [9] By using this process, we can convert the information set that we have

previously developed into a survey with good questions. This process can generally be applied to questions of either the behavior/attributes or the attitudes/beliefs type. Behavior represents what people **do**, attributes represent what people **are**, attitudes encompasses what they **want**, and beliefs signify what they **think** is true. At the other end of the process we get questions of four standard types: open-ended, close-ended with ordered choices, close-ended with unordered choices, and partially close-ended.

3.5.1.1 Open-Ended Questions

These questions are designed in such a manner that there are no predetermined answers for the respondent to choose from. These types of questions are most useful for pilot studies in which the surveyor does not have a great deal of prior information to base a study on. Open-ended questions are also helpful as a follow up to close-ended question. An example of this is if the surveyor asks the respondent to explain their reasoning in answering the previous question. This can be very helpful in analyzing the answers to certain survey questions. A final situation you would use this type of question is if the answer is well known and happens to be a precise piece of information that can easily be recalled by the respondent.

There are also many characteristics of open-ended questions that the surveyor may wish to avoid. First of all, these types of questions may be very demanding for respondents. Furthermore, the time required to answer these questions, as well as the time taken to analyze the answers will both generally come at a high cost. Another disadvantage of asking open-ended questions is the variety of answers that can be given. Without predetermined choices, there is no way to ensure the answers will pertain to any

one topic. In this case the answers must be viewed as more informational than statistical. All of these factors often make open-ended questions difficult to measure and compare.

3.5.1.2 Close-Ended Questions with Ordered Choices

These types of questions present the responder with answers whose range reflects a progression of a single concept. Each answer represents a different degree on the continuum of this concept. An example of this would be a question that asks how a respondent feels about a certain topic. This type of question would list answers from Strongly Disagree to Strongly Agree with any number of "feelings" in between these categories. Usually, a Not Applicable (N/A) answer is also provided as an option for the responder. Although the answer is still considered a relative decision the ordered choices give a basis to compare the answers. A less relative example of a close-ended question would be one which ask the respondent to choose their last level of education, listing all possible educational levels. These questions are generally used when the answers need to be unambiguous. The cost of question difficulty and analysis is reduced when using these types of questions.

3.5.1.3 Close-Ended Questions with Unordered Choices

A surveyor may chose to use close-ended questions with unordered choices if the answers need to be specific while also being unique. When answering this type of question, all choices must be looked at equally and the one that best describes the user must be chosen. These questions are best used when enough information is know about a topic to present all relevant choices, and also in cases that the respondent is asked to rank

items. These questions are very useful for the surveyor, allowing a consistent and comparable basis to evaluate the results.

These types of questions generally come at a higher cost then close-ended, ordered choice questions. This type of question is more difficult for the responder to answer, especially as the number of choices grows larger and the person is asked to consider more choices simultaneously. Although these questions are slightly obscure, they can be used to provide very relevant and valid statistics.

3.5.1.4 Partially Close-Ended Questions

Partially close-ended questions allow for a compromise between close-ended and open-ended questions. The respondent is confronted with a list of unordered responses, while also being given ability to add their own response. If the choices given are relevant and cover the topic of the question comprehensively the respondent will usually not need to add their own answer. This approach leaves room for previously undetermined answers and prevents the surveyor from forcing the respondent to respond in an unrepresentative manner.

3.5.2 Selecting Question Types for our Study

We decided to use a broad range of question types to assemble our survey. There is certain strategic information that we need to obtain from these surveys such as demographics, technology related opinions, task completion, and information literacy. Each of these categories are treated differently in the analytical process, and therefore they are created using a different question model.

3.5.2.1 Demographics

When assessing the information that is to be obtained from demographics, we decided that the answers needed to be specific and easily compared. Due to the nature of these answers the best questions to use are close ended with ordered choices. This allows us to precisely establish the predetermined categories that each respondent belongs to.

3.5.2.2 Technology Opinions

We formulated our opinion questions with two goals in mind. The first is to stimulate the respondent to think about the implications of technology use, an important topic of our survey. The second was to obtain information on the level of technology awareness possessed by the respondent. Both of these goals could be met by formulating the questions using a hybrid approach of the close-ended, ordered list model and an open question model. The close-ended ordered list portion of the question is used to gauge the respondent's level of technology awareness. The next portion of the question was asked in an open-ended manner. The results obtained from this technique will allow us to analyze the reason why the respondent may have answered the first part of the question as they did, while also getting the respondent to consider the implications of technology use.

3.5.2.3 Task Completion

The level of familiarity with computer-oriented task also falls in the scope of data that is pertinent to our study. Through these questions we hope to obtain a general idea

of the span and types of task that the respondent is familiar with and able to perform. The question model which best fits the purpose of these questions is a partially close-ended technique. We already have a great deal of knowledge of commonly performed computer tasks, and therefore can present a relevant list of choices to the respondent. We also avoided constraining the respondent by our predefined task, offering them a chance to enter other tasks that they have performed.

3.5.2.4 Technological Demographics

A final topic we wish to examine is the individual demographics of the respondents pertaining to certain technologies. Since we are analyzing demographics we used the same close-ended, ordered choice method that was chosen to analyze the previously mentioned demographical information. This ensures us consistent and comparable information that can be easily correlated during the analysis.

3.5.3 Collective Analysis Strategy

Another form of measurement error results from the interpretation of the response to a specific question. It is very hard to judge accurately from only one question such measured quantities as access to or benefits received from technology. In order to circumvent this problem, we designed a series of questions to be interpreted together as a single measurable quantity. To attain an actual measure of the access and benefit that the respondents receive from technology, we adopted the series of questions for both the residents and students. This will later be explained in terms of two scaled quantities called the TABS and ETABS, the (Educational) Technology Access and Benefit Scale.

3.5.4 Wording

Another concern in forming the questionnaire is the wording of the questions. There are several provided guidelines that should be followed in order to minimize the measurement error associated with the respondents' interpretation of the question. These are as follows [9]:

- Be specific.
- Keep it short.
- Do not be vague.
- Use simple words.
- Do not be too specific.
- Do not talk down to respondents.
- Do not use undefined abbreviations and jargon.

3.5.5 Question Rationale

When conducting a survey a clear line of questioning must be maintained in order to extract the data needed for the study in an efficient manner. In this section we will show the thought that went into question four of our student survey in order to keep the question relevant to our topic and statistically valid. The rationale for the rest of the questions can be found in Appendix E for the students and Appendix F for the residents.

Table 3.3: Question 4 of Student Survey

4) If so, what kinds of tasks do you perform on the school computers?
(Choose all that apply for every class/subject)

a) Word Processing	h) Spreadsheets
b) Internet Chat	i) Writing Reports
c) E-mail	j) Games
d) Instant Messaging	k) Music Downloading
e) Encyclopedia Software	l) Create Presentations
f) Internet Research	m) News/Current Events
g) Programming	n) Artistic Creations

	CLASS	TASK (Please include other tasks)
Example:	*History Class*	*a, c, e, f, i, Software on Civil War*
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____

The purpose of Question four is to obtain information on the level of knowledge that the respondent possesses in relation to common computer tasks. We previously decided in Section 3.5.2.3 that a question dealing with task completions should be asked using a partially close-ended question model. We created a relevant and unordered list of

possible computer tasks that are commonly performed using a computer. We chose to use a large list in order to fully encompass the various tasks that can be performed on a computer without limiting the respondent's choices. The tasks we chose represent the respondent's ability to use a computer in such varied areas as civil participation, entertainment, research, communication, and general computer proficiency. We also left room for the respondent to add any task that they perform using a computer that we did not list. There are two reasons why we chose to keep this question only partially close-ended. First, due to the generality of the question we did not wish to constrain the respondent to our choices. Second, our research is aimed to be a pilot study; by keeping the question partially open we can obtain information that will help to better formulate future studies on the topic of the digital divide.

3.5.6 Forming the questionnaire

After each question is in the proper form the surveyor must then decide the order in which the questions will be asked. Seymour Sudman states that "The same care and thought that are given to the wording of individual questions must also be given to the construction of the total questionnaire" [11]. He also points out many major points that must be considered when deciding the order of the questions when constructing a survey. These critical points are listed below:

The questionnaire should begin with the easiest and most non-threatening questions that yield necessary data. We took this into consideration when placing the technological demographics first, followed by a partial close-ended question geared towards the respondent's knowledge of computer related tasks.

Many people may view certain demographical questions as threatening or an invasion of privacy, for this reason these types of questions should be placed at the end of the survey. Following this major point we place demographical questions asking about age, race, income, and education at the end of the survey.

If the questionnaire deals with multiple topics, the survey should fully complete questions on one topic and then move on to the next. Our survey is structured to obtain maintain information on these four main topics respectively, technological demographics, task completion, technology opinions, and finally respondent demographics.

The surveyor must ensure that the questionnaire is clear and concise and free of all redundancies. We made sure of this by carefully selecting in each question of the survey so that we only obtained information that is pertinent to our study.

3.6 Distributing the Surveys and Data Collection

3.6.1 Worcester Public Schools

In order to conduct a survey for the Worcester Public Schools, the county Superintendent's Office must clear any survey that will potentially be conducted in the schools. Our first step was made through contacting Charles Cambell PhD, the Superintendent of all Worcester Public Schools. Doctor Cambell notified us that the school district's testing and assessment specialist, Patricia Mostue PhD, must approve all surveys. Doctor Mostue requested that we submit a project proposal and a sample questionnaire along with the standard survey request forms required by the school district. We were notified shortly after submitting these items that our study has been

approved and that we could start making plans to deliver the surveys throughout the school district.

The next step in distributing our student surveys was to choose and contact the specific schools in which to conduct the study. The Worcester Public Schools are comprised of four separate quadrants. These four quadrants are called Burncoat, Doherty, North, and South. Each of these quadrants contains one high school and one middle school. Given that both high school and middle school students could fill out our surveys, we contacted the principals of each of these schools and asked for permission to conduct our study. Unfortunately, neither school from the Burncoat quadrant responded to our request. As a result we were only granted permission to conduct our study in three of the four quadrants. The schools that allowed us to conduct our survey were Forest Grove Middle School from the Doherty Quadrant, South High School and University Park Campus School from the South Quadrant, and Worcester East Middle School from the North Quadrant.

Our third step in surveying the Worcester Public Schools was to actually administer the surveys. We asked the principals of each respective school to set aside two to four social studies classes for us to survey. We decided to survey social studies classes for two reasons. The first reason being that all students in the public schools are required to take a social studies class. The fact that all students are required to take this class keeps our sample population valid as explained in section 3.4.3.3.2. The second reason we chose Social Studies is because it lends well to the topic of our study; the Digital Divide in Worcester is a subject matter that confronts many societal issues. Our ideal method of distribution was a self-administered survey model. In this case, one of

the group members personally dropped-off the surveys to each respective class, and then collected them when the entire class had finished completing the questionnaire. The self-administered model was used for South High, Worcester East Middle, and the University Park Campus Schools. The other distribution method we employed was a traditional drop-off model. When using this model we left the student surveys with a social studies teacher, Frederick Rushton, at Forest Grove Middle school giving him instructions on whom to administer the surveys. We returned the following day to collect the completed surveys. The drop-off model was only used to distribute surveys to the Forest Grove Middle School because of a special request on behalf of the department.

3.6.2 Worcester Residents

For reasons stated in section 3.3.2 we chose to utilize a face-to-face surveying method for our study. Due to the relatively low response rate and high manpower needs associated with the face-to-face survey model our group was forced to utilize many different methods for collecting surveys.

The first and most practical method we chose was a door-to-door approach. In this case, each group member chose a house within our previously defined quadrants through the use of an area-frame sampling. The sampling technique we used for Worcester residents is explained in greater detail in Section 3.4.3.3.1. A group member administered each survey and the results were collected upon completion.

Another technique we used in gathering residential data was to station ourselves in public areas where a wide variety of residents frequent. We contacted many local businesses in order to get permission to survey on their property. In the end we chose

supermarkets as our best forum for this approach. Our group administered surveys on site at these local grocery stores and the results were made immediately available.

The final method we used to gather residential data was in cooperation with the Worcester Public Schools. We asked and received permission from the schools to send home residential surveys with the students in hopes to have them filled out by the parents and returned to the school. A group member distributed these surveys to the students, and the returned questionnaires were picked up the following day from the schools.

3.7 Methodology for the Analysis of Data

3.7.1 Summarizing the Data

The first step in analyzing any data set is finding appropriate summary measures of location and spread. This will effectively be the results section of our report. For most data sets it is necessary that the data be stationary, or follow a reasonable distribution, in order for correlations drawn later to be considered valid. Also, providing these summaries will give us a good idea of how distributed technology access is over the whole of Worcester.

3.7.2 The Need for TABS and E-TABS

In order to make it easier to summarize the data and draw correlations we developed the Technology Access and Benefit Scale (TABS). As mentioned previously, this scale is designed to incorporate key factors related to information literacy into a single quantifiable value that can be used to analyze the data in an efficient manner.

TABS incorporates variables such as computer ownership, telephone access, Internet presence, job-benefit, and public access. Based on the impact that the factors have on everyday life, certain weights are assigned to specific responses and then the relevant weighted values are summed. This creates a scale based on 100 points that can be later used to analyze correlations between technology access and the various demographic qualifications. The exact model that will be used to calculate values on the TABS is provided in Appendix C for the residents and Appendix D for the students.

3.7.3 Residential and School Divide

With the latter in place, we perform an analysis of the data to look for correlations between the TABS and E-TABS values and the demographic information of the residents and school pupils respectively. This is the classical part of any study relating to the digital divide. We will examine correlations in detail for both the residential and the student portions of the study. For residents, we will examine the effects of income, household type, education level, and ethnicity on the TABS values and individually for important factors such as Internet access. For students, we will primarily concentrate on the effects of ethnicity on the corresponding ETABS values. In addition, we will examine the geographical elements of the digital divide and the evidence of such in both city residents and school students.

3.7.4 School-Resident Correlations

As part of our study, we would also like to find any existing ties between the ETABS values of a school and the TABS values of the residents in the corresponding district. Although this in no way corresponds to the study of the digital divide, it

provides us with great insight on the impact that schools have in establishing a good groundwork for students' future use of technology. One of our hypotheses was that schools play a very important role in establishing a broad knowledge of computers and their applications, and our data allows us to do just that.

With the preceding three parts of the study, we will cover several very important parts of assessing the digital divide. We will not only find socio-economic borders, but will be able to tie everything in with school-level access and conclude whether or not there are in fact parts of Worcester that require significantly more attention than the rest. Our analysis should also give us an idea of factors that have not previously been seriously considered as crucial for the digital divide. The end product will be a detailed overview of the state of technology in Worcester, both residential and school related; including the important factors, additional considerations, and a good idea of how to proceed with future studies aimed at further analyzing and eventually treating any possible divide.

Chapter 4: RESULTS

In this section, we provide the raw results from the surveys that were conducted for our project. Since we are not analyzing the results, but rather providing a completely unbiased presentation of the data, we keep the residential and school portions separate. The results of the residential surveys are grouped together and are then subdivided into the regions that were used for the sampling. For the student surveys, the results are provided and then discussed in accordance to the quadrants specified by the Worcester Public School System. Furthermore, the opinions provided by the respondent to the open-ended questions in the survey are tabulated into a list that will be further analyzed in section five.

One very important note is that for our project, it is essential to formulate the TABS and ETABS values before performing any crucial analysis. This renders the raw data from the surveys almost useless. For this reason, what we present below is an incomplete overview of the results. We provide examples of distributions of responses for various questions with comments on their usefulness. There are certain answers to questions that are left out completely because there is no easy way to summarize their results without performing an actual analysis. Most of these questions contribute to the calculation of the two scales we use and their results are presented in the Analysis in section 5.2.3 and in more detail in section 5.3.

4.1 Worcester Residents

Using the data gathered from the residential surveys, we present examples of several results. For the whole of Worcester we provide ethnic and income distributions. We use the quadrant results to highlight some of the topics covered by the surveys such as number of computer in the home, last completed education level, and age of respondent.

4.1.1 Aggregate results for Worcester

From all the surveys from Worcester residents we tabulated the ethnicity and income distributions. Figure 4.1 below summarized the ethnic breakdown of all the residents.

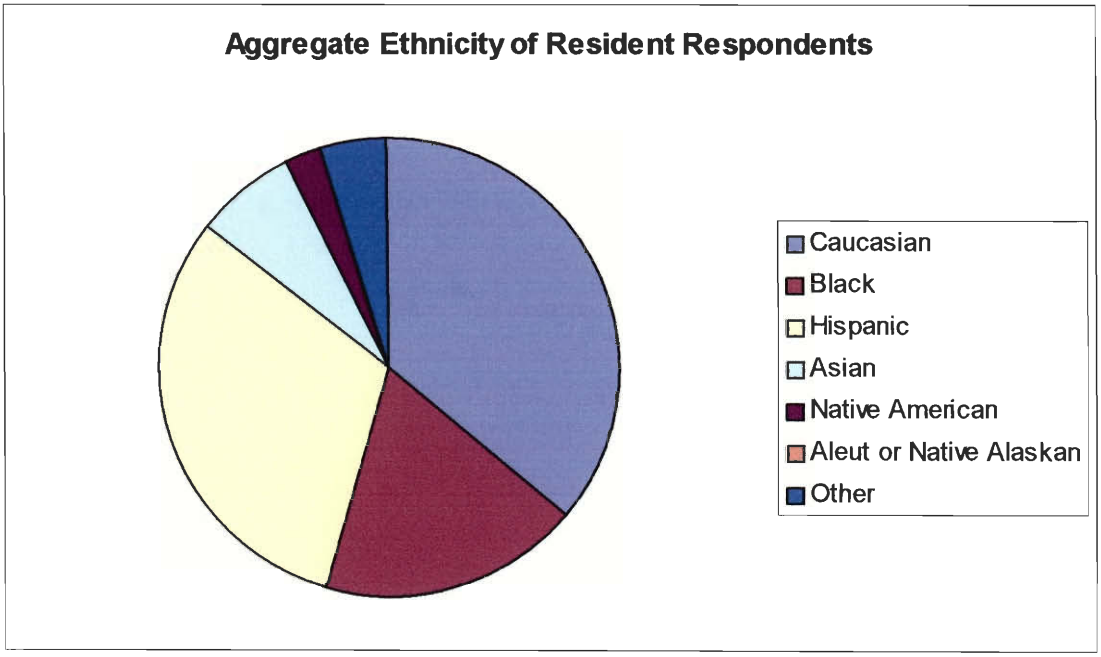

Figure 4.1: Ethnic distribution of all residents in Worcester

From the above figure we can see that the majority or residents surveyed are Caucasian, Black, and Hispanic. There is a very low proportion of individual other categories. Although this may hold true to the real ethnic distributions in Worcester, there is a possibility of sampling error in relation to these ethnicities. What would be a better way to perform surveying of these ethnicities is to collect more data and then scale the results to the actual proportion of residents in the ethnic group.

The second example summarizes the income distributions in Worcester. The categories, or ranges, for the salary are exhibited on the X-axis, while the number of respondents is the Y-axis.

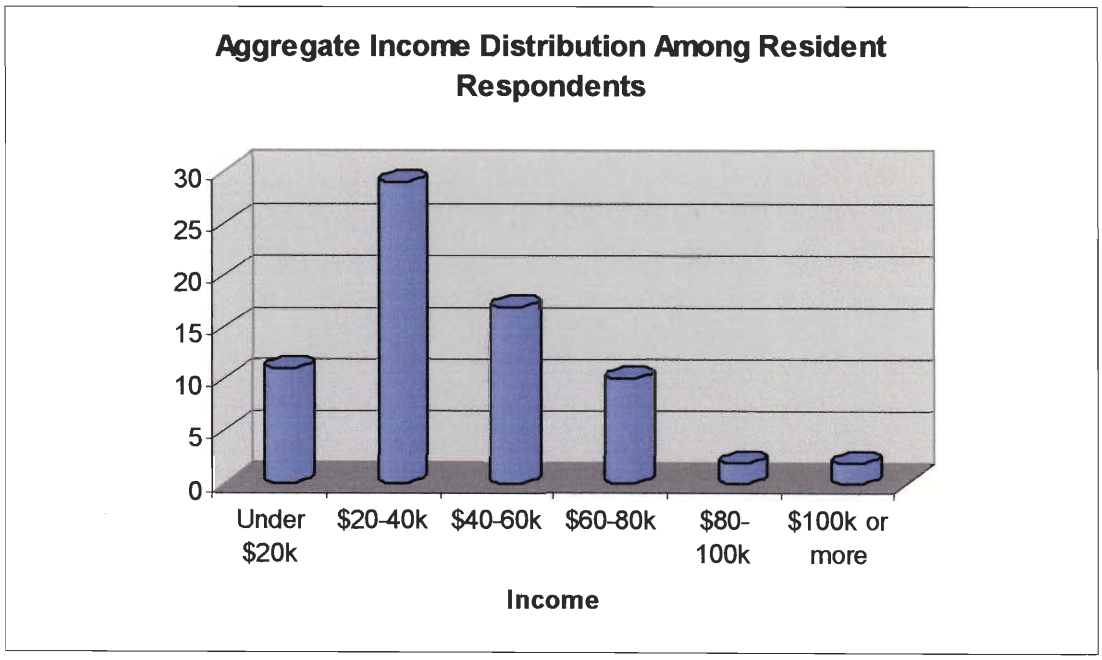

Figure 4.2: Distribution of income for surveyed Worcester Residents

There are two important observations that we get from examining the above graph. First, we can see that even without breaking the respondents into demographic categories, incomes are very skewed towards the lower level. This represents a low average income among residents of all characteristics. Second, we can see a rough 80%-

20% split among respondents in the first and latter three categories. This directly relates to the assumption of the 80-20 split that we made when determining the statistically significant levels of response sizes.

4.1.2 Quadrant Data Summaries

4.1.2.1 North Quadrant

We use results from the North Quadrant to highlight some sample data concerning the presence of computers in residential homes. A pie graph with the results is provided below in figure 4.3.

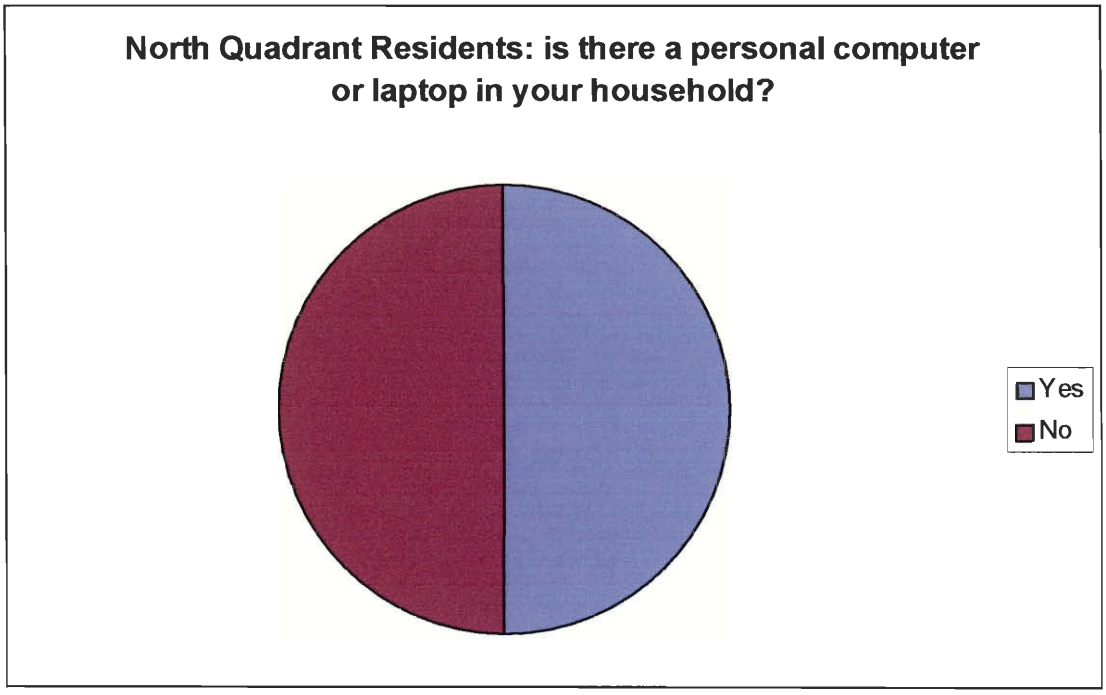

Figure 4.3: Computer Ownership in the North Quadrant

Interestingly enough, these results show an equal split between households with and without computers. Without summarizing the data from specific task completion on a computer, this shows that fifty percent of people in this quadrant have performed no

tasks on home computers since they do not even own one. This is an interesting result and we are sure that it will exhibit a significant effect on the distribution of TABS and ETABS values provided in the following chapter.

4.1.2.2 South Quadrant

Using results from the South Quadrant, we summarize how many of the residents completed incremental levels of education in figure 4.4. We found that about two thirds of the population had completed at most a high school education. What was surprising was that we found a lower proportion of four year college attendees than the 1990 Worcester Census had showed. Although of no relevance to the digital divide, this shows a disturbing decrease in persons attending college.

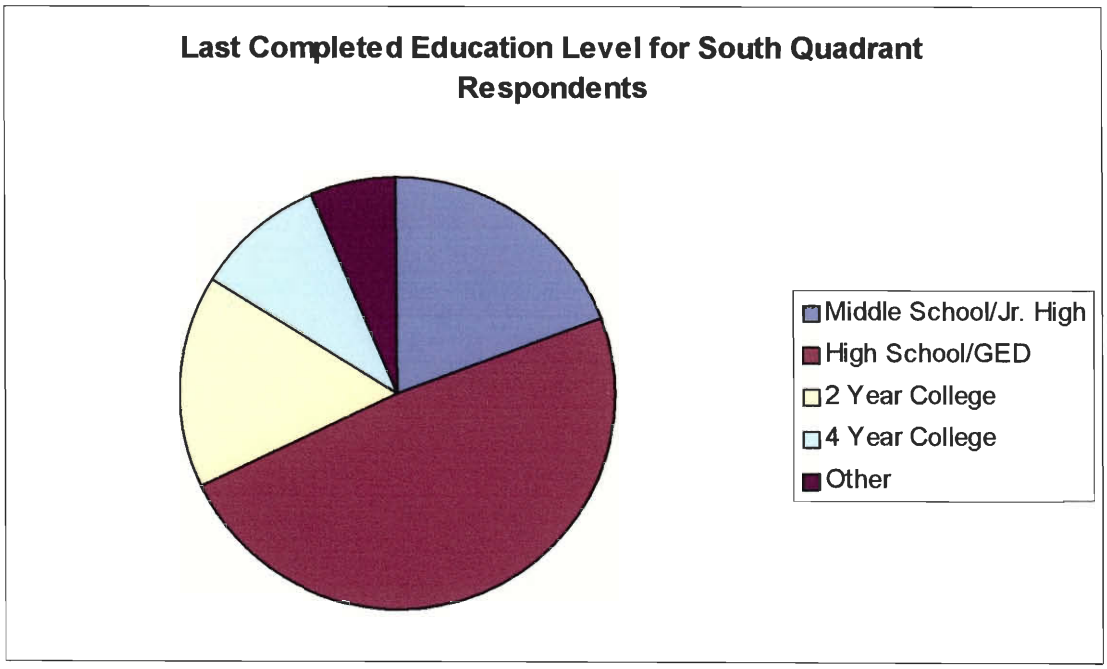

Figure 4.4: Education Levels for South Quadrant Respondents

4.1.2.3 Doherty Quadrant

From the Doherty quadrant we present a summary of age distributions for the residents. Figure 4.5 below displays how many of the residents fit into the increasing age categories. Although we do not consider age as a factor in forming the digital divide, it is relevant to characterizing the population. We found that about one quarter of the population surveyed was fifty-five years or older. This has an interesting relevance to our hypothesis that the schools' technology levels strongly influence the residential ones. Having such an old population implies that most of the residents attended the Worcester schools before the time that computers were first installed.

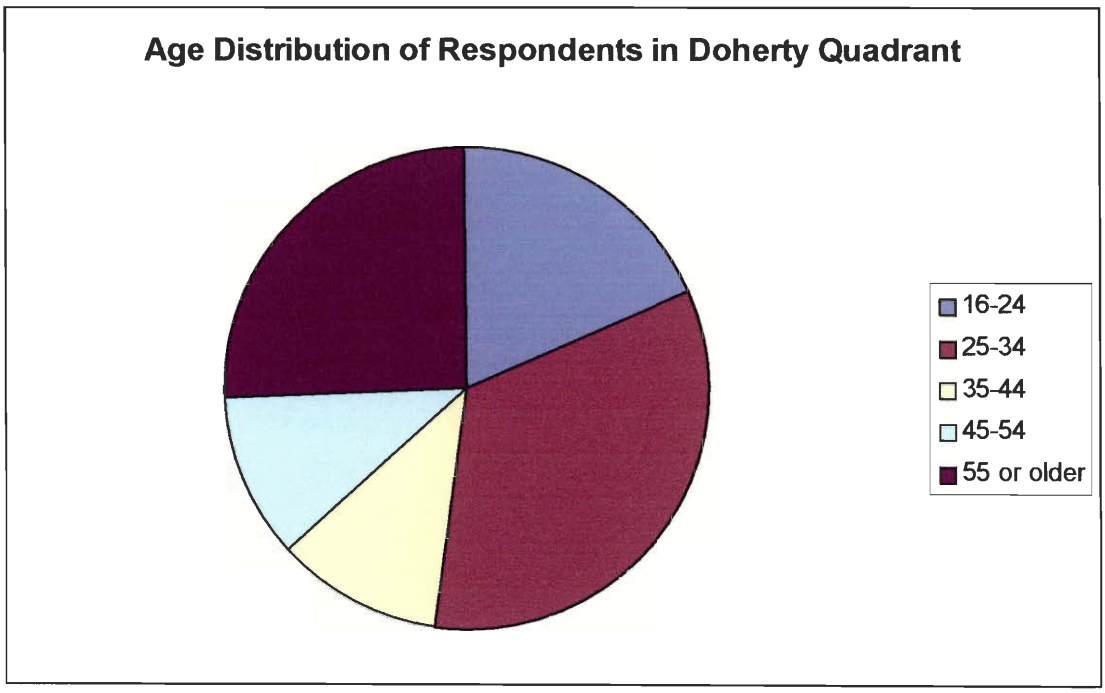

Figure 4.5: Ages of Doherty Quadrant Residents

4.1.2.4 A Note About Data From the Burncoat Quadrant

Initially, residential surveys were collected from all four of the city quadrants. In the process of our study of the Worcester schools, we found ourselves unable to conduct

any surveying in this quadrant. Because of this handicap we decided to limit our residential surveying there and concentrate on the other three quadrants. Furthermore, it would not be valid statistically to include residential results from the quadrant without considering the complementary school data.

4.2 Student Surveys

Similar to the residential results, we provide examples of aggregate results of the surveys obtained from the Worcester Public Schools as well as a breakdown of the quadrants.

4.2.1 Aggregate results for students

We feel that it is important to highlight the distribution of Internet usage for all Worcester school students. About fifty five percent of all students reported using the Internet everyday. Out of the remaining students thirty three percent of students used it several times a week with the remaining twelve percent using the Internet less often. We consider this an incredible result since only six years ago none of the Worcester Public Schools had Internet access in the classrooms. These results are summarized below in figure 4.6.

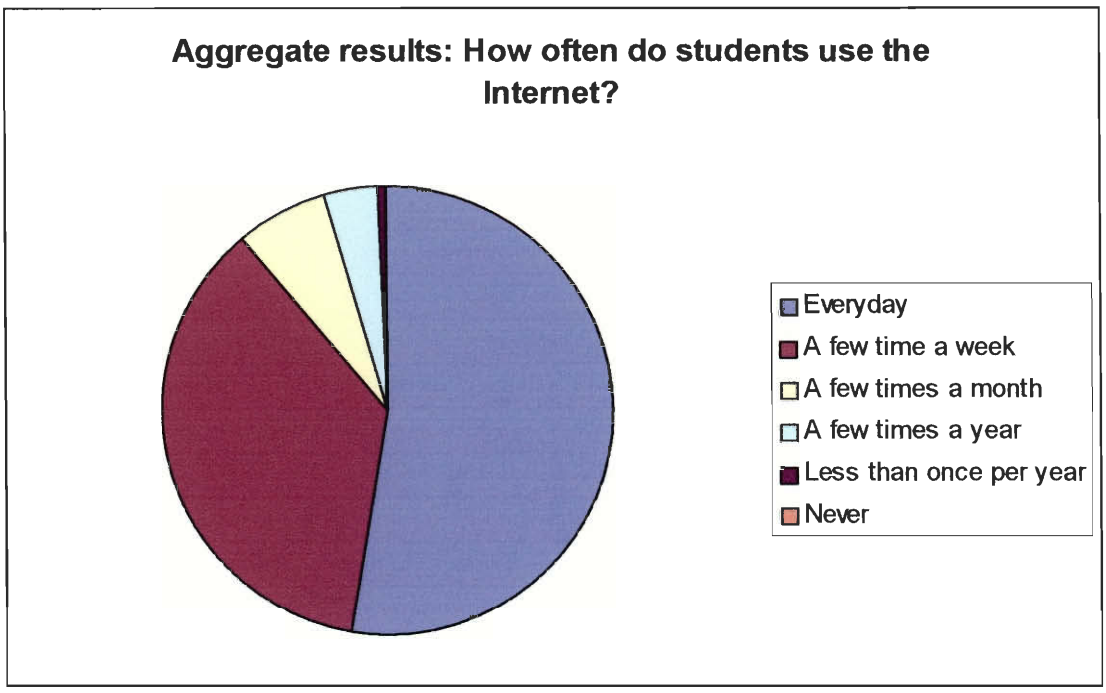

Figure 4.6: Internet Usage in the Worcester Public Schools

4.2.2 Quadrant summaries for students

For the individual quadrants we examined the distribution of ethnicity among students. We did this so that we could compare the results to the actual distributions in the schools. We found that the ethnic distributions are varied among the schools, but overall hold true to the distribution in Worcester. Certain schools had an overly high level of "other" results. This might be due to certain people not disclosing their ethnicity and that our coverage of various ethnic groups was not complete. The results are presented in figure 4.7.

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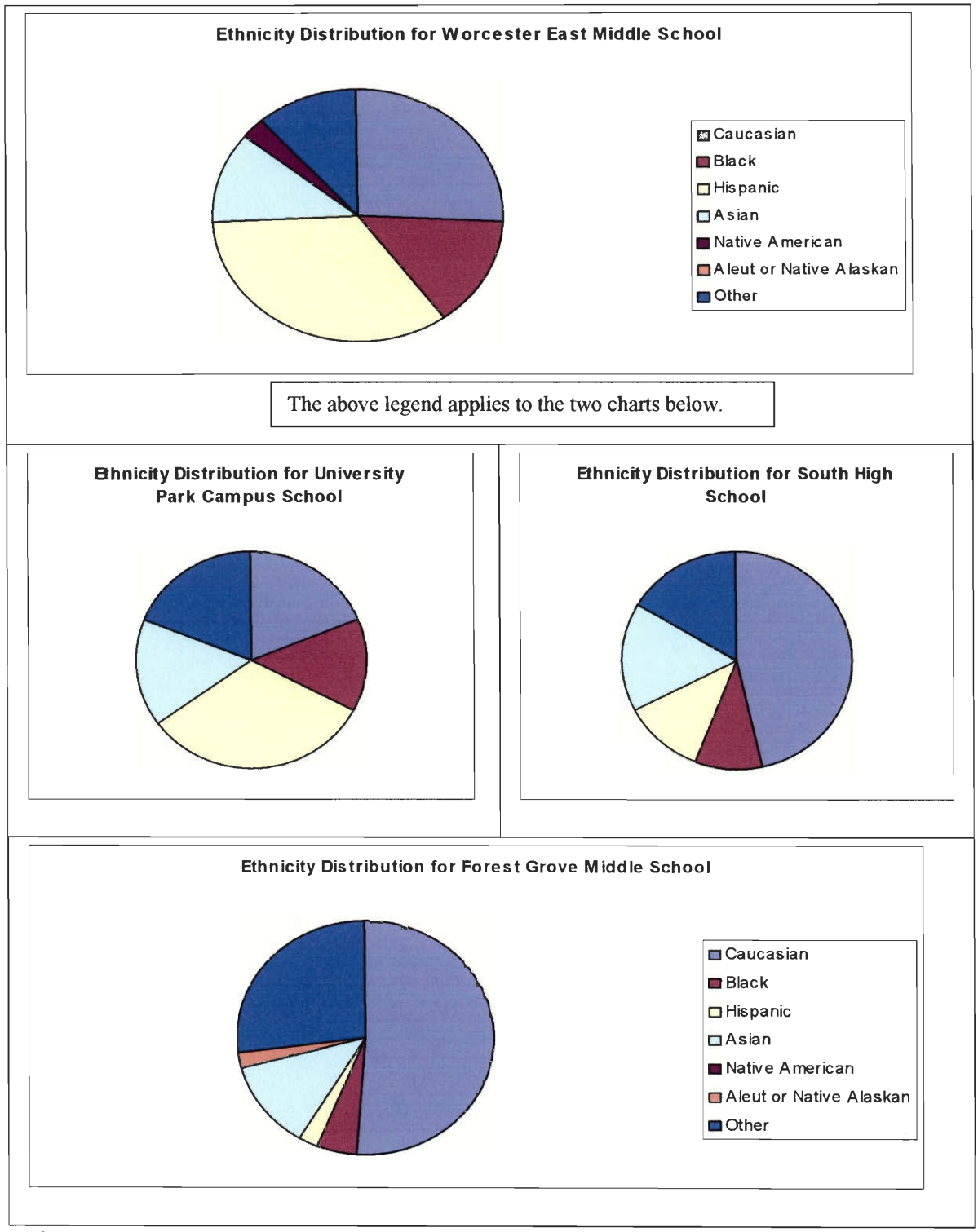


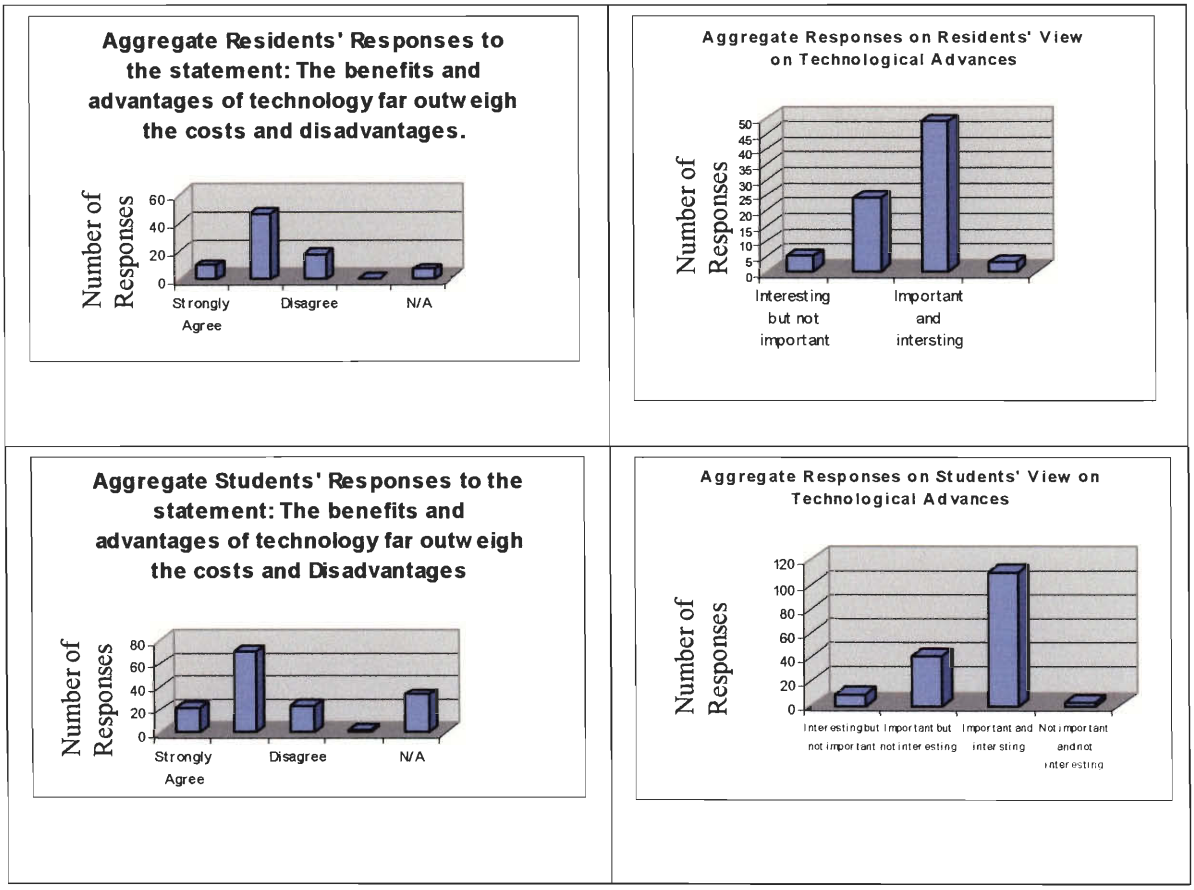
Figure 4.7: Distributions of Ethnicity for Worcester Public School Students by Quadrant

4.2.3 Further Note about Burncoat Quadrant

As we mentioned above, we ran into difficulty collecting survey data from the Burncoat quadrant. The high school and middle school principals were unwilling to grant us permission to survey the students in their schools. Since elementary school students would not be able to provide accurate responses to the survey that we designed, it would have been contrary to our study to attempt to survey the elementary schools. These unfortunate circumstances force us to leave out this quadrant from our analysis. Furthermore, this prevents us from drawing any conclusions about the extent of the digital divide in the Burncoat quadrant. This will be further explained in the future recommendations section of the conclusions.

4.3 Surveyed Opinions

The opinions that were gathered from the surveys have no impact on our statistical assessment of the digital divide. Therefore, we do not have to break them into quadrants. Summarizing the results of the opinions it is amazing how similar the responses of the students and the residents tended to be. Most of the responders found that technological advancements were both important and interesting. The majority of all people surveyed also agreed with the statement that the benefits and advantages of technology outweigh the costs and disadvantages. These results are graphically displayed in figure 4.8. In the conclusion section, we will further discuss the significance of these opinions and their relevance to our study of the digital divide.



<Figure 4.8>
Respondents Opinions of Technology Benefits and Technological Advancements

Chapter 5: ANALYSIS

5.1 Scaled Technology Access and Benefit

Looking at the raw data results does not lead to a good understanding of technology access and benefit in Worcester. Through the use of the TABS/ETABS we will be able to draw all the necessary correlations and conclusions that we seek. TABS/ETABS were derived from a compilation of questions from the survey and calculated with the aid of computer software. Below we present a discussion of this process and an overview of the distribution of values in Worcester.

5.1.1 Deriving TABS and ETABS

TABS/ETABS were derived directly from answers to specific questions. About one half of the weight corresponds to the tasks that are performed by the respondent on their computer at home and other places in the community. The weights that were assigned to the different tasks were based on the level of computer knowledge and skills necessary to perform them. Additional weights were assigned to the number of phone lines in the household, computer ownership, and the variety of places computers are used. Several other questions contributed slightly to the total scale. A complete description of the scale and the specific weights associated with the tasks is available in Appendix C and D for further review.

5.1.2 How calculated

Due to the complicated manner in which the scales are derived, it is necessary to develop a systematic way to determine these values. TABS/ETABS are calculated with the aid of a computer program written in C++. We created two versions of code, each suited specifically to the TABS and ETABS respectively. We input all our data into spreadsheets and then export them as delimited text files. These files are then read in by the program and the values are generated and put into a separate output file. This file can then be read into the spreadsheet and the analysis can be performed.

5.1.3 Summary of results

In this section we provide the results of the tabulated TABS and ETABS values. Below, in figure 5.1 we show a scatter plot of all the TABS values for the respondents from the residential portion of the study. Figure 5.2 shows all the ETABS values for the respondents from school.

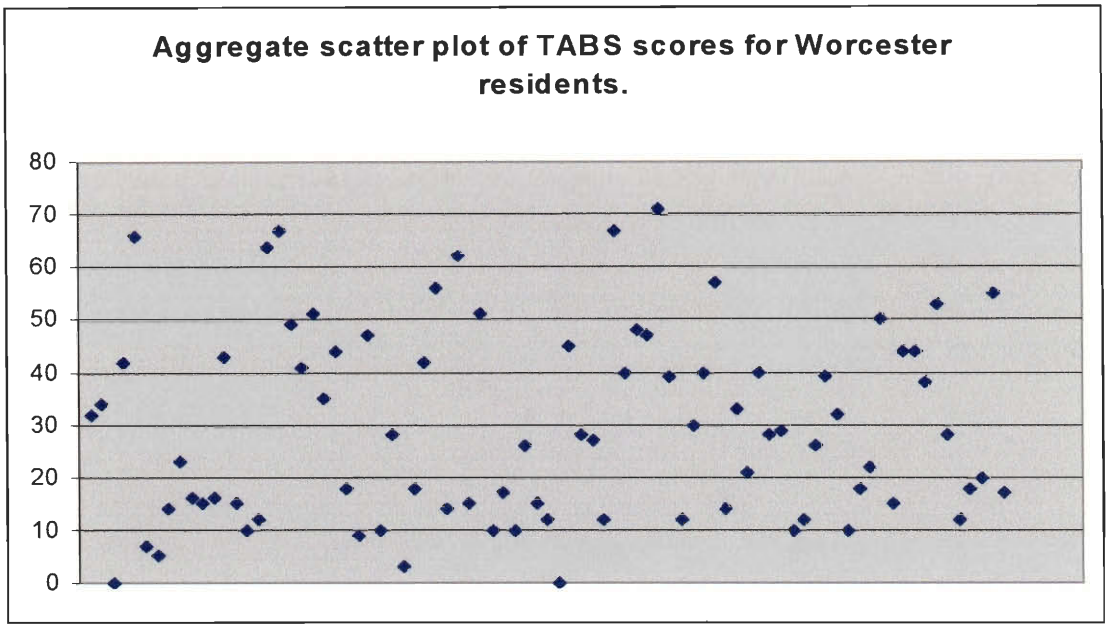


Figure 5.1: TABS From all Parts of Worcester

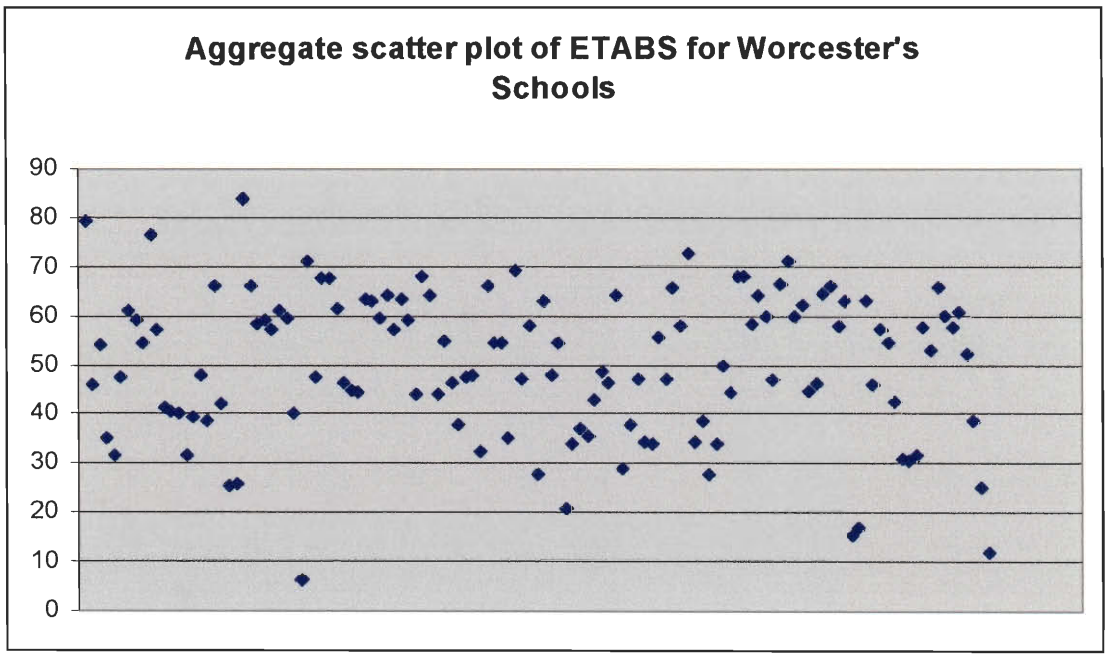


Figure 5.2: ETABS from Worcester

5.2 Correlations relative to the Digital Divide

There are five major demographic characteristics that we consider then analyzing the correlations relative to the Digital Divide. These criteria are income, household type, educational level, ethnicity, and geographical location. While ethnicity and geography apply to both the residential and school target population, the other three characteristics are reserves solely for the Worcester residents. Besides being very relevant to the digital divide, these five criteria were selected due to ease of data collection and grouping.

5.2.1 Income

The first demographic characteristic for which we sought data of an influence on the TABS and ETABS values was income. Income tends to be very important in defining a digital divide and is a very crucial part of our study. By graphically representing the data, we are able to see if there is any evidence of this category being significant throughout Worcester. We analyzed the results for the whole of Worcester as well as the underlying quadrants for a more detailed idea of where an income-based divide may lie. For both the aggregate analysis and the individual quadrants we found evidence of the impact that income has on the access and benefit received by residents from technology.

5.2.1.1 Worcester Aggregate

In analyzing the aggregate results for Worcester residents' TABS scores we found that the increasing income ranges exhibited a positive influence on the TABS values. People with higher incomes tended to have significantly higher scores indicating that there is in fact some sort of correlation. It is a limiting factor of our study that we do not

perform a complete statistical test on these values, but as presented below in Figure 5.3, this connection is obvious from the results.

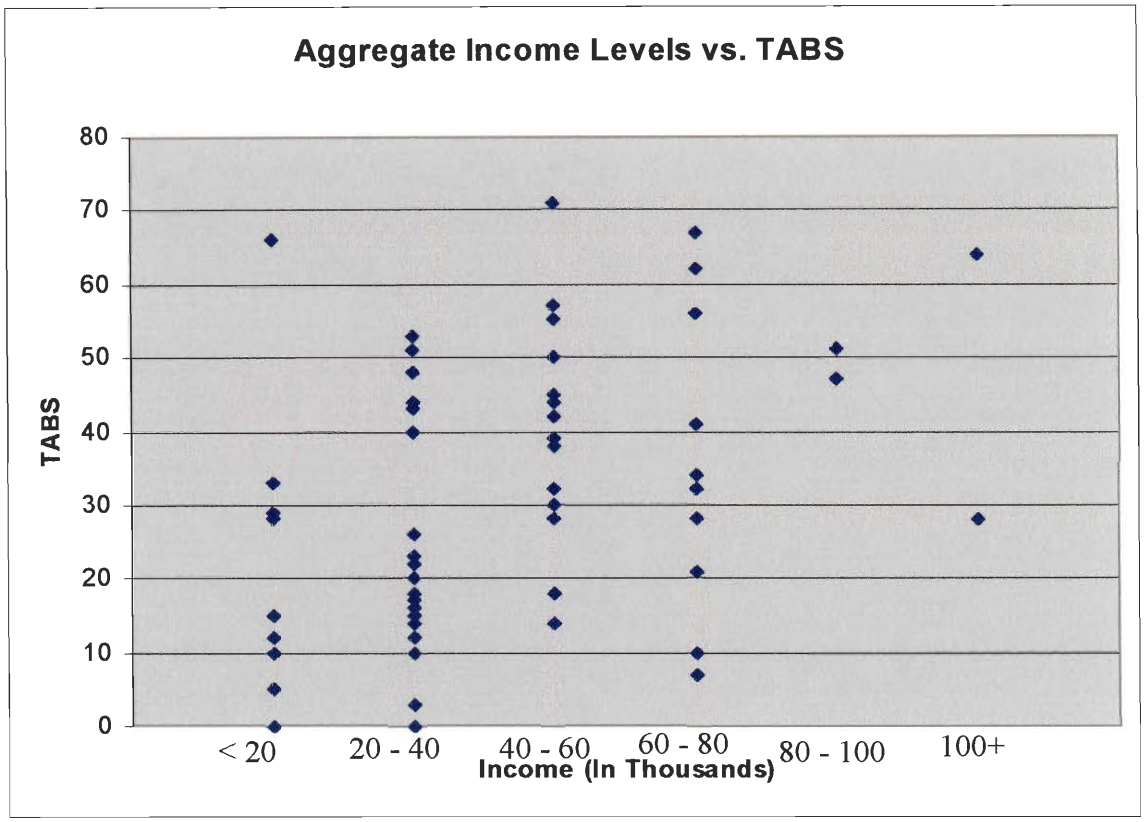


Figure 5.3: Income vs. Technology Access and Benefits for Worcester Residents

5.2.1.2 Quadrant divisions

By examining the individual quadrants, we found a few interesting results. South quadrant had the strongest evidence of an income-based digital divide. As seen on figure 5.4, there is a steady increase in the TABS values as income rises. Doherty quadrant exhibited a similar pattern except for the large number of outliers evident from the plot. The results from the North quadrant were lower in numbers and did not exhibit as strong a connection between income and the TABS values. This may either mean that the North

quadrant has a much lower divide among various income ranges or that there was sampling error in our design that could have lead to inaccurate results.

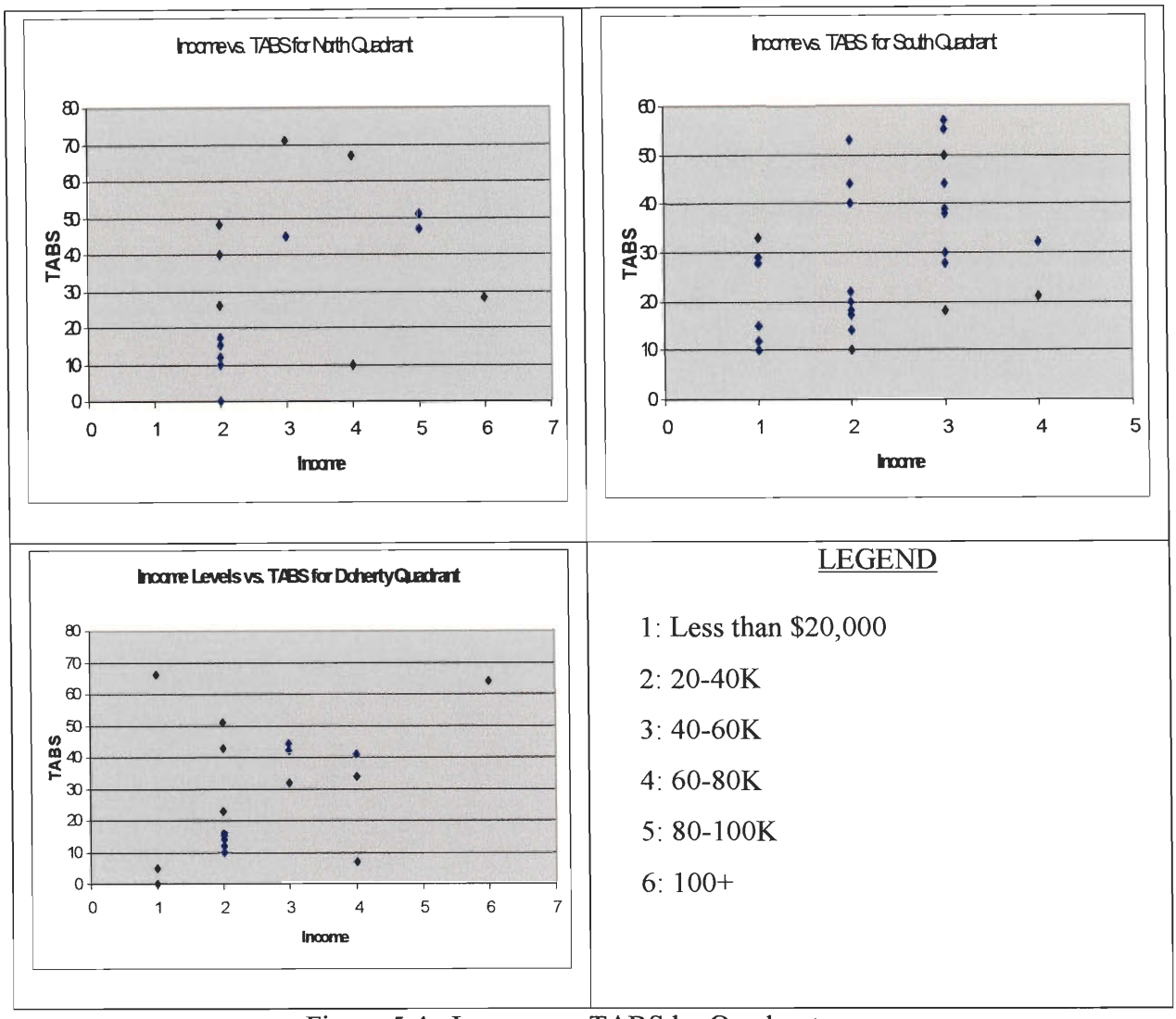


Figure 5.4: Income vs. TABS by Quadrant

5.2.2 Household

Household type is not classically considered in a study about the digital divide, but we felt that it may play an important role in defining the presence of technology in households and therefore performed an analysis of the latter. Figures 5.5 and 5.6 below display the TABS scores plotted against the types of households for the aggregate of Worcester and for individual quadrants respectively. None of our plots reveal any strong

evidence that one household type is more likely to have technology access than another. In fact a surprising result is that even single mothers, a typically lower-technology group, had about even TABS values with the other household types.

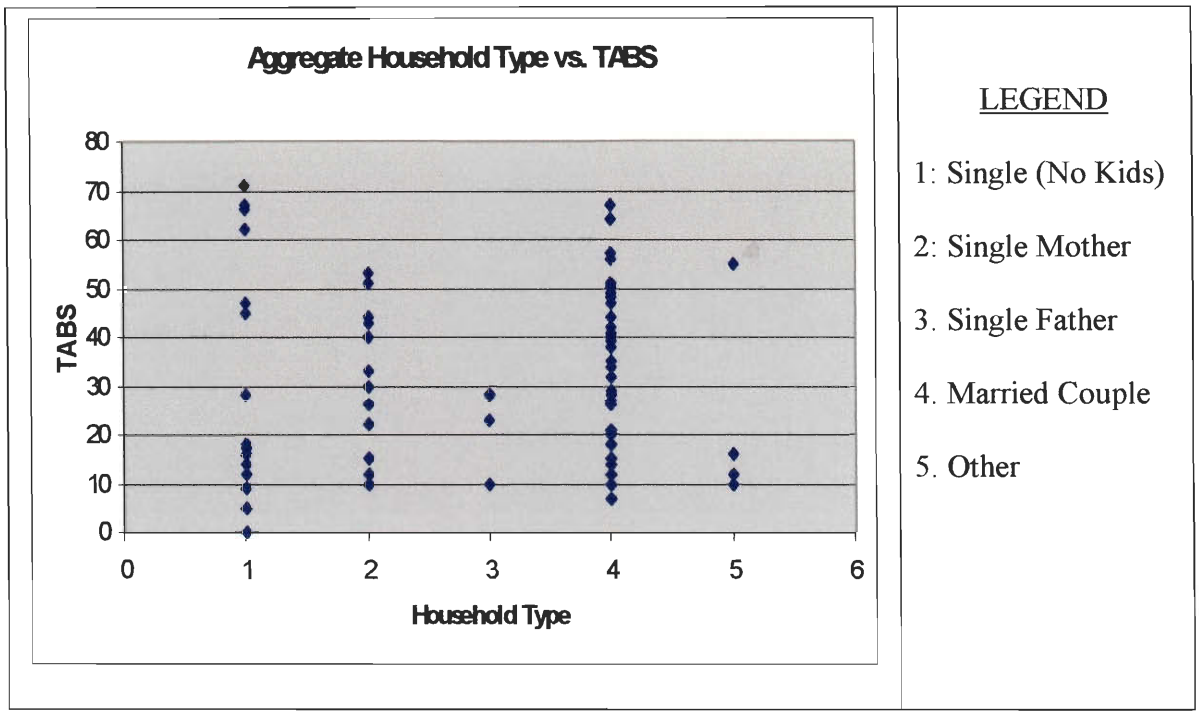


Figure 5.5: Household vs. TABS: Worcester Aggregate

5.2.2.1 Quadrant divisions

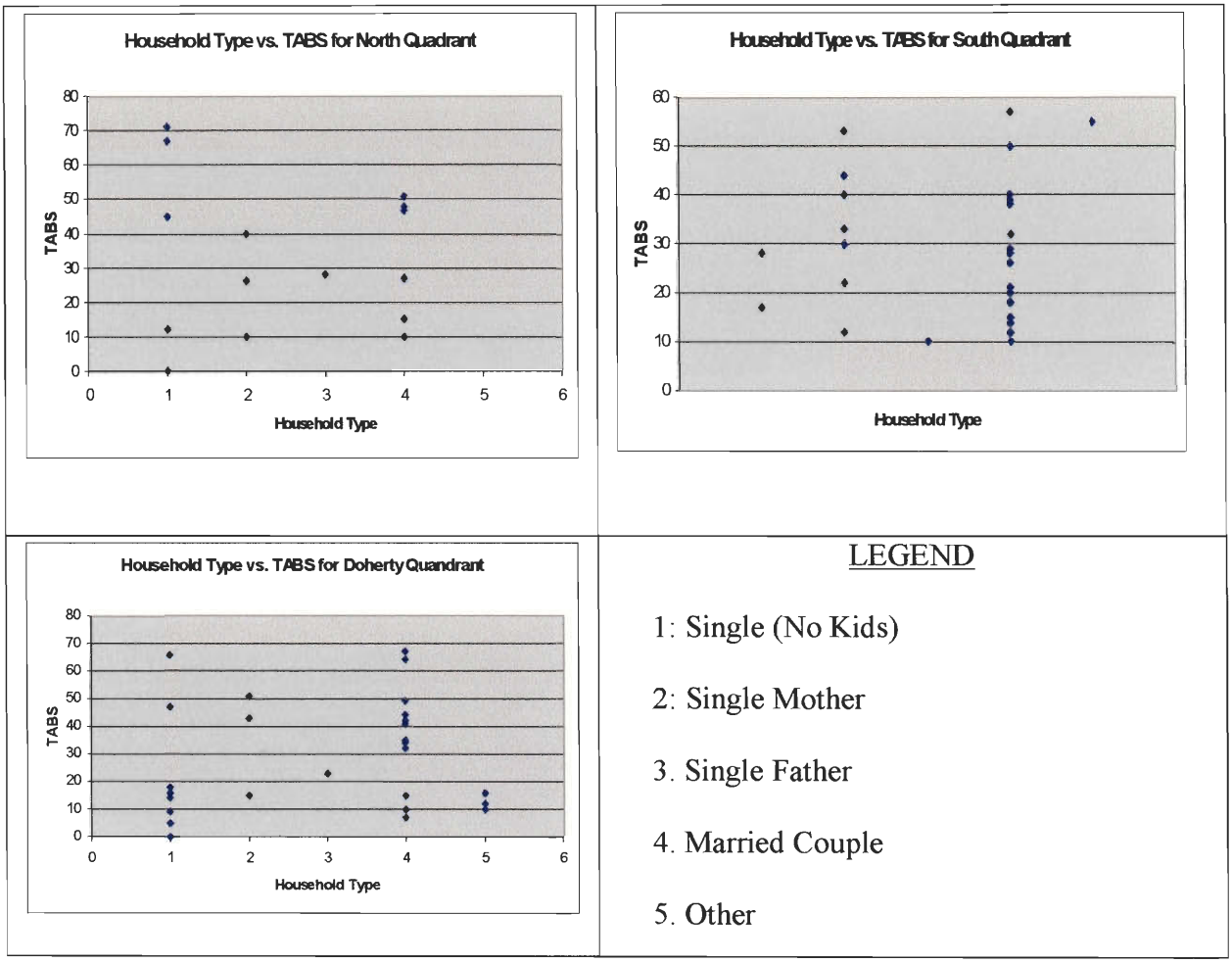


Figure 5.6: Household vs. TABS by Quadrant

5.2.3 Educational level

5.2.3.1 Worcester Aggregate

Our analysis of how different education levels affected the TABS values yielded some interesting results. As seen below in figure 5.7, there is a fairly evident correlation between the last education level completed and how much technology access is available. Just as we predicted, this shows that people who received more education tend to have a lot better knowledge of technology and are able to take the best advantage of it. This

information suggests that a possible digital divide has formed in Worcester among people of different education levels.

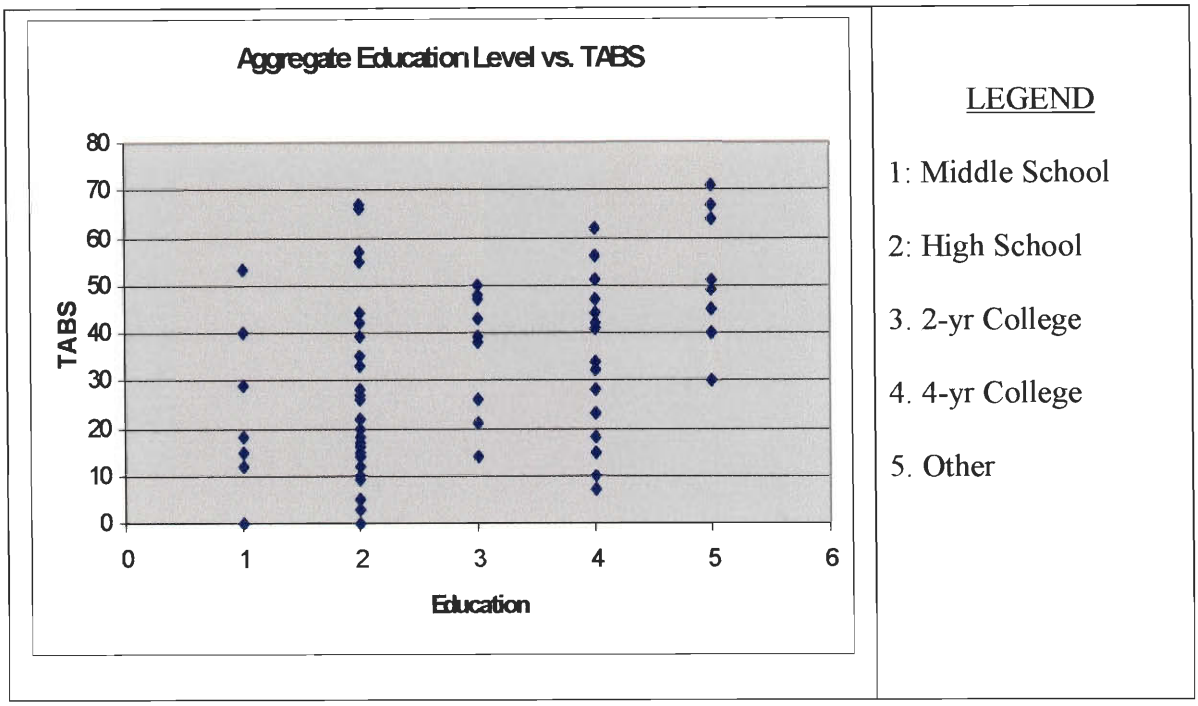


Figure 5.7: Education Level vs. TABS: Worcester Aggregate

5.2.3.2 Quadrant divisions

In analyzing similar data for the individual quadrants in Worcester, we found that only two of them yielded such strong evidence of a digital divide. The North quadrant, although lacking in respondents, showed very strong evidence of a positive slope in the plot of TABS vs. Education level. The Doherty quadrant exhibited a less evident correlation among all the categories, but a very drastic difference among those who chose "other". We believe that this is because the vast majority of "other" responders are those that completed post-graduate work. This shows that the higher the level of education, the more significant the effect on the level of technology access.

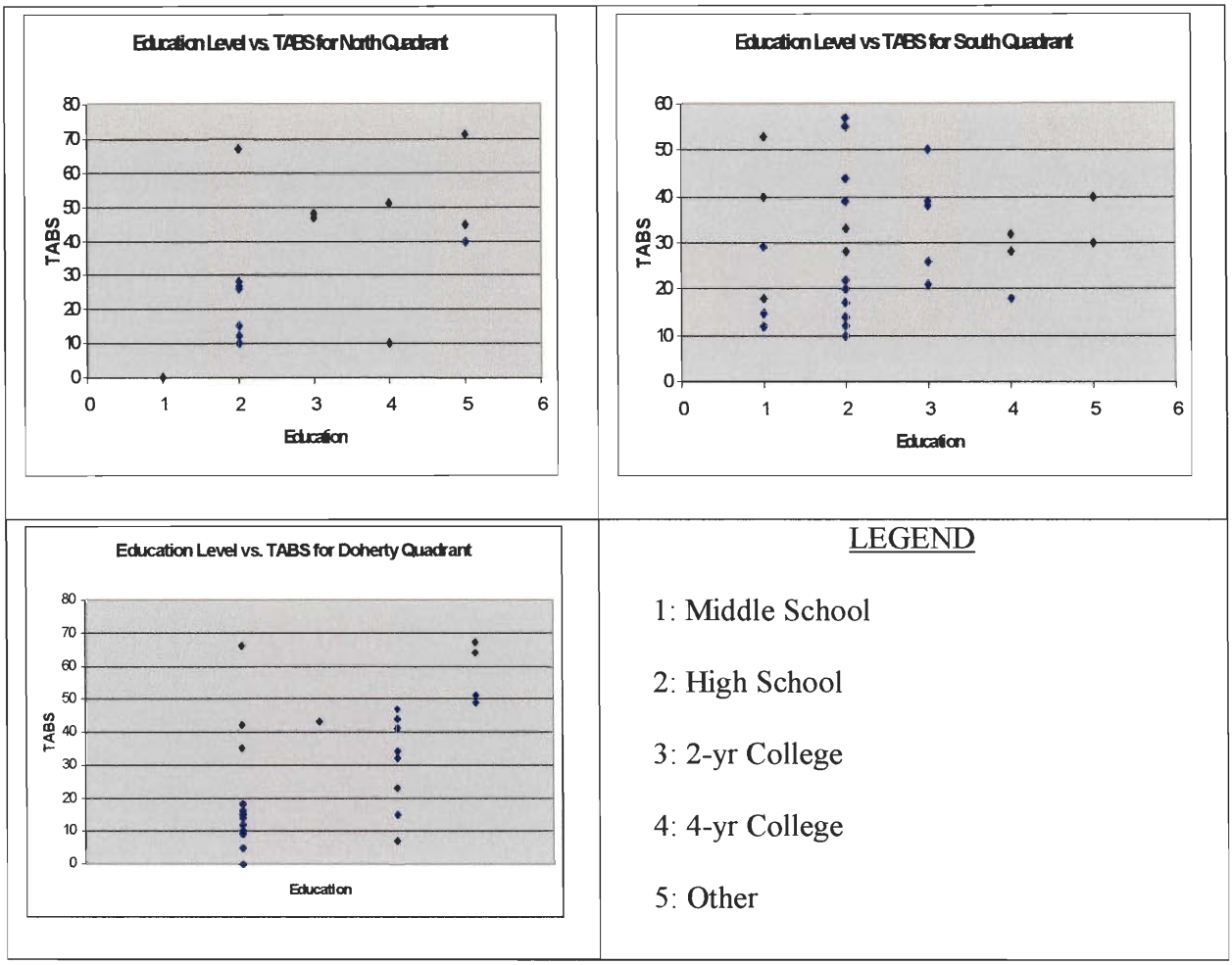


Figure 5.8: Last Completed Education Level vs. TABS by Quadrant

5.2.4 Ethnicity

Ethnicity is very important to our study because it is pertinent to both the residents and the students in Worcester. Besides income, ethnicity has traditionally been targeted as the most influential border in the digital divide. What follows is an analysis of the effects of ethnicity on the residential TABS and the school ETABS.

5.2.4.1 Residential

5.2.4.1.1 Worcester Aggregate

An aggregate analysis of Worcester yielded one major result. We found that Caucasians had an overall higher level of technological awareness that all other ethnic

groups. The remaining groups, however, displayed little deviation from a roughly equal distribution of computer access. From figure 5.9 below we can see that people in the other category tended to score higher. We do not have a good explanation of this. In fact, we cannot really comment on the validity of that result since there were only four respondents who fell into that category.

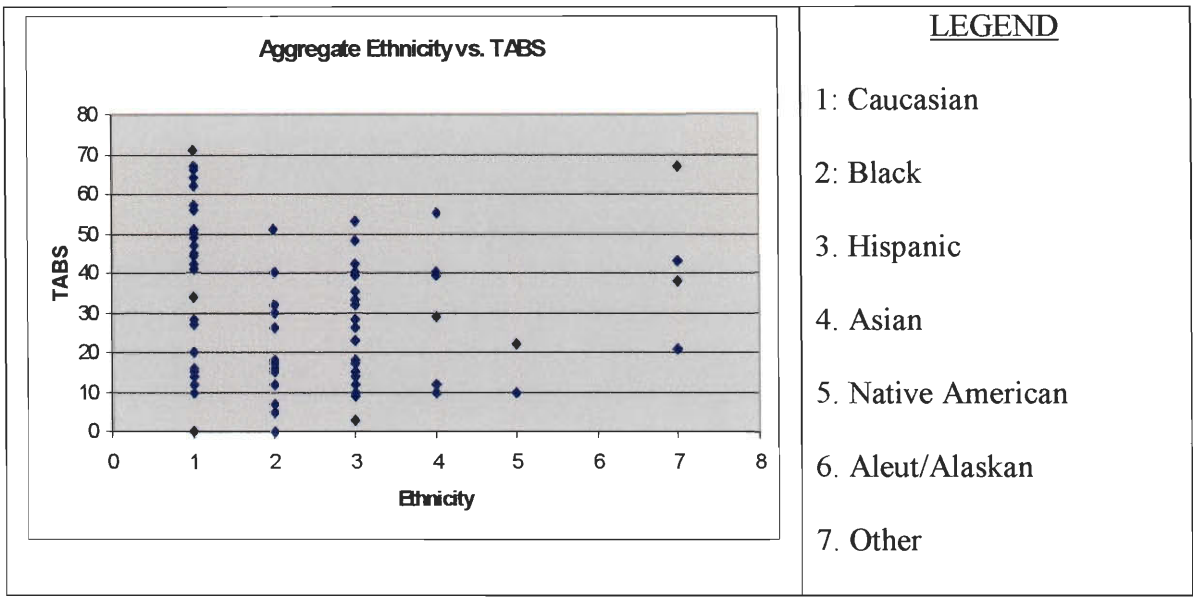


Figure 5.9: Ethnicity vs. TABS: Worcester Aggregate

5.2.4.1.2 Quadrant divisions

Examining the quadrants individually, we found that they did not necessarily provide us with new data. In the North and South quadrant there was not much evidence of any major differences among the ethnic groups. Doherty quadrant on the other hand showed a much more distinct divide among the groups. Caucasians scored significantly higher with Hispanics coming in a definite second place. There were not enough Asians to comment on their distribution. Blacks, however, displayed a definite lack in computer access and technology benefit. These results are summarized below in figure 5.10.

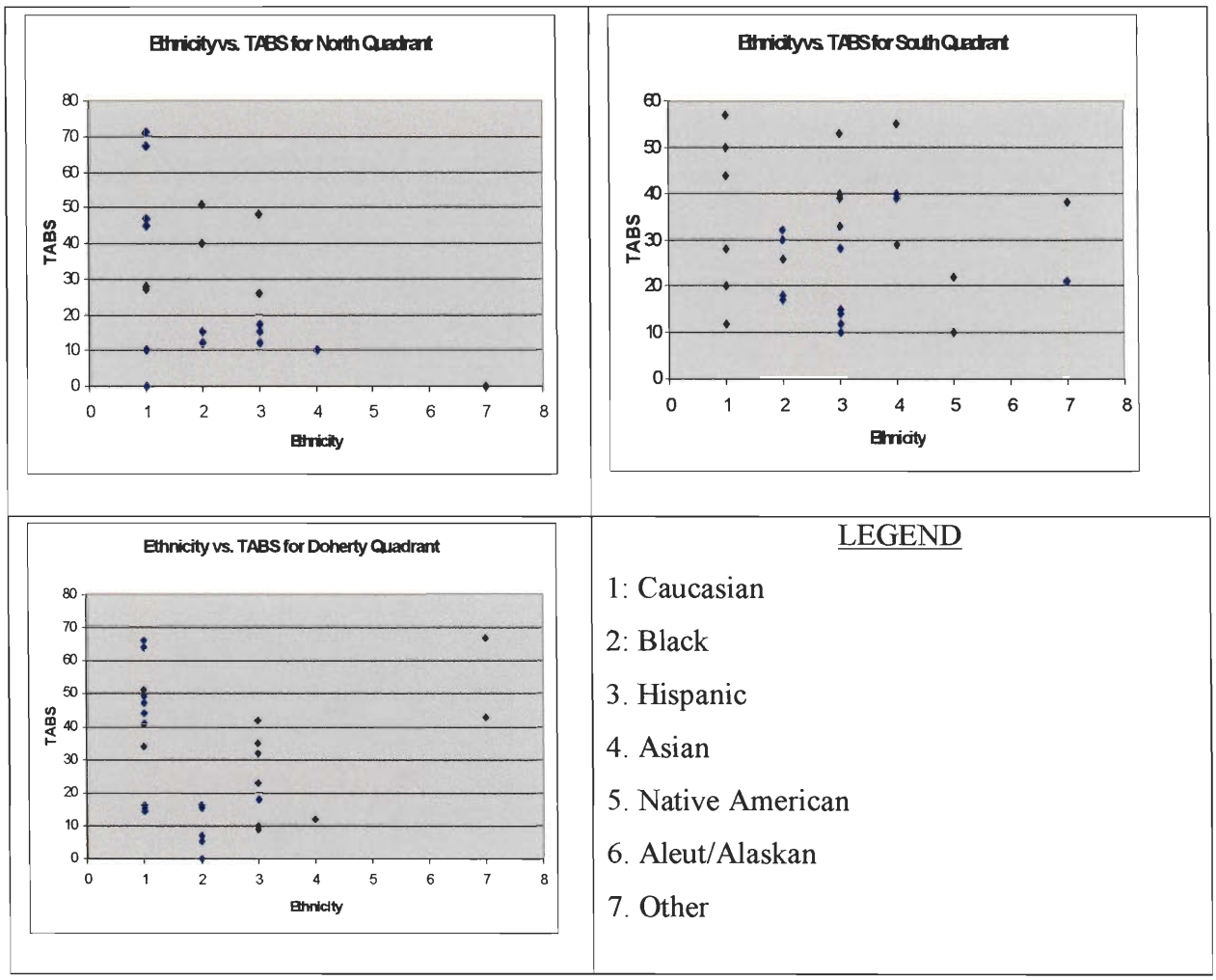


Figure 5.10: Ethnicity vs. TABS by Quadrant

5.2.4.2 Schools

5.2.4.2.1 Worcester Aggregate

For the aggregate analysis of all schools, we found that there was not a very big impact that ethnicity had on the ETABS values. Just as with the residents, we found that Caucasians had higher access in general, but the remaining ethnic groups were all on about the same level of technology use. Figure 5.11 presents these results below.

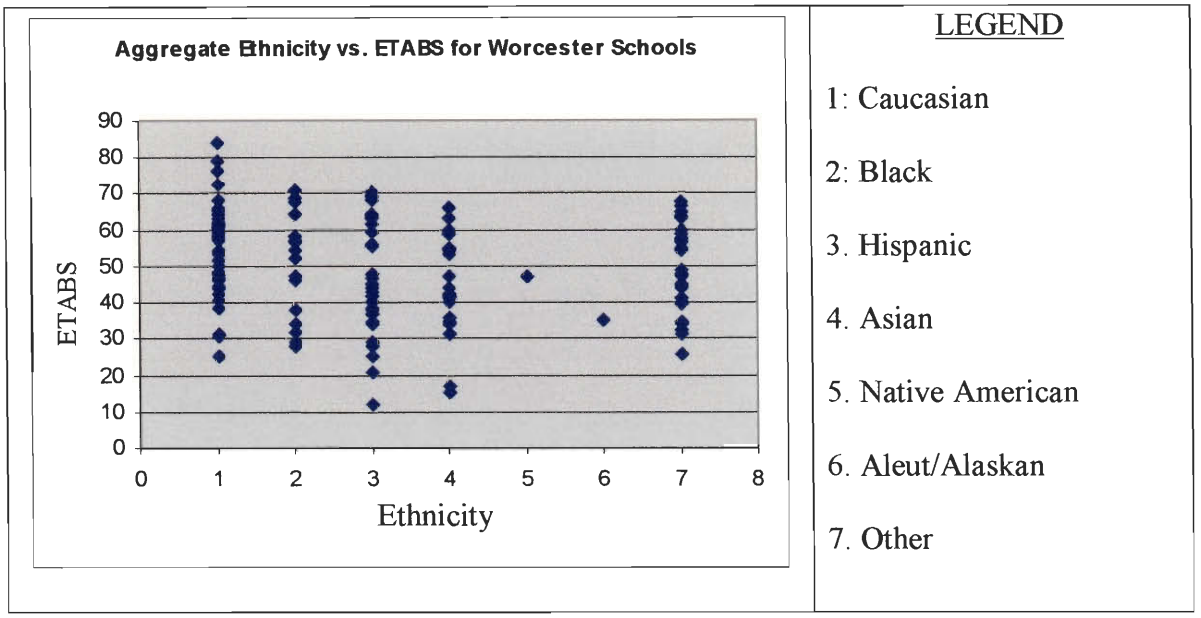


Figure 5.11: Ethnicity vs. TABS: Worcester Aggregate

5.2.4.2.2 Quadrant divisions

Due to the distributions of the ethnic groups among the quadrants, examining the data in this capacity yielded no new results. Caucasians were found to have higher access, but not by a significant margin. In Doherty quadrant, there were so many "other" responses that only the Caucasian group could possible realistically reflect the number of students belonging to the group. Neither of the other two quadrants even showed slight signs of a significant divide among the ethnic groups. Although discouraging because

our hypothesis is disproved, we are very encouraged to see that the Worcester Public Schools are doing a good job in providing equal technology access to all its students.

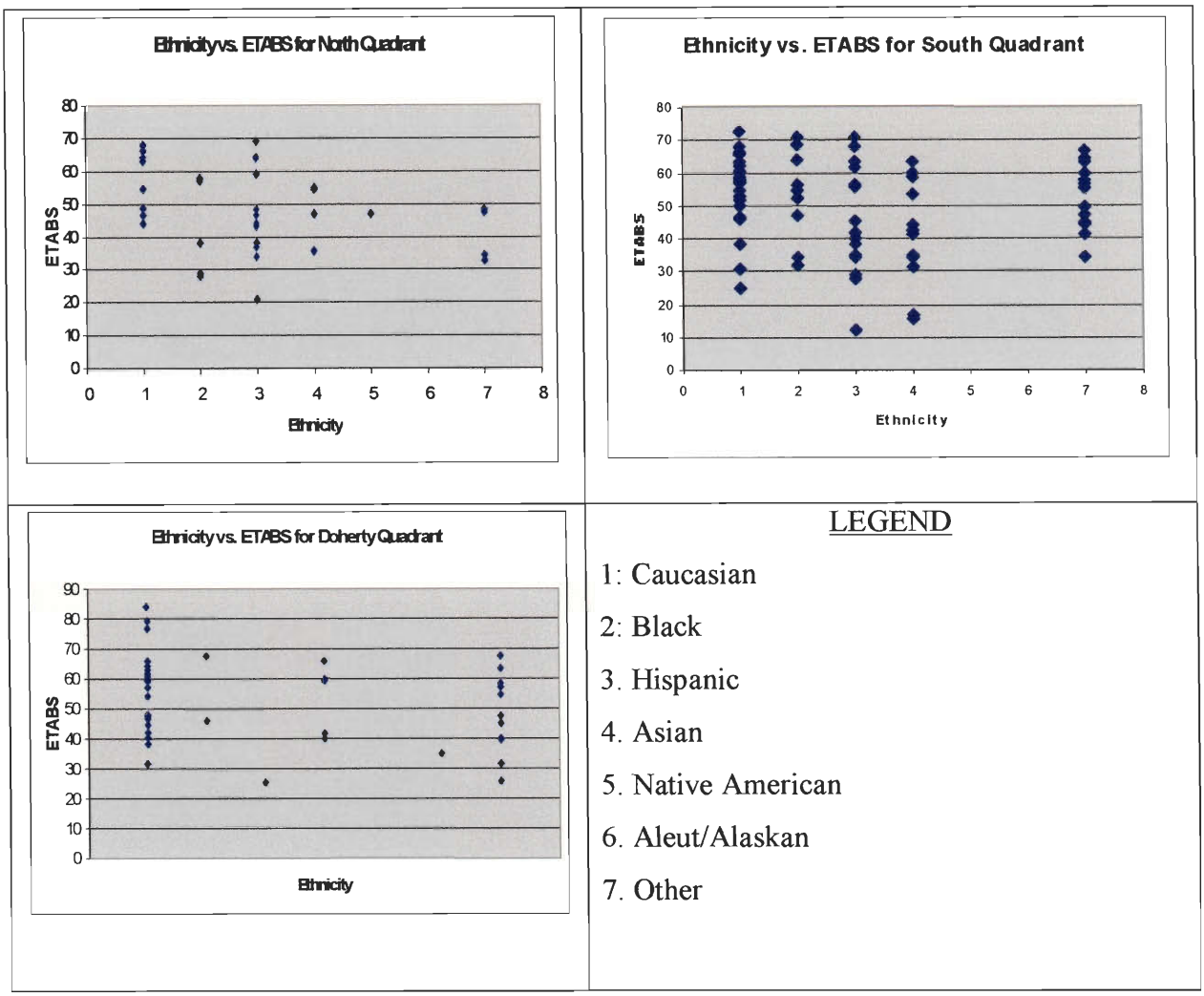


Figure 5.12: Ethnicity vs. ETABS by Quadrant

5.2.5 Geographic location

The geographical location portion of the digital divide analysis differs significantly from that of the other four demographical criteria. Instead of performing the analysis on a quadrant level, the quadrants are used as the actual categories for grouping the data. We did not really know coming into this project which quadrants would have better computer access than others. What we found was that there was not much

difference among them. In both the residential and school surveys, no evidence of a geographic divide was found. These results can be found below in figures 5.13 and 5.14 for the residents and students respectively.

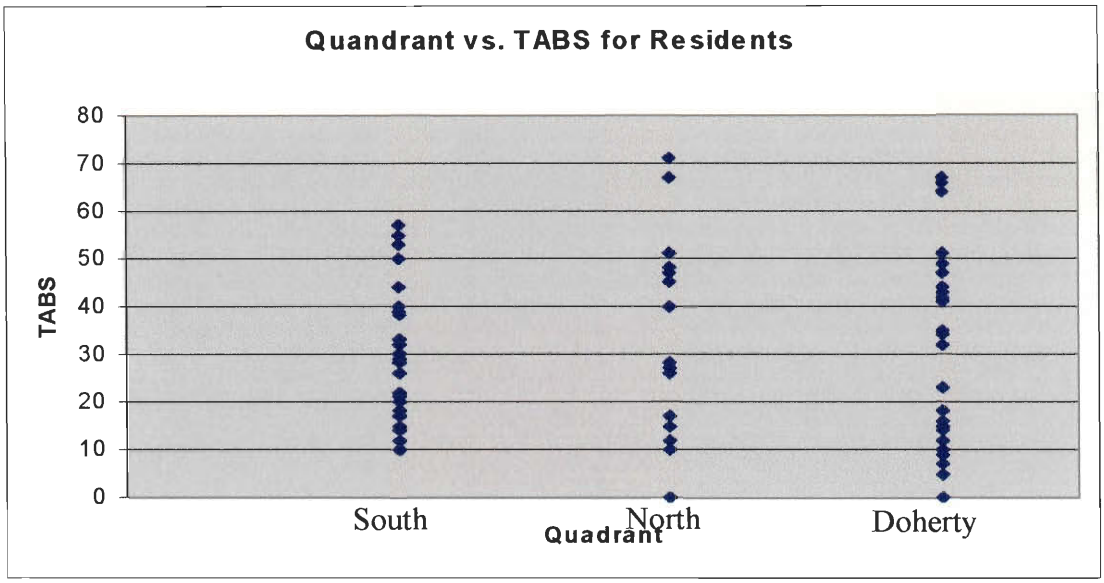


Figure 5.13: Residential: Quadrant vs. TABS

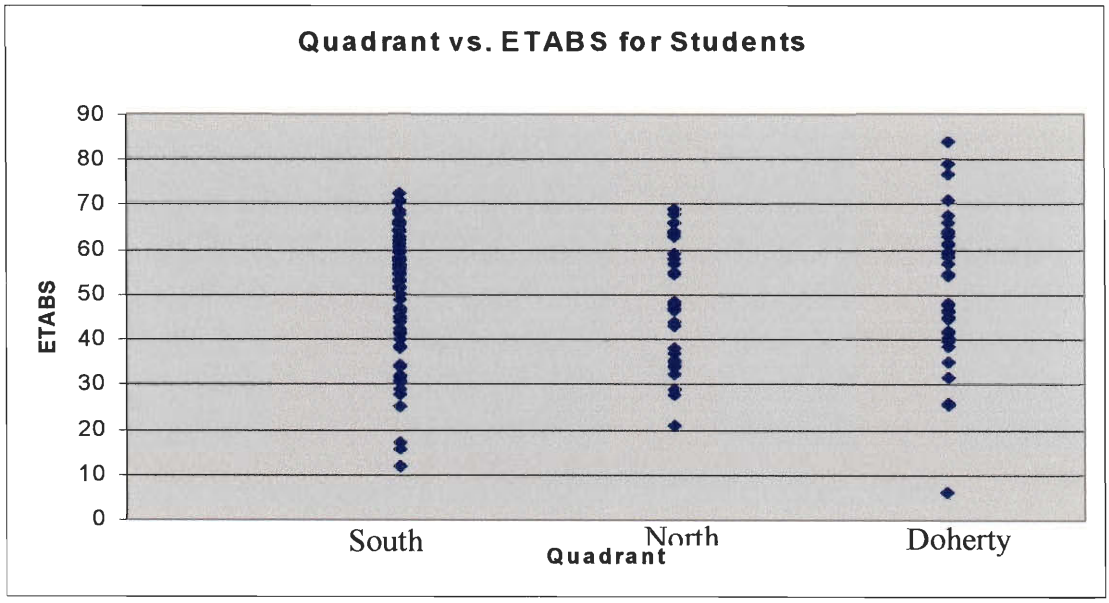


Figure 5.14: Students: Quadrants vs. ETABS

5.3 School-Resident Correlation

We perform this analysis to attain a measure of how the level of technology access and benefit in schools correlates with that of the residents. To do this, we produce a plot with the averages of the TABS and ETABS for the various quadrants and look for a pattern.

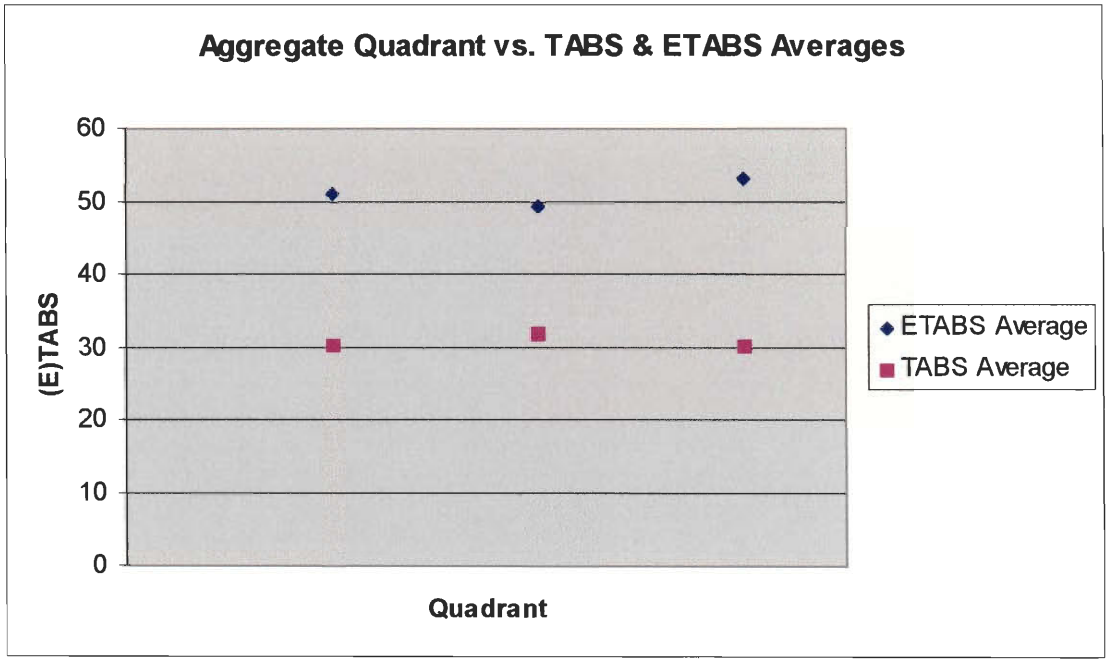


Figure 5.15: Quadrant comparisons of TABS/ETABS relationship

From the above figure we can see that the distributions of both the TABS and ETABS are fairly non-correlated. There is no evident connection between increases either scale to fluctuations in the other.

Chapter 6: CONCLUSIONS

6.1 Background and Hypothesis

In essence, a digital divide is an uneven distribution of technology across some continuum of people. This continuum could be made up of all races, all income levels, or any such categorization of society. Through our background research we found that all documented cases of a digital divide yielded a multi-faceted problem, where the divide is shown to exist over many of these factors simultaneously.

Although the divide has been shown to exist over many demographical categories, these categories prove to remain constant. An uneven allocation of technology seems to persistently lie across the categories of race, income, age, household type, and geographical location. Previous studies show that minority groups, those with lower incomes, the educated, single parent families, and those who live in impoverished communities have consistently lower access to technology then others. This research leads directly to our hypothesis on the state of the digital divide in Worcester. We hypothesize that our research will show that a lack of technology access and literacy in the city of Worcester will be found in minority groups, low-income families, the less educated, single parent households, and those from underprivileged communities.

6.2 Overview of Procedure

As stated many times before the purpose of our project is to find whether or not a digital divide exists in Worcester. We created a very detailed strategy on how to go about doing this. Throughout the assembling of this study we had to take a great number

of factors into account in order to maintain the validity of the results. Weighing the cost and benefits produced by various sampling models, surveying techniques, question wording, question placement, and a analytical model is not a straightforward task. Our group had to assess the cost and benefits for each of these decisions for both the schools and the residents.

Choosing a sampling model was the first decision that we had to make in the survey process. For both the schools and the residents we chose to implement an RCBD Design. For the schools this was easily implemented since the school district is already split up into four quadrants. We modeled the resident quadrants after the predefined school quadrants so we could perform comparisons later.

The second step in our procedure was to chose survey techniques for the residents and the schools. For the residents we chose a face-to-face model because of its traditionally high response rate and low response error. For the Worcester Public Schools we thought it best to administer group surveys. Using the group survey approach we could obtain both a high response rate while keeping the cost of manpower low.

Our next task was to design the actual surveys we planned on using for our study. We had to decide what sort of data we needed to obtain from the sample population and how we would present the questions to the respondents. Our questions were designed around four main topics that would encompass all of the data we needed to gather to show a Digital Divide. These topics were socio-economic demographics, technological task completion, technological demographics, and technological opinions. The questions were then designed and placed throughout the survey using standard survey conventions

that we researched earlier. These conventions ensure that the survey is non-threatening, easy to understand, and will generate the data needed.

Finally we needed to decide what methods to use when analyzing the data. To prove a digital divide form single questions would be a very cumbersome and difficult task. We decided that it would be more efficient to use a collective analysis strategy. This means that we assigned weights to each of the questions and tabulated them into a single measurable quantity. This quantity was named TABS (Technology Access and Benefits Scale) for residents and ETABS (Educational Technology Access and Benefits Scale) public school students. This quantity will allow us to easily compare and contrast the total technology access in Worcester between students and residents, and help us to show whether or not a digital divide exist.

Choosing the correct sampling model, surveying technique, question wording and placement, and a analytical model are critical step when designing a study. A lot of thought went into realizing how each of these decisions would effect our project both separately and in relation to each other. Many Trade-offs were made between these categories to finally arrive at a complete and valid survey model that can be best used to illustrate our hypothesis.

6.3 What do our Findings Show

Our findings show that there is in fact a digital divide in Worcester, Massachusetts. After analyzing our data it seems that this divide does in fact exist across some of the continuums of residents that we originally hypothesized. The following is an explanation of where the divide falls in Worcester.

6.3.1 Defining the Divide

Our data shows that a divide exists among varying income levels of Worcester residents. We found this by correlating the income aggregate in Worcester with the residents' level of technology access (see figure 5.3). We found that those with lower incomes generally had lower access to technology. When analyzing the separate quadrants we found that the south quadrant exhibited the strongest income divide. These findings help to prove our hypotheses, given that income is one of the continuums that we originally thought the divide would lie across.

The Worcester residents' education level also plays a significant role in technology access. Correlating the respondents' last educational level yielded a direct correlation to their access to information technologies. The analysis showed that those with less education have less access to technologies, and those more educated have a higher access. This data illustrates the importance of education in relation to increased access.

Ethnicity is another continuum that we believe the divide exist across. Analyzing the ethnic backgrounds of the resident respondents shows that Caucasians, Hispanics, and Blacks respectively have lower access to technology. Also, the Doherty quadrant yielded the most significant divide among resident and student Caucasians, Hispanics, and Blacks. After analyzing this data, we can only conclude that Caucasians have a higher access across all four quadrants for both residents and students. We could not decipher which minorities had lower access then others. Nevertheless, the data we gathered shows that our hypothesis holds true and a divide exists among different ethnicities.

Our hypothesis did not hold completely true when considering some demographical continuums did not play as big of a role in the divide as we thought they might. This was the case when comparing household types to the Residential TABS values. We found that the type of household the respondent is from is not a factor in technological access. Another factor that did not seem to play a role in the divide is the geographical location of the respondent. The generated data from this correlation did not yield any significant results.

6.3.2 Importance of Schools

We found that there is no statistical correlation between the level of technology access in the Worcester schools, and the level of access among residents. There are many possible reasons why this would hold to be true. First of all, a large number of residents may have moved to Worcester later in life, and therefore received their education outside of the Worcester School District. Another reason a correlation does not exist may be due to the fact that technologies change at such a rapid pace. The fortification of schools with information technologies is a fairly recent movement. Over three quarters of the residential respondents were over the age of twenty-five; therefore they may not have had nearly as much access to information technologies in either middles school or high school. For these reasons we have come to the conclusion that comparing the level of technology access between students and residents is not a valid correlation.

6.2.3 Technological Opinions

Three technologically oriented opinion questions are asked on both the student and residential surveys. These questions were placed into the survey for two reasons. First, we wanted to find if respondents who are rated lower in technological access view technologies more negatively then those with higher access. Second, this project is a study of a topic that raises both technological issues and implications. By asking these questions we hoped to raise awareness of these technological issues.

Question 13 of the Residential Survey requests the respondents to best describe their views of technological advancements. They were given five choices to express their views of technological advancements, interesting but not important, important but not interesting, important and interesting, not important and not interesting respectively. We then analyzed the correlation of the residential TABS totals versus the Question thirteen results. We found that those who thought technology was important and interesting also had higher TAB totals. Furthermore, those who believed technological advancements were important but not interesting possessed the second highest overall TAB totals. This shows us that those who are aware that technology plays an important role in society generally have a higher access to technology. A person who believes modern technologies play an import role in society will effectively seek out and educate themselves in the use of these technologies. This is why we feel it is important to raise the awareness of the influence that technologies have on society through questions fourteen, and fifteen.

6.4 Shortcomings of our Study

We feel that our study hold some shortcomings in its design. Our use of preconceived notions about the population of Worcester may lead to skewed results that can potentially making them less valid. One of our preconceived notions was that private schools would not play a significant role in the final tabulation of a digital divide among students. We assumed that the number of students enrolled in the Worcester private schools was insignificant when compared to the number of students enrolled in the public schools. This oversight can presumably lead to less significant results concerning the digital divide among students.

A similar assumption was made concerning the distribution of residents in Worcester. When designing the four quadrants we took into consideration the distribution of population in Worcester, creating quadrants that roughly contain the same number residents. Though we overlooked this distribution of population within the quadrants when designing our area-frame sampling model. When choosing the random samples we did not take into account that some areas of the quadrant may be more thickly settled then others. This oversight could lead to slight misrepresentations of the target population

We feel another shortcoming lies in our survey implementation. Although the complete survey model we designed was very sound, in many cases it was not possible to follow it as completely as we intended. The fact that we personally administered the survey to certain people left room for response bias that should be avoided by the surveyor. Furthermore, we ran into many problems trying to carry out the area frame sampling in each quadrant as it was designed. This led us to start surveying in areas that

a large portion of the population frequented. The problem with this is that it opens the study up to population bias, which is another factor surveyors should try to avoid at all cost. Finally due to our limited manpower, we found it was very difficult to collect a large amount of data. Sixty-one surveys needed to be collected in each quadrant, for both the schools and the residents, to make the survey statistically valid. Due to the large amount of manpower needed to conduct a face-to-face survey of this scale we were not able to collect this number of surveys. Due to this fact, some of the population may have been underrepresented.

6.5 Proposed Changes to our Study

While conducting this study we made many discoveries that would have changed some of our earlier project decisions. All of these changes would be made in the implementation of our surveys. To undoubtedly show that a divide exist throughout Worcester we would need to show its presence in all four quadrants. This sort of coverage was not possible due to the lack of cooperation we received from the Burncoat Quadrant. Without school data from the Burncoat Quadrant we decided not to collect any residential data from this region. Looking back we would have devoted more time and energy trying to convince the Burncoat Quadrant's administration to grant us permission to survey within their schools. We feel that given more time we could have illustrated to the principals the social importance and benefit that our project held, and eventually be granted permission to distribute our surveys.

One last thing we would have taken into account after the fact is the feasibility of conducting a face-to-face survey for Worcester residents. This approach resulted in a

smaller collection of data then previously hoped for. We chose the face-to-face technique because it offered us high response rates and low respondent error. Although this technique comes at a high manpower cost that presented a challenge at times. If given another chance we would try to implement more group surveys to residents similar to the ones we conducted in the Worcester Public Schools. This approach possesses all of the advantages of a face-to-face approach while also offering lower costs for time and manpower.

6.6 Recommendations for Future Studies

Although our project shows the existence of a Worcester digital divide there is a lot of room for future studies in this area. Our project was only intended as a pilot study, for this reason we took into account, and searched for, a large number of factors that may have contributed to a divide. It would be beneficial to know in more detail the extensive role that any one of these factors may play in creating and maintaining a divide. If the technology gap in Worcester is better defined, steps can then be taken to bridge this gap. Future studies may be undertaken to form strategies on how to introduce greater access to information technologies in the sections of Worcester that need it the most. When we started this project we intended only to find evidence of a divide. This issue is a mult-faceted problem with many causes and implications, therefore it can only be fully addressed in the long term through future projects and studies.

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APPENDIX A: Various Digital Divide Statistics

A.a. Access

- Survey of southern Californians: 22% of households earning less than $25000 had access to computers, compared to 69% with incomes over $50,000 (1996)
- 80% of families making more than $100,000 have computers. 25% of families making less than $30,000 have computers (1998)
- 53% of those with an undergraduate degree or higher use the web, while only 19% of those with a high school education or less use the web
- 6% of U.S. households lack telephone service. 43.5% of families who depend entirely on public assistance and 50% of female-headed households living at or below the poverty line lack telephone service.
- In 1995, the public libraries of Chicago had just one computer for every 20,000 residents they served. Libraries in the suburbs had one for every 13,000 residents.
- In 1997, 72.3% of all public libraries had some type of Internet connection. Those libraries serving 25,000 and above had a greater than 90% connection rate. Those serving 5,600 or fewer had a 56% connectivity rate.
- At incomes below $40,000, whites were more likely than African Americans to have Internet access, own, or use a PC. The gaps greatly diminish at incomes greater than $40,000
- About 1/3 of all Americans have already have Internet access from some location. ¼ have access at home.
- Of households with a PC or WebTV that do not have Internet access cite "cost" and "do not want" access as the main reasons for not using the internet.
- Of those who access the Internet outside the home, 56.3% do so at work. Those with advanced degrees are ten times more likely to have access at work than those with only a high school education or less. 87.2% vs. 8.7%.
- Why households with computers have never had Internet Access:
    - 25.7% "do not want" access
    - 16.8% "cost" too high
    - 9.6% "can use [it] elsewhere"
    - 8.7% have "no time" to access it
    - 8.3% do not have a computer that is "capable"
    - 7.5% have "future access planned"

- 7.5% are "concerned with children" accessing certain materials on the Internet
- 5.6% think it is "not useful"
- 2.7% say it is "not user-friendly"
- 1.3% have a "problem with service provider"

- Why households with computers have discontinued use:
  - 15% said the "cost, too expensive"
  - 14% "no longer own a computer"
  - 10% "not enough time"
  - 9.0% "can use elsewhere"
  - 7.0% "do not want it"
  - 7.0% "moved" to another location
  - 17% "other"

A.b. Schools

- Schools with a minority enrollment of greater than 90% had a student-to computer ratio of 17 to 1, compared to the national average of 10 to 1.
- 62% of schools in high income areas had internet access in 1995, while only 31% in low income populations had access
- 75% of schools in high income areas had internet access in 1996, while only 55% in low income populations had access
- 70% of American schools have at least one computer connected to the Internet, but less than 15% of classrooms have internet access
- 83% of all new college students report using the Internet for school work and 2/3 use email.
- 90.2% of private college freshman use the Internet for research, yet only 77.6% of students attending black public college do so. (1998)
- 80.1% of private college freshman report using email regularly. Only 41.4% of students attending black public colleges do.

A.c. E-Rate

- 75% of all school districts have applied for E-Rate funds. 50% of all public libraries and 15% of all private schools have applied
- 58% of E-Rate funds supported the acquisition of equipment and services for internal building connections. 34% used for telecommunications series and 8% for Internet access

A.d. Usage

- 40 to 80 million adults in the United States alone have access to 800 million pages of unique content. (1999)
- 22% of Americans currently use the Internet from home. 17% use it somewhere outside the home. 32.7% use it somewhere. 67.3% do not use it at all.
- Among households with a PC or WebTV, 61% use the PC to connect, 1% use WebTV, and 38% do not connect at all.
- 77.9% of Americans who use the Internet use it to send email. 53.6% of those access outside the home use it for email.
- Minorities at home are taking online courses and conducting school research online at rates higher than the national average of 36.1% or the white average of 35.3%. 43.5% for Blacks and Hispanics. 42.9% for Indians/Eskimos/Aleuts and 41.1% for Asians/Pacific Islanders.
- Minorities are also more likely than whites to search for jobs online. 19.1% for Blacks, 18.1% for Asian/Pacific Islanders, 17.4% for Hispanics, and 13.2% for whites.
- Americans have concerns about confidentiality on the web. Of those polled, 40% are "very concerned," 24% are "somewhat concerned," and 24% are "not concerned.

APPENDIX B: Proposal to Worcester Public Schools

We are three students from WPI conducting a research project on technology access and benefits in the city of Worcester. Our study is modeled after research that has been done in the past on the global, national, and state level. In recent years, studies have been conducted throughout the United States that have yielded troublesome results indicating a large information literacy gap across socio-economic borders. This development has been labeled the "Digital Divide." Utilization and familiarity with information technologies is already beginning to affect the well being of the average American. It will be increasingly difficult for people who lack technological skills to play an extensive roll in society. They could potentially be left at a disadvantage when looking for a job, trying to broaden their education, or having a voice in the community. There are a great number of issues that need to be addressed in order to narrow the technology gap. Previous studies lead us to believe that such a divide can form on a city level. Our project is a pilot study aimed at researching and documenting the extent of technology access and use in Worcester.

The Worcester public schools offer a reliable representation of the surrounding community's population. This allows for an effective means to gather data on the state of technology use and benefit. We would like to distribute surveys to various students in the school, preferably in a Social Studies class since we feel the study faces important societal issues. We intend to collect 30-60 samples, encompassing at most 2 classes. If possible, we would also like to send residential surveys home requesting students' parents to fill them out and aid our study.

Through our interaction with students we hope to gain a good perspective of technology access on a local level. We believe that any plans to improve the general access and use of technology in Worcester can only be made after a good understanding of the status of technology on a local level is established. This research project is intended to do exactly that, we hope that our findings will be a first step in the right direction.

APPENDIX C: Explanation of the TABS Scale

The TABS scale is a score from 0 to 100 that represents a student's access to and benefit from information. It is calculated based on the responses we received from the resident surveying that was performed. The method and rationale of calculating the score from the surveys is specified below.

Question 2: *How many phone lines do you have?*

Weight: two or more = 10, one = 7, none = 0

The phone is a piece of information technology that is possessed by the great majority of Americans. The lack of a phone line in one's home is a sign of a great lack of technology access and benefit, and therefore anyone without a phone receives no points for this question. Having a phone line is a prerequisite for connecting to the Internet, and people often get a second line specifically for Internet connection purposes. Points are assigned accordingly for each of these cases.

Question 6: *If you do not have a computer now, have you ever had a computer in your household?*

Weight: Yes = 5, No = 0

This question only applies to people who do not currently have a computer. If they once had a computer in their house, they have had more access to and benefits from technology.

Question 9: *Where, and for what purpose do you use computers outside of your home?*

Weight: 2 points for each place they use a computer, plus certain bonus points depending on what activities they perform.

Using a computer at more places means that a person has more access to technology. Therefore each different place is worth 2 points.

The different tasks performed are worth different points. Activities that require a high level of computer skill and have redeeming educational or societal value are worth more points. 1-point responses are: games and entertainment. 2-point responses are: educational, email, word processing, and research. Using the Internet is worth 3 points, and programming is worth 4 points.

Question 10: *How many computers do you have at home?*

Weight: 4 or more = 10, three = 9, two = 8, one = 7, none = 0

The greater the number of computers a person has, the greater the benefits from and access to technology for the person. One computer provides a much greater access and benefit than no computers, but two computers only provides a slight advantage over one. The points are assigned accordingly.

Question 11: *How many computers do you have than are connected to the Internet?*

Weight: 2 or more = 10, one = 7, none = 0

The greater number of Internet connections a person has, the greater the benefits from and access to technology for the person. One Internet connection provides a much greater access and benefit than no connections, but two computers with an Internet

connection only provides a slight advantage over one. The points are assigned accordingly.

Question 12: *What tasks do you perform on your computer?*

Weight: Various responses are worth different values.

The different tasks performed are worth different points. Activities that require a high level of computer skill and have redeeming educational or societal value are worth more points. 1-point answers are: instant messaging, watch movies, games, music downloading, and artistic creativity. 2-point answers include: word processing, email, spreadsheets, and shopping. 3-point answers include: community involvement, research, educational, and selling via the Internet. The only question worth 5 points was programming, due to its technical nature.

Question 13: *Circle the choice that best describes your view of technological advancement.*

Weight: Important and interesting = 5, Important but not interesting = 3, Interesting but not important = 2, Not important and not interesting = 0

A person's views on the societal impact of technology will affect their willingness to seek out opportunities to access and to educate themselves in aspects of these modern technologies. As such, those students who feel that it is both interesting and important are more likely to access and benefit from technology than those students who do not. The most points have been awarded to a response of both "important and interesting." Those who find it "important but not interesting" feel that it does have an impact on them. This

shows an awareness of technology that deserves a slightly higher score than "interesting but not important." A person who thinks that technology is unimportant is not aware of the possible implications it may have one their lives. Those who are neither think it important nor interesting receive no points for this question.

APPENDIX D: Explanation of the ETABS Scale

The ETABS scale is a score from 0 to 100 that represents a student's access to and benefit from information. It is calculated based on the responses we received from the student surveying that was performed. The method and rationale of calculating the score from the surveys is specified below.

Question 3: *Do you have a computer at home?* *YES* *NO*

If so, how many? *1 2 3 4 5*

Weight: None 0, One = 6, Two = 7, Three = 8, Four = 9, Five = 10

A person who does not have computer in their home receives a score of 0. A computer at home contributes highly to a person's access to and benefit from technology. Those people with at least one computer in their household are assigned 6 points for this question. Only a single point is added for each computer over the first, because two computers does not increase technology access over one computer as much as one computer over no computers.

Question 4*: If so, what kinds of tasks do you perform on the school computers?*

Weight: 1 point for each class listed, plus different point values for the various responses, plus different point values depending on the total number of tasks listed.

The different tasks performed are worth different points. Activities that require a high level of computer skill and have redeeming educational or societal value are worth more points. 1-point answers include: Internet chat, instant messaging, games, and artistic

creations. Responses that were worth 2 points are activities that either require a slightly higher level of computer skill or have a greater redeeming educational or societal value. Two point answers include: word processing, e-mail, encyclopedia software, and spreadsheets. Responses that were worth 3 points are activities that require an even higher level of computer skill or have a greater redeeming educational or societal value. Three point answers include: Internet research, writing reports, create presentation, and news/current events. Only one response was worth more than 3 points. An answer of "programming" was worth 5 points on the ETABS scale. The very technical nature of programming demonstrates a high level of technology access and benefit.

Question 6: *Do you ever use computers in places other than school? If so, please say where and for what purpose.*

Weight: 1 point for each different place where the person uses a computer, plus one point for each task listed, plus bonus points for certain answers. Divide this sum by 2 to get the final point total for this question.

The different tasks performed are worth different points. Activities that require a high level of computer skill and have redeeming educational or societal value are worth more points. Responses that were worth 1 bonus point are activities that require a decent level of computer skill or have redeeming educational or societal value. One point answers include: e-mail, encyclopedia software, furthering education, writing reports, news/current events, and selling via Internet. Two point answers include: Internet research, community involvement, and job searching. The only response worth 3 bonus points is "programming" due to its technical nature.

Question 7: *Refer to the task list in question 6. Circle all the tasks that you believe can be performed on a computer.*

Weight: Each response is worth ½ of a point.

All of the listed tasks can be performed on a computer, so each response shows a greater knowledge of what a computer can accomplish

Question 8: *How often do you use the Internet?*

Weight: Everyday = 15, A few times a week = 10, A few times a month 6, A few times a year = 3, Less than once per year = 1, Never = 0

The more often a person uses the Internet, the greater their access and benefit from the technology. These points are assigned accordingly.

Question 9: *Circle the choice that best describes your view of technological achievements*

Weight: Important and interesting = 5, Important but not interesting = 3, Interesting but not important = 2, Not important and not interesting = 0

A person's views on the societal impact of technology will affect their willingness to seek out opportunities to access and to educate themselves in aspects of these modern technologies. As such, those students who feel that it is both interesting and important are more likely to access and benefit from technology than those students who do not. The most points have been awarded to a response of both "important and interesting." Those who find it "important but not interesting" feel that it does have an impact on them. This

shows an awareness of technology that deserves a slightly higher score than "interesting but not important." A person who thinks that technology is unimportant is not aware of the possible implications it may have one their lives. Those who are neither think it important nor interesting receive no points for this question.

APPENDIX E: Student Survey Rational

QUESTION 1

Have you ever used a computer before? *YES NO*

This is a very straightforward question that is necessary for our study. The purpose of this question is to find out whether or not the respondent has used a computer at any time in their life. Since many questions in the survey will be computer related it made sense to start the questionnaire asking this The most efficient way to ask this question is to use a close-ended unordered list the in this case the YES or NO choice.

QUESTION 2

Have you ever used a computer in school? YES NO

The purpose of this question is to get an understanding of the level of technology access in the schools. The purpose of this questionnaire is to gauge the level of technology access in Worcester, in order to do this we need to know if computers can be accessed in the public schools

QUESTION 3

Do you have a computer at home? *YES NO*

If so, how many? (circle one) *1 2 3 4 5*

The purpose of this question is to gain an understanding of the level of technology access that the students have at home. Students spend most of their time in school or at home. Therefore finding the level of access computer access at home is very important to us.

QUESTION 4

Explained in Section 3.5.5

QUESTION 5

Do you ever use computers in places other than school? YES NO

The purpose of this question was to gain an understanding of the level of technology access the student has outside of school and the house. A third topic we are concerned about is the level of technology access in the community. This question will shed some light on the surrounding communities available technology access

QUESTION 6

If so, please say where and for what purpose?

(Choose all that apply)

a) Word Processing	*k) Spreadsheets*
b) Internet Chat	*l) Writing Reports*
c) Email	*m) Games*
d) Instant Messaging	*n) Music Downloading*
e) Encyclopedia Software	*o) Create Presentations*
f) Internet Research	*p) News/Current Events*
g) Programming	*q) Artistic Creations*
h) Community Involvement	*r) Job Searching*
i) Watch Movies	*s) Order Groceries*
j) Furthering Education	*t) Selling Via Internet*

Place	*Tasks*
Home	_____
Public Library	_____
Friend's home	_____
Community Center	_____

Other (Please be specific) _____

We created a relevant and unordered list of possible computer tasks that are commonly performed using a computer. We chose to use a large list in order to fully encompass the various tasks that can be performed on a computer without limiting the respondent's choices. The tasks we chose represent the respondent's ability to use a computer in such varied areas as civil participation, entertainment, research, communication, and general computer proficiency. We also left room for the respondent to add any other places they perform computer related tasks that we did not list.

QUESTION 7

Refer to task list in question #6. Please circle all of task that you believe can be performed on a computer

The purpose of this question was to gain a better understanding of the student's technological knowledge. In the previous question we asked which tasks they perform on computers and where. This question asks them which task they believe can be performed on computers, giving us a better idea of their overall knowledge.

QUESTION 8

Do you know what the Internet is? *YES* *NO*

This is yet another question to gain an understanding of the level of technological knowledge that the students posses. We felt that knowledge of the Internet is an important factor when gauging technological awareness.

QUESTION 9

Circle the choice that best describes your view of technological advancements:

Technological Advancements are:

1) *Interesting but not important*
2) *Important but not interesting*
3) *Important and interesting*
4) *Not important and not interesting*

This is the first opinion-oriented question in our survey. This question was intended to gauge how the school students felt about technology in general. We feel that lack of access to technologies may not be the only factor causing a divide. The groups that have lower access to technology may feel that this sort of access is not important to them. We intend to find how these groups view technology as a whole through this question.

QUESTION 10

Technology often gets out of control, and lots of people are hurt directly or indirectly when this happens.

Strongly agree *Agree* *Disagree* *Strongly Disagree* *N/A*

If you agree with the above statement, can you think of an example?

_____

This is the second opinion-oriented question in our survey. The purpose of this question was to get the respondent's thinking about technological issues. Raising a topic about the social implications of technology stimulates technological awareness, which was a goal of ours when designing this study.

QUESTION 11

The benefits and advantages of technology far outweight the costs and disadvantages.

Strongly agree *Agree* *Disagree* *Strongly Disagree* *N/A*

This question was designed with the same goal in mind as Question 10. We felt that in order to stimulate thought about technological awareness in the respondent we should ask another question dealing with this topic.

QUESTION 12-15

12) What is your age?

_ *10-11*

_ *12-13*

_ *13-14*

_ *14-15*

_ *16-17*

_ *18+*

14) What is your gender?

_ *Male*

_ *Female*

13) What is your ethic background?

_ *Caucasian*

_ *Black*

_ *Hispanic*

_ *Asian*

_ *Native American*

_ *Aleut or Native Alaskan*

_ *Other*

15) Select your grade level

_ *7th*

_ *8th*

_ *9th*

_ *10th*

_ *11th*

_ *12th*

These questions are all designed to gain socio-economic demographics of the respondents. Without these statistics it would be impossible to find where a digital divide lies.

APPENDIX F: Residential Survey Rationale

QUESTION 1

Do you have a telephone in your home? *YES* *NO*

The purpose of this question is very straightforward; telephone access is a basic and important informational technology, and an important technological demographic when trying to show a digital divide.

QUESTION 2

If so, how many phone lines do you have? _____

The purpose of this question is the same as the last. The reason we ask how many phone lines the respondent has is to gauge the level of technology they have in their area.

QUESTION 3

Do you have a fax machine? *YES* *NO*

This question is along the same lines as question two, for the reason that it gives us another technological demographics of the respondents. If a respondent owns a fax machine then they have a fairly high level of technology access from their home.

QUESTION 4

Have you ever used a computer before? *YES* *NO*

This is a very straightforward question that is necessary for our study. The purpose of this question is to find out whether or not the respondent has used a computer at any time in their life. This is an appropriate question.

QUESTION 5

Is there a personal computer or laptop in this household? *YES* *NO*

The purpose of this question is to gain an understanding of the level of technology access that the resident has in their home. Finding the level of computer access at home is very important to us if we are to show a digital divide.

QUESTION 6

Have you ever had a computer in your household? *YES* *NO*

We ask this question to cover the portion of the sample population that may have had a computer in their house at one time. If the respondent owned a computer at one time we consider them as having a higher technology access.

QUESTION 7

If so, why do you not have it now? *YES* *NO*

If the respondent owned a computer at one time we wish to find out why they no longer have one. We are interested to see if they no longer own the computer because they feel that it was not an important tool, or there is a circumstance that prevents them from owning one.

QUESTION 8

Do you ever use computers in places other than your house?

The purpose of this question was to gain an understanding of the level of technology access the resident has outside of the home. This directly relates to the level of technology access available in the surrounding community.

QUESTION 9

If so, please say where and for what purpose?

Place	*Task*
Work	_____
Library	_____
Friend's home	_____
Community Center	_____
Other (Please be specific)	_____

We ask this question to determine the proficiency of the residents computer use. We also hope to find out all of the locations in the community that offer technology access.

QUESTION 10

How many computers do you have in your home?

The purpose of this question is to gain an understanding of the level of technology access that the residents have at home. Finding the level of access computer access at home is very important to us if we are to find a digital divide.

QUESTION 11

Are any of them connected to the Internet? *YES* *NO*

This is yet another question to gain an understanding of the level of technological knowledge that the students posses. The Internet can be considered a very large information technology, and we feel that being connected to the Internet is an important factor when gauging technological awareness. If a respondent is connected to the Internet they inherently have a greater access to technology.

QUESTION 12

What task do you perform on your computer? Circle all that apply

Word Processing	*Spreadsheets*	*Games*
E-mail	*Job Searching*	*Educational*
Instant Messaging	*Watch Movies*	*Music Downloading*
Research	*Shopping*	*Selling via Internet*
Community Involvment	*Programming*	*Artistic Creativity*

*Other (please specify)*_____

We created a relevant and unordered list of possible computer tasks that are commonly performed using a computer. We chose to use a large list in order to fully encompass the various tasks that can be performed on a computer without limiting the respondent's

choices. The tasks we chose represent the respondent's ability to use a computer in such varied areas as civil participation, entertainment, research, communication, and general computer proficiency. We also left room for the respondent to add any other places they perform computer related tasks that we did not list.

QUESTION 13

Circle the choice that best describes your view of technological advancements:

Technological Advancements are:

1) *Interesting but not important*
2) *Important but not interesting*
3) *Important and interesting*
4) *Not important and not interesting*

Pease circle the choice that most closely represents how much you agree or disagree with the statement.

This is the first opinion-oriented question in our survey. This question was intended to gauge how the school residents felt about technology in general. We feel that lack of access to technologies may not be the only factor causing a divide. The groups that have lower access to technology may feel that this sort of access is not important to them. We intend to find how these groups view technology as a whole through this question.

QUESTION 14

Technology often gets out of control, and lots of people are hurt directly or indirectly when this happens.

Strongly agree *Agree* *Disagree* *Strongly disagree* *N/A*

If you agree with the above statement, can you think of an example?

This is the second opinion-oriented question in our survey. The purpose of this question was to get the respondent's thinking about technological issues. Raising a topic about the social implications of technology stimulates technological awareness, which was a goal of ours when designing this study.

QUESTION 15

The benefits and advantages of technology far outweigh the costs and disadvantages.

Strongly agree *Agree* *Disagree* *Strongly disagree* *N/A*

This question was designed with the same goal in mind as Question 10. We felt that in order to stimulate thought about technological awareness in the respondent we should ask another question dealing with this topic.

QUESTION 16

What is you age?

_ 16-24

_ 25-34

What is your household income?

_ Under $20K

_ $20K – 40K

_ *35-44*

_ *45-54*

_ *55 or older*

What is your gender?

_ *Male*

_ *Female*

What is your ethnic background?

_ *Caucasian*

_ *Black*

_ *Hispanic*

_ *Asian*

_ *Native American*

_ *Aleut or Native Alaskan*

_ *Other*

What is your occupation?

_ *Proffesional*

_ *Technical*

_ *Admin/Managerial*

_ *$40K – 60K*

_ *$80K – 100K*

_ *$100K or more*

How many children do you have living at home?

_____

If you have children living at home, what local school(s) do they attend?

_ *No school*

_ *College or University:*

_____

_ *High School :*

_____

_ *Middle School*

_____

_ *Elementary School*

_____

Please select description that most closely resembles your household

_ *Single (No Kids)*

_ *Single Mother*

_ *Clerical*

_ *Sales*

_ *Service Worker*

_ *Laborer*

_ *Craftsperson*

_ *Homemaker*

_ *Military*

_ *Full Time Student*

_ *Retired/Not Working*

_ *Single Father*

_ *Married Couple*

_ *Other (specify)*

These questions are all designed to gain socio-economic demographics of the respondents. Without these statistics it would be impossible to find where a digital divide lies.

APPENDIX G: Technology Access and Benefit Survey for Worcester City Residents

1) Do you have a telephone in your home? YES NO

2) If so, how many phone lines do you have? _____

3) Do you have a fax machine? YES NO

4) Have you ever used a computer before? YES NO

5) Is there a personal computer or laptop in this household? YES NO

(If you answered "YES" to #5, skip to question 8)

6) Have you ever had a computer in your household? YES NO

7) If so, why do you not have it now? YES NO

_____

_____

8) Do you ever use computers in places other than your house?

9) If so, please say where and for what purpose?

Place	Task
Work	_____
Library	_____
Friend's home	_____
Community Center	_____
Other (Please be specific)	_____

(If you answered "NO" to #5, skip to question 13)

10) How many computers do you have in your home?

11) Are any of them connected to the Internet? YES NO

12) What task do you perform on your computer? Circle all that apply

Word Processing	Spreadsheets	Games
E-mail	Job Searching	Educational
Instant Messaging	Watch Movies	Music Downloading
Research	Shopping	Selling via Internet
Community Involvement	Programming	Artistic Creativity

Other (please specify)_____

13) Circle the choice that best describes your view of technological advancements:

Technological Advancements are:

1) Interesting but not important
2) Important but not interesting
3) Important and interesting
4) Not important and not interesting

Pease circle the choice that most closely represents how much you agree or disagree with the statement.

14) Technology often gets out of control, and lots of people are hurt directly or indirectly when this happens.

Strongly agree Agree Disagree Strongly disagree N/A

If you agree with the above statement, can you think of an example?

_____

15) The benefits and advantages of technology far outweigh the costs and disadvantages.

Strongly agree Agree Disagree Strongly disagree N/A

16) What is you age?

_ 16-24

_ 25-34

_ 35-44

_ 45-54

_ 55 or older

17) What is your gender?

_ Male

_ Female

18) What is your ethnic background?

_ Caucasian

_ Black

_ Hispanic

_ Asian

_ Native American

_ Aleut or Native Alaskan

21) What is your household income?

_ Under $20K

_ $20K – 40K

_ $40K – 60K

_ $80K – 100K

_ $100K or more

22) How many children do you have living at home?

_____

23) If you have children living at home, what local school(s) do they attend?

_ No school

_ College or University:

_____

_ High School :

_____

_ Other

_ Middle School

_____

_ Elementary School

_____

19) What is your occupation?

_ Proffesional

_ Technical

_ Admin/Managerial

_ Clerical

_ Sales

_ Service Worker

_ Laborer

_ Craftsperson

_ Homemaker

_ Military

_ Full Time Student

_ Retired/Not Working

24) Please select description that most closely resembles your household

_ Single (No Kids)

_ Single Mother

_ Single Father

_ Married Couple

_ Other (specify)

APPENDIX H: Technology Access and Benefit Survey for Students

1) Have you ever used a computer before? YES NO

2) Have you ever used a computer in school? YES NO

3) Do you have a computer at home? YES NO

If so, how many? (circle one) 1 2 3 4 5

4) If so, what kinds of tasks do you perform on the school computers? (Choose all that apply for every class/subject)

a) Word Processing
b) Internet Chat
c) E-mail
d) Instant Messaging
e) Encyclopedia Software
f) Internet Research
g) Programming
h) Spreadsheets
i) Writing Reports
j) Games
k) Music Downloading
l) Create Presentations
m) News/Current Events
n) Artistic Creations

	CLASS	TASK (Please include other tasks)
Example:	*History Class*	*a, c, e, f, i, Software on Civil War*
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____

5) Do you ever use computers in places other than school? YES NO

6) If so, please say where and for what purpose?

(Choose all that apply)

a) Word Processing	k) Spreadsheets
b) Internet Chat	l) Writing Reports
c) Email	m) Games
d) Instant Messaging	n) Music Downloading
e) Encyclopedia Software	o) Create Presentations
f) Internet Research	p) News/Current Events
g) Programming	q) Artistic Creations
h) Community Involvement	r) Job Searching
i) Watch Movies	s) Order Groceries
j) Furthering Education	t) Selling Via Internet

Place	Tasks
Home	_____
Public Library	_____
Friend's home	_____
Community Center	_____
Other (Please be specific)	_____

7) Refer to task list in question #6. Please circle all of task that you believe can be performed on a computer

8) Do you know what the Internet is? YES NO

9) Circle the choice that best describes your view of technological advancements:

Technological Advancements are:

1) Interesting but not important
2) Important but not interesting
3) Important and interesting
4) Not important and not interesting

10) Technology often gets out of control, and lots of people are hurt directly or indirectly when this happens.

Strongly agree Agree Disagree Strongly Disagree N/A

If you agree with the above statement, can you think of an example?

_____

11) The benefits and advantages of technology far outweight the costs and disadvantages.

Strongly agree Agree Disagree Strongly Disagree N/A

12) What is your age?

_ 10-11
_ 12-13
_ 13-14
_ 14-15
_ 16-17
_ 18+

14) What is your gender?

_ Male
_ Female

13) What is your ethic background?

_ Caucasian

15) Select your grade level

_ 7th

_ Black

_ Hispanic

_ Asian

_ Native American

_ Aleut or Native Alaskan

_ Other

_ 8th

_ 9th

_ 10th

_ 11th

_ 12th