A PROFILE OF STUDENTS WHO DISPLAY EXCEPTIONAL TALENT IN COMPUTER TECHNOLOGY

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The focus of this study was to identify certain characteristics and behaviors unique to students who exhibit exceptional skills in computer technology. Five public schools in Western Pennsylvania were chosen to participate in this study. Within each school, the building principals were asked to identify a focus group of teachers who were likely to be able to discuss with the researcher certain characteristics exhibited by computer talented students. In addition, the technology coordinator from each school was interviewed by the researcher. The data revealed common characteristics that can be attributed to this unique group of students. Implications for policy and practice include the following: These students tend to be good problem solvers and possess divergent thinking skills. They enjoy helping their teachers and fellow students who are having difficulties with computer technology. Their talent is first observed sometime between the second semester of their eighth grade year and their ninth grade year similar to mathematical or athletic talent which also gets noticed during this time period. They tend to prefer to work independently on formal classroom assignments with little or no direction from the teacher. They especially enjoy playing higher order thinking games when using computers in an educational setting. Finally, where some schools create an environment which fosters talent in athletics or music, implications for policy and practice suggest that schools could create an environment which fosters computer talent.

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PREFACE

To my wife Carolyn and my two daughters, Jamie Lynn and Cara Marie.

1.0 REVIEW OF THE LITERATURE

1.1 INTRODUCTION

The study of educating the gifted and talented in the United States requires an in depth examination of the many concepts and definitions contained in the literature on this subject. A review of the literature included an examination of the nature of giftedness as it has evolved in the public school system from the late 19th century to the present. From the review of the literature, a case was made that there is an unidentified subset of gifted and talented students who exist in today's public schools who display an exceptional talent in computer technology usage. In the 1980's, Gardner initially identified seven categories of intelligences and subsequently an eighth category of intelligence. The categories he identified are linguistic intelligence, logical mathematical intelligence, spatial intelligence, kinesthetic intelligence, interpersonal and intrapersonal intelligence, and naturalist intelligence. Presently, his theory on multiple intelligences is generally accepted by researchers in the field of giftedness, and a discussion of his theory is included in the review of the literature. However, since the 1980's access to computers, the internet and other digital technologies in schools and homes has dramatically increased. During the 1990's, this increase continued. Grunwald Associates (as cited in Revenaugh, 2000, ¶ 12) reported that in the United States, "recent statistics show that almost two-thirds of all family households have home computers, and that 46 percent of those

households are connected to the internet. More than 17 percent of children currently have online access from home, with the number expected to almost double within the next five years." In addition, the National Telecommunication and Information Administration (as cited in Revenaugh, 2000,) stated that "from 1997 to 1998 home-internet access increased 53 percent for white households, 52 percent for African American households, and 48 percent for Hispanic households" (¶ 12). Furthermore, Bialo and Sivin-Kachala (1996) found a significant increase in the number of computers in schools over the past 25 years. They reported that:

> Throughout the 1980's, the United States experienced dramatic growth in the use of computer-based technology for instruction. The U.S. Office of Technology Assessment reported that the percentage of schools with one or more computers grew from approximately 18 percent in 1981 to 95 percent in 1987. The Software Publishers Association estimated that as of December 1994 more than 18.1 million computers had been installed in various types of educational institutions in the United States, including 6.2 million units in the nation's more than 109,000 public and private K-12 schools (¶ 1).

Because of this dramatic increase in availability to computer technology in today's society, the majority of students now have access to computers throughout the course of their day. Furthermore, Siegle (2005) found that "technologies that seemed miraculous 5 years ago are commonplace today" (¶ 1). Within the general population of America's schools, there exists a group of students who can be identified as computer talented. O'Brien, Friedman-Nimz, Lacey and Denson (2005), explored the possibility that "patterns of formative experiences, cognitive abilities, and personality characteristics that could be labeled as computer technology talent" could be found in certain students (¶ 2). The literature suggested that there are various programs available to, and used by, gifted students today in a vocational-technical setting as well as their regular educational setting. Vocational-technical education has been undergoing significant changes in order to meet the increased demand by businesses for computer literate graduates who

are ready to enter the workforce. Evidence of this can be found in the literature examining trends in vocational-technical education in recent years. Levesque and Hudson (2003) reported that "computer technology and communications technology generally exhibited increases in both breadth and depth of course-taking over the period studied" (p. viii). In addition, McQuay (2002), found that "vocational–technical education uses more and higher technology" (p. 4). Furthermore, McQuay (2000) also reported that "vocational-technical education uses cyberspace as a resource" (p. 4). However, in the majority of public schools today, O'Brien et al. (2005) found that "technology use tends to be applied to another subject area like science or communications and is not considered as its own talent area" (Section on classroom application, ¶ 1). Failure of schools to identify and provide challenging programs that focus on computer technology talent is beginning to produce some adverse effects on the nation's economy. Businesses involved with computer technology are struggling to find skilled people to fill jobs. Some of these positions require advanced knowledge in the field of information technology. Evidence of this lack of highly skilled labor in the United States can be found in the Government's decision to lessen the restrictions on Visas and Green Cards enabling workers from around the world to fill these much needed highly skilled jobs. The review of the literature will examine several areas related to computer technology for the gifted and talented students.

In summary, first, the review of the literature presents an outline of a brief history of intelligence testing and education of the gifted and talented in America in order to gain better insight into the evolution of programs and services available to the gifted and talented. Second, a discussion of the various definitions on giftedness and talent was included in the review of the literature. These definitions were drawn form some of the prominent researchers in the field of gifted education which included Terman, Gallagher, Renzulli and Gardner. Their definitions

were examined along with the United States Department of Education's and the State of Pennsylvania's definitions of giftedness. Third, the various types of accelerative programs were reviewed to illustrate what schools may be implementing for students who display an exceptional talent in computer technology. Fourth, the relationship between computer technology and the gifted and talented was also reviewed. Finally, the conceptual framework based on the evidence from this review was presented.

1.2 HISTORY OF INTELLIGENCE TESTING AND GIFTEDNESS IN THE UNITED STATES

An examination of the history of intelligence testing and giftedness indicates that the two are inextricably linked throughout much of the 20th century. Karnes and Nugent (2002) reported that a "history of gifted education is rich with events and people who have influenced the field for centuries" (¶ 1). However, in this study, the primary focus remained on the major events that developed during the course of the 20th century.

Before the advent of compulsory schooling in the United States, the single room schoolhouse provided educational services to the majority of the nation's student population. Although in some respects limited, Colangelo, Assouline and Gross (2004), stated that "the one-room schoolhouse let students learn at their own pace. Teachers knew their students well and nothing held back a student's progress" (p. 11). As the nation's industrial capabilities increased, the demand for labor produced an unprecedented massive influx of immigrants into the country's major cities. Accordingly, as the nation's population increased, Colangelo, Assouline and Gross (2004), found that "America's culture became more collective and standardized, one-room

schoolhouses were replaced by schools that grouped students according to age instead of by ability and motivation" (p. 11). However, several programs were initiated by public school systems to provide educational opportunities to the gifted and talented prior to and during the early part of the 20th century.

"In 1870, St. Louis initiated tracking, allowing some students to complete the first eight grades in less than eight years" (Colangelo & Davis, 1997, p. 5). As the 20th century dawned, gifted education programs had expanded into a majority of the nation's cities. "About 1900, some rapid progress classes telescoped three years of school work into two" (Colangelo & Davis, 1997, p. 5). Colangelo and Davis (1997) discovered that "in 1901, Worcester, Massachusetts, opened the first special school for gifted children" (p. 5). Eventually, other cities across the nation began to follow suit by adding programs for their gifted populations. "In 1916, special classes for gifted children were created in Los Angeles and Cincinnati; Urbania, Illinois, followed in 1919, and Manhattan and Cleveland in 1922" (Colangelo & Davis, 1997, p. 5). Subsequently, by 1920, "approximately two-thirds of all major U.S. cities had some type of educational programming for gifted students" (Colangelo and Davis, 1997, p. 6).

Approximately the same time, a pivotal development in the history of education occurred. In 1905, French psychologist, Alfred Binet, was charged with developing a test to identify mentally retarded school children. Later, he and Theodore Simon "solved this problem by determining specific age levels ordinary children complete certain tasks, such as tying a shoelace or telling the cardinal point of the compass" (Gowan, 1977, p. 10). From these tasks, they could determine a child's mental age, "a concept introduced three years later by Binet and Simon (1908) in their revised scale" (Gowan, 1977, p. 11). Furthermore, Gowan (1977) stated that "this breakthrough advance in developmental psychology was hailed around the world. Some

like Henry H. Goddard were willing merely to translate the scale into English and use it for testing many children" (p. 11).

By the 1920's, public school systems had come to rely almost exclusively on intelligence test scores to determine which students were eligible to participate in special programs for the gifted. Eventually, negative trends began to develop, and testing methods began to be called into question with regards to children of color, poverty or those who lacked adequate knowledge of the English language. Ackerman (1995) found that:

> Historians have described how school systems quickly adopted intelligence testing in the 1920's in order to facilitate the establishment of tracking systems, and how the elitist, racialist, and hereditarian beliefs of the founders of the testing profession-H.H. Goddard, Lewis Terman, Robert Yerkes, and Carl Brigham-provided legitimacy to the under representation of immigrants, blacks, and the poor in the upper tracks. They have also pointed out that a number of Americans were quick to attack the views of the testers and to charge that intelligence testing unjustifiably discriminated against minority and lower-class children. (p. 279)

Fortunately, this narrow approach to identifying the gifted did not persist as American educational practices progressed during the inter-war years. Researchers began to call into question the earlier theories on intelligence and intelligence testing. According to Ackerman (1995) during the 1930's, "Thurstone challenged the view that human cognitive ability consisted of a single entity called general intelligence" (p. 289). In addition to this, applied psychologists began to see the need to develop aptitude tests that could determine specific areas of ability in science, law, the arts, music etc. Educators quickly embraced the idea of a multi-varied approach to intelligence testing instead of the notion of a single general intellectual ability. Subsequently, Ackerman (1995) argued instead that "human intelligence actually consisted of seven or eight separate primary mental abilities and he developed tests to measure each of these" (p. 289). By the end of the decade, Lindquist had developed the Iowa Tests of Basic Skills and

Educational Development which became widely used by schools. "By the beginning of World War II, many psychologists and educators had abandoned the belief that mental capacity could be evaluated on a single scale; a much more complex and varied picture of human capacity had been formed" (Ackerman, 1995, p. 289). During the 1930's, the economy continued to industrialize at a rapid pace. As such, many Americans began to realize the importance of a college education as a means to improve one's position in life. However, with the onset of the Great Depression, this goal became unattainable for many. "Although eventually compulsory schooling became available to all children, availability of secondary and postsecondary education was initially based upon not only academic prowess, but also the ability to pay for such services" (Karnes & Nugent, 2002, ¶ 2). In addition, Ackerman (1995) found that "although public institutions, which generally accepted all high school graduates, expanded rapidly in these decades, the rising costs of attending college, particularly in the wake of the depression, prevented many young people from attending" (p. 280). As a result, by 1940, "only 15.6 percent of college-age youth were attending institutions of higher learning" (Ackerman, 1995, pp. 280-281).

However slow the progress, substantial changes continued to occur in testing and educating the gifted from all social classes during and after World War II. Ackerman (1995) found that:

> In the 1940's and 1950's educators maintained that mental tests could further the schooling of lower-class children. First, advocates of equal educational opportunity argued that a meritocratic testing program could help reverse the harmful consequences of racial, ethnic, and class-biased discrimination. In addition, educators who favored the expansion of higher education maintained that enrollments could be increased by drawing upon previously untapped talent with the aid of newly developed measures of ability and aptitude (p. 280).

In addition, advocacy groups began to organize shortly after the war to promote gifted education. Karnes and Nugent (2002) reported that the "positive effects of advocacy groups" was among the top ten significant events in gifted education during the 20th century (¶ 6). Historically, these groups began to organize shortly after World War II. Karnes and Nugent (2002) found that:

> Professionals and parents formed interest groups, such as the 1947 establishment of the American Association for the Gifted. In 1953, the National Association for the Gifted was founded. The Association for the Gifted began in 1959 under the umbrella of The Council for Exceptional Children (¶ 4).

Similarly, Roberts (2007) reported that "the establishment of national and state organizations in gifted education has been very important in the development of support and advocacy for addressing the needs of children and youth who are gifted and talented" (¶ 4).

There were two other significant events during the 1950's that influenced and advanced the cause of gifted education. First, the Ford Foundation "established the College Board Advanced Placement Program (AP), which allows colleges and universities to offer credit and advanced standing to high-school students" (Colangelo, Assouline, & Gross, 2004, p. 12). Second, "the academically talented child was seen as the savior of the society, as the Cold War and Sputnik defined being competitive with the Soviet Union as necessary to the survival of the United States" (Piirto, 1999, p. 51). Likewise, Roberts (2007) stated that "the launching of Sputnik I shook the confidence of the public in the United States, making it obvious that the Soviet Union was ahead in science and technology" (¶ 3). Subsequently, he found that "during crisis, gifted individuals are considered a valuable resource to be developed to the highest level" (Roberts, 2007, ¶ 3).

In conclusion, Karnes and Nugent (2002) found that "the field continues to be influenced by persons from the areas of psychology, college and university professors, government officials, and professionals in education" (Conclusion section, ¶12). As such, many definitions have been formulated by influential people in the field. Among these are the work of Terman, Gallagher, Renzulli, and Gardner. An examination of their definitions of giftedness follows.

1.3 DEFINITIONS OF GIFTEDNESS

1.3.1 Terman

Earlier studies on intelligence precede Terman; however, for the purpose of this study, his work will be reviewed because it provides the first comprehensive longitudinal study on intelligence and will serve as a sufficient starting point for understanding subsequent studies discussed in this review.

Early in the 20th century, Terman expanded the work of Binet and Simon who discovered "a method of measuring intellectual developmental progress in all children, not just the feebleminded; hence the scale could be modified to all children and particularly adapted for the measurement of gifted children"(Gowan, 1977, p. 11). Multiplying an individual's intellectual age with respect to his chronological age by 100, he established what we commonly refer to today as the intelligence quotient or IQ. At the time, "the phrase quickly passed into the vernacular and became one of the most popular psychological inventions ever made" (Gowan, 1977, p. 11). Afterward, he focused solely on the study of the principles of intelligence and

genius. His foremost accomplishment in this field is his groundbreaking work, *Genetic Studies of Genius, 1922-1972*.

General opinion at the time Terman began to study the nature of giftedness held that gifted children "were more prone than the average to insanity, were weaker physically, undersized, unduly specialized or one-sided in their abilities, and without play interests normal for their age" (Sears, 1979, p. 75). To debunk this myth, Terman selected 1,000 gifted children and attempted to measure their social, intellectual, and physical characteristics. Taking the results of this study, he compared them to children who were not identified as gifted. It should be noted however, that this study was limited in that the initial sample was not selected randomly. All the children were from California and from urban areas. However, "by 1928, he had added another 528 cases to the gifted group; and with a series of tests, questionnaires, and interviews over the succeeding decades, he created a truly life-cycle study of human development" (Sears, 1979, p. 77). In 1925, the first volume was published. Subsequently, the study continued after his death in 1956 and will conclude sometime in the early 21st century until the last of the original children are expected to expire.

To summarize, Oden, Stanley and Terman (as cited in Gowan, 1977) found the following general characteristics among his gifted population:

1. The gifted are not homogeneous, but differ among themselves in many ways (III, p. 472). Considerable stability of IQ is one of the few commonalities (III, p. 425).
2. The stereotypes that the gifted child is either puny, asocial, or pre-psychotic or that high intelligence is akin to insanity were discounted by the facts (I, chaps. 6, 8, 9, 16; IV, chaps. 3, 4, 9, 10).
3. The best way to identify the most intelligent child in a class was not to ask the teacher, but to consult the record book for the youngest (I, p. 33). (Stanley, 1974)
4. The superiority in intelligence is maintained. (V, p. 144).
5. Acceleration at all levels is beneficial (I pp. 285, 629; IV, pp. 281; Oden 1968, p. 90).

6. Gifted students who did not attend college had the same intellectual level as Ph.D candidates (V, p. 144).
7. Research on the difference within the gifted group between the most and the least successful men showed that socioeconomic status (SES) and college education of the father were the major factors, as well as force of character of the gifted person himself (IV, pp. 311-51, especially p. 352; (Oden, 1968), pp. 62, 70, 72, 77).
8. Mental age of the gifted group continues to increase through middle age (V, p. 157), especially as shown by Part I scores on the Concept Mastery Test.
9. The mean IQ of the children of the Terman group was 132.7 (IV, p. 238; V, p. 141)
10. There were several times as many very high IQ persons (over 150) in the Terman group as is predicted by the normal curve of probability (I, p. 633).
11. Males exceeded females in the general sample 116/100; in the high school sample by 212/100 (III, p. 471) (pp. 13-14).

Terman's early work on the study of giftedness emphasized the importance of longitudinal study in this area. However, further analysis suggested that he provided a narrow and somewhat conservative definition of giftedness. His definition primarily emphasized the genetic factor when identifying the gifted. Furthermore, the fact that the early sample is non-random and includes only the top one percent of the population further supports this opinion. In summary, Gowan (1977) reported that:

> Again with the advantage of hindsight, the major mistakes or omissions which were made were as follows: (a) the consideration of intelligence as one-dimensional; (b) the lack of control of the socioeconomic state (SES) factor; (c) the neglect of creativity; (d) the lack of explicit guiding hypotheses; and (e) the failure to investigate, control, or balance the ethnic aspects. Admittedly, this is holding up a harsh standard, since most of these matters were not fully explicated at the time of the inception of the study (p. 15).

Nevertheless, Terman laid the groundwork for additional comprehensive research into the study of giftedness. For the sake of this study, three other definitions of giftedness by prominent researchers in the field of gifted education will be reviewed. Gallagher examined

giftedness through a study of accumulated knowledge passed on from one generation to the next which begins with a discussion on Terman's research.

1.3.2 Gallagher

Gallagher's definition of giftedness can best be discussed by examining the history of accumulated knowledge that one generation passes on to another. However, as this knowledge is accumulated and passed on, he found that "along with the hard-won wisdom that comes from experience and the progressive accumulation of knowledge, collections of misinformation and misjudgments that can only be explained by understanding the temper and biases of the times are also passed" (Gallagher, 1979, p. 28). According to Gallagher, in the past, these misjudgments have led to the practice by schools of using only a single intelligence test score when identifying gifted students. Furthermore, he argued that Terman's early research on giftedness is too narrow in its approach to identifying and understanding this complex phenomenon. According to Gallagher, Terman and other earlier researchers assumed that giftedness was "entirely created by genetic forces" (Gallagher, 1979, p. 28). Terman's research failed to take into consideration the impact of environmental forces that also influence intelligence. Furthermore, Gallagher (1979) stated that "a single intelligence test score was usually considered sufficient to define giftedness, thus implying that we did not expect major changes or modifications in measured ability in the child as a result of environmental intervention, except in the most seriously deprived situations" (p. 28). This narrow approach to defining giftedness eventually produced results which became inconsistent as research in child development progressed. For example, significant differences soon became apparent in the number of children identified as gifted with regards to race and ethnicity. Gallagher (1979) found that "the acceptance of the purely genetic nature of

intelligence led to some embarrassing and troubling results, such as the consistent racial and ethnic differences found in the proportions of children testing as gifted. Such results were not widely quoted or displayed, although there have been clear and consistent findings on the question. (p.29)

As more and more research was conducted in the area of giftedness, the findings suggested that the relationship between genetic and environmental factors could not be so easily explained. Gallagher (1979) stated that "studies in child development suggest there is a subtle and complex interaction between environment and native ability, the result of which is what is measured by a score on an intelligence test." (p. 26). However, Gallagher assumed that the implications from studies conducted into this field need to continue to assist educators in identifying and providing appropriate educational opportunities for gifted students. Additional steps need to be taken in order to develop a multi-faceted approach in identifying the gifted. Gallagher's position held that many educators still fail to grasp the concept that "we can create giftedness through designing enriched environments and opportunities, or that we can destroy it by failing to create those environments and opportunities" (Gallagher, 1979, p. 29).

Like Gallagher, other researchers in this field, such as Getzels and Jackson who conducted studies on giftedness and creativity further supported the need for a broader definition of giftedness. Additionally, Torrance attempted to identify distinctive characteristics in creative children. These studies along with others led to new efforts by researchers to begin to move away from the intelligence-test only approach "to think of other dimensions that should be included in a general definition of giftedness"(Gallagher, 1979, p. 30). In a report to Congress, Marland (as cited in Gallagher, 1979) reported on the education of the gifted in America's schools. In addition to the concept giftedness, he also included the concept of talent which

schools could interpret as an extension of giftedness. There was now a broader definition of giftedness and talent which stated that:

> Gifted children and talented children are those identified by professionally qualified persons [and] who by virtue of outstanding abilities are capable of high performance. These are children who require differentiated educational programs and services beyond those normally provided by the regular school program in order to realize their contribution to self and society.
>
> Children capable of high performance include those with demonstrated achievement and/or potential ability in any of the following areas: (a) general intellectual ability, (b) specific academic aptitude, (c) creative or productive thinking, (d) leadership ability, e) visual and performing arts, (f) psychomotor ability. (p. 30).

However, further analysis of this broader definition now challenged educators to answer several compelling questions. What characteristics define leadership ability? Which define psychomotor ability? What are the characteristics that define creative or productive thinking? In the rush to broaden the concept of giftedness to include more areas of ability, Gallagher stated that "there is now some suspicion that in our eagerness to specify these new dimensions we may have overestimated their separateness from high intellectual ability" (p. 31).

Gallagher addressed these issues by pointing out that there is an inherent problem in education when attempting to define any new concept. Furthermore, he argued that "scientists know that the definition of a concept is not the first thing to be completed, but quite literally the last" (Gallagher, 1979, p. 31). He found that this problem is symptomatic, as research uncovers new findings. The "misinformation" and "misjudgments," noted by Gallagher previously in this section occur as a result of the accumulation and the passing on of knowledge from one generation to the next. In conclusion, Gallagher (1979) found that:

> We will not have a better definition until we find out more than we now know about the questions posed above. The inadequacies of the definition are merely symptoms pointing to our incomplete knowledge about the relevant concepts. If we are to pass along a more coherent statement to the next generation, then we will need not only better rhetoric but more sustained research and development as well (p. 31).

The complexity of defining, identifying, and educating the gifted can be better understood from analyzing additional studies from other prominent researchers in the area of giftedness. A discussion of the work of Renzulli follows.

1.3.3 Renzulli

As a scholar-researcher in the field of gifted education, Renzulli challenged schools to provide adequate programs that would promote both the process aspect of education as well as the content aspect. Because many schools fail to incorporate both into classroom pedagogy, they experience failure in providing an appropriate gifted education for those students identified as gifted. According to Renzulli (2005) "the achilles heel of gifted education has been its inability to adequately include children who do not fall into the nice, neat stereotype of good test takers and lesson learners-ethnic minorities, underachievers, children who live in poverty, and young people who show their potential in nontraditional ways" (p. 80). Like Gallager, he called on educators to continue to provide appropriate opportunities for meeting the needs of the gifted. His research led him to focus on the process of "how subsequent opportunities, resources, and encouragement can be provided to support continuous escalations of student involvement in both required and self-selected activities" (Renzulli, 2005, p. 81). Similar to previous researchers, including Terman, he agreed with the notion that there is an inherent historical problem in defining giftedness because of the complexity of this phenomenon. However, he has determined

that “two broad categories of giftedness that have been dealt with in research literature: schoolhouse giftedness and creative-productive giftedness” need to be brought to the forefront in the education of the gifted” (Renzulli & Reis, 2000, p. 369).

According to Renzulli and Reis (2000) “schoolhouse giftedness might also be called test-taking or lesson-learning giftedness. It is the kind most easily measured by IQ or other cognitive ability tests, and for this reason it is also the type most often used for selecting students for entrance into special programs” (p. 369). Accordingly, schools should make every possible adaptation and accommodation in addressing those students who perform well on standardized tests of cognitive abilities. Various methods of acceleration incorporated by schools in gifted programs will be discussed later in this review. However, schoolhouse giftedness does not account for the total population of students who may fall into the category of gifted.

Creative-productive giftedness may account for a significant number of students who meet the criteria for gifted programs. According to Renzulli and Reis (2000):

> Creative-productive giftedness describes those aspects of human activity and involvement in which a premium is placed on the development of original material and products that are purposefully designed to have an impact on one or more target audiences. Learning situations that are designed to promote creative-productive giftedness emphasize the use and application of information (content) and thinking skills (process) in an integrated, inductive, and real problem-oriented manner. The role of the student is transformed from that of a learner of prescribed lessons to one in which she or he uses the *modus operandi* of a firsthand inquirer. This approach is quite different from the development of lesson-learning giftedness, which tends to emphasize deductive learning, structured training in the development of thinking processes, and the acquisition, storage, and retrieval of information. (p. 370)

Furthermore, Renzulli and Reis (2000) challenged educators to recognize that both types of giftedness are important. They also emphasized that “there is usually interaction between the two types” (p. 369). Most importantly, however, schools should implement gifted programs

which "make appropriate provisions for encouraging both types of giftedness as well as the numerous occasions when the two types interact with each other" (Renzulli & Reis, 2000, p. 369). In order to accomplish this task, Renzulli developed a plan which he calls the Schoolwide Enrichment Model.

Renzulli (2005) stated that since "most efforts to make major changes in schooling have failed" he developed a model to assist schools in making appropriate changes in order to provide an enriched educational experience for all students (p.83).

According to Renzulli (2005):

> The Schoolwide Enrichment Model is a systemic set of specific strategies for increasing student effort, enjoyment, and performance, and for integrating a broad range of advanced-level learning experiences and higher order thinking skills into any curricular area, course of study, or pattern of school organization. The Schoolwide Enrichment Model is based on the broadened conception of giftedness discussed earlier. This definition focuses on the many kinds of aptitudes, talents, and potentials for advanced learning and creative productivity that exist in all school populations. (p. 82)

In this model, emphasis is placed on providing all students the opportunity "to achieve his or her maximum potential" (Renzulli, 2005, p. 82). Furthermore, Renzulli (2005) argued that it is not imperative that schools determine who is gifted and who is not, but "in the Schoolwide Enrichment Model, the language of the model is that of *labeling the services, not the student*" (p. 82-83). In addition, the Model is a compilation of a shared vision among researchers in the field of education and has been "embraced by thousand of teachers, school counselors and administrators" (Renzulli, 2005, p. 83). According to Renzulli (2005):

> This vision of schools for talent development is based on the belief that everyone has an important role to play in societal improvement, and that everyone's role can be enhanced if we provide all students with opportunities, resources, and encouragement to aspire to the highest level of talent development humanly possible. Rewarding lives are a function of ways we use individual potentials in

> productive ways. Accordingly, the Schoolwide Enrichment Model is a practical plan for making our vision of schools for talent development a reality. (p. 84)

In this era of state standards, accountability, and the use of standardized tests as the primary indicator in determining academic achievement, Renzulli (2005) had challenged everyone involved in education "to view schools as places that go beyond the acquisition of information that will make us look good on tests-schools are places for developing the talents of all students" (p. 88).

Gardner's work on multiple intelligences challenged the whole idea of IQ as a sole measure of intelligence. A discussion on his groundbreaking theory on multiple intelligences follows.

1.3.4 Gardner

In 1985, Gardner's work on multiple intelligences, "*Frames of Mind* "sparked a revolution of sorts in classrooms around the world, a mutiny against the notion that human beings have a single, fixed intelligence" (Checkley, 1997, ¶ 1). Like Renzulli, Gardner held to the belief that schools should focus on talent development of the child while encouraging full development of the child. To accomplish this, schools must make fundamental changes in the way they teach students. However, he is quick to point out that "the introduction of new ideas in education has predictable consequences. When educators first hear about cooperative learning or performance based assessment or reciprocal teaching, their curiosity is touched with confusion. Is there anything really new here? Will it take time-particularly time that I don't have? What's in it for the kids, and for me? Not another fad, please" (Gardner, 1997, p. 20). However, an

understanding of the theory of multiple intelligences (MI) gives practitioners a partner to improve learning.

In the early 1980's, Gardner defined seven categories of intelligence. Recently, he has identified an eighth area of intelligence. The first of these is linguistic intelligence, the ability to use language, either native or foreign, to communicate with other people. Individuals who possess high linguistic intelligence include poets, writers, lawyers, orators etc. Logical mathematical intelligence includes working with and understanding numerical quantities and operations such as the work mathematicians perform. "Spatial intelligence refers to the ability to represent the spatial world internally in your mind-the way a sailor or airplane pilot navigates the large spatial world, or the way a chess player or sculptor represents a more circumscribed spatial world" (Checkley, 1997, Section on the Intelligences, ¶ 30). Athletes and performing artists, such as ballet dancers, possess a high degree of bodily kinesthetic intelligence. "Musical intelligence is the capacity to think in music, to be able to hear patterns, recognize them, remember them, and perhaps manipulate them" (Checkley, Section on the Intelligences, ¶ 5). Teachers, salespeople, doctors etc, display the ability to understand other people. Gardner referred to this capacity as interpersonal intelligence; however, "intrapersonal intelligence refers to having an understanding of yourself, of knowing who you are, what you can do, what you want to do, how you react to things, which things to avoid, and which things to gravitate towards" (Checkley, 1997, Section on the Intelligences, ¶ 7). Recently, Gardner has identified naturalist intelligence which he described as the "human ability to discriminate among living things (plants, animals) as well as sensitivity to other features of the natural world (clouds, rock configurations)" (Checkley, 1997, Section on the Intelligences, ¶ 8).

Gardner argued against the popular notion that "the standard view of intelligence is that intelligence is something you are born with; you have only a certain amount of it; you cannot do much about how much of that intelligence you have; and tests exist that can tell you how smart you are" (Checkley, 1997, Section on the Intelligences, ¶ 9). Gardner challenged this view by asserting that all humans possess certain amounts of the eight intelligences. However, some individuals possess greater amounts of a particular intelligence. This accounts for different intellectual ability levels from one individual to the next. He found that:

> Rather than one or two intelligences, all human beings have several (eight) intelligences. What makes life interesting, however, is that we don't have the same strength in each intelligence area, and we don't have the same amalgam of intelligences. Just as we look different from one another and have different kinds of personalities, we also have different kinds of minds. (Checkley, 1997, Section on the Intelligences, ¶ 9)

Most importantly, the theory of Multiple Intelligences (MI) challenged educators to rethink the ways in which they teach students. "The premise has very serious educational implications. If we treat everybody as if they are the same, we're catering to one profile of intelligence, the language-logic profile. It's great if you have that profile, but it's not great for the vast majority of human beings who do not have that particular profile of intelligence." (Checkley, 1997, Section on the intelligences, ¶ 11).

Blythe and Gardner (1990) have developed several alternatives to traditional educational practices. First, they argue that "it is important for education to address other human abilities and talents besides the linguistic and logical-mathematical intelligences which have long been the primary focus of most schools" (p. 33). Second, they called on schools to enhance the learning environment. They reported that "one cannot develop musical intelligence by talking and writing about music. Sustained hands-on practice with the procedures, materials, and

problems of such a domain are crucial to achieving deep knowledge within it. Thus, MI theory places an emphasis on learning in context, particularly via apprenticeships." (Blythe & Gardner, 1990, pp. 33-34). Third, Blythe and Gardner (1990), challenged "the viability of standardized machine-scored, multiple-choice assessments, which by their very nature appraise students' knowledge through the filter of the linguistic and logical-mathematical intelligences" (p. 34). Accordingly, educators need to test to all intelligences. Fourth, MI theory "calls into question the prevailing policy of educating all students in the same subjects with the same methods and materials" (Blythe & Gardner, 1990, p. 34). Teachers need to focus on the student as an individual learner with specific capabilities and adjust pedagogical practices accordingly. For example, Blythe and Gardner (1990) suggested the following:

> To students with high degrees of spatial intelligence, for example, the history of an era might best be introduced through art, architecture, and/or geography. For students with high interpersonal or linguistic intelligences, biographies and dramatic reenactments might prove better vehicles. (p. 34)

Furthermore, other proponents of Gardner's theory see the need for schools to develop a more authentic system of student assessment. Brualdi (1996) stated that:

> Schools have often sought to help students develop a sense of accomplishment and self-confidence. Gardner's theory of Multiple Intelligences provides a theoretical foundation for recognizing the different abilities and talents of students. This theory acknowledges that while all students may not be verbally or mathematically gifted, children may have an expertise in other areas, such as music, spatial relations, or interpersonal knowledge. Approaching and assessing learning in this manner allows a wider range of students to successfully participate in classroom learning. (Conclusion section, ¶ 1)

After reviewing the works of the various researchers and experts in the field of gifted education, Pennsylvania's guidelines and regulations for its public school systems to use when planning and implementing gifted programs is discussed. From the works of Termin, Gallagher,

Renzulli and Gardener, identifying the gifted has evolved from the use of a single intelligence test score to using multiple criteria. In addition, the concept of talent is now an extension of giftedness has now become accepted in education. The state of Pennsylvania and the federal government based their guidelines on the work of these and other researchers. Close examination of the state's guidelines reveals a general adherence to the current research available. However, the state's guidelines, as well as the U.S Department of Education's guidelines, offer a more narrow definition of talent and giftedness while allowing schools the use of multiple criteria to identify the gifted and talented.

1.3.5 Pennsylvania Department of Education gifted guidelines

Under 22 Pa. Code Chapter 16, outlined in the Pennsylvania Department of Education (PDE) Gifted Guidelines (2004), Pennsylvania's public schools are mandated to implement procedures and programs which provide educational programs for its gifted population. The Pennsylvania Department of Education has adopted a set of principles designed to assist school districts in planning and implementing gifted programs. The major guidelines concerning schools are as follows:

1. The local school district is primarily responsible for identifying all exceptional children and developing educational programs to meet their needs. (24 P.S. §13-1371).
2. Appropriate specially designed instruction should be based on the gifted student's needs and abilities. (22 Pa. Code §16.41 (b)(1)).
3. The Gifted Individualized Educational Program (GIEP) should be based on information obtained from formal and informal comprehensive needs assessments, including input from parents. (22 Pa. Code §16.22 and §16.32).
4. The placement of a gifted student should ensure that the student is able to benefit meaningfully from the rate, level and manner of instruction. (22 Pa. Code §16.41).

5. The placement of a gifted student should provide learning opportunities that go beyond the program the student would receive as part of regular education. (22 Pa. Code §16.41).
6. Gifted education programming must be an integral part of the instructional school day.
7. Gifted students benefit from being grouped with their intellectual peers for a significant part of their instructional day. (Pa. Department of Education Gifted Guidelines, 2004, pp. 3-4).

Along with these guidelines, PDE has also adopted a definition for the mentally gifted. As the research suggested, the state has allowed the use of an IQ score but has also identified categories of multiple criteria in its guidelines. Although this definition recognized IQ scores as an important factor in identifying gifted students, it allowed schools to use multiple criteria in the identification process. According to PDE, the definition of the Mentally Gifted is as follows: "Mentally gifted is defined as outstanding intellectual and creative ability the development of which requires specially designed programs or support services, or both, not ordinarily provided in the regular education program" (22 Pa. Code §16.1, 2004, p. 6). In addition, the state has established an IQ score of 130 as a benchmark in determining gifted ability. "The term 'mentally gifted' includes a person who has an IQ of 130 or higher, when multiple criteria as set forth in Department Guidelines indicate gifted ability. Determination of gifted ability will not be based on IQ score alone…The determination shall include an assessment by a certified school psychologist" (22 Pa. Code §16.21, 2004, p. 6). PDE has determined that "a person with an IQ score lower than 130 may be admitted to gifted programs when other educational criteria in the profile of the person strongly indicate gifted ability" (22 Pa. Code §16.21, 2004, p. 6). Finally, the state of Pennsylvania has established five categories of multiple criteria to be used in addition to or in lieu of IQ. These are as follows:

1. Achievement A year or more above grade achievement level for the normal group in one or more subjects as measured by nationally normed and validated achievement tests able to accurately reflect gifted performance. Subject

results shall yield academic instruction levels in all academic subject areas. (Pa. Code §16.21 (e)(1)).

2. Rate of Acquisition, Rate of Retention An observed or measured rate of acquisition/retention of new academic content or skills that reflect gifted ability. (22 Pa. Code §16.21 (e)(2)).
3. Demonstrated Achievement Demonstrated achievement, performance or expertise in one or more academic areas as evidenced by excellence of products, portfolio or research, as well as criterion-referenced team judgment. (22 Pa. Code §16.21 (e)(3)).
4. Early Skill Development Early and measured use of high level thinking skills, academic creativity, leadership skills, intense academic interest areas, communications skills, foreign language aptitude or technology expertise. (22 Pa Code §16.21 (e) (4)).
5. Intervening Factors Masking Giftedness Documented, observed, validated or assessed evidence that intervening factors such as English as a second language, learning disability, physical impairment, emotional disability, gender or race bias, or socio/cultural deprivation are masking gifted abilities. (22 Pa. Code §16.21 (e)(5)), (2004, pp. 6-7).

An examination of the state's definition and guidelines reveals that these have been based, at least in part, on the current research on giftedness, talent development, and multiple intelligences. The U.S. Government's definition of giftedness is less well defined and allowed states varying degrees of latitude in developing and implementing programs for their gifted population.

1.3.6 United States Department of Education definition of the gifted and talented

According to Stephens and Karnes (2000), "the federal definition of gifted and talented students has progressed through several transitions over the years, serving as a guide for states as they develop their definitions and policies regarding gifted education" (Section on Federal definition, ¶ 1). Furthermore, under PL 100-297 (as cited in Stephens and Karnes, 2000) the Education Amendments of 1969 defined giftedness as follows:

> The term ‘gifted and talented children’ means in accordance with objective criteria prescribed by the Commissioner, children who have outstanding intellectual ability or creative talent, the development of which requires special activities or services not ordinarily provided by local education agencies. (Section on Federal Definition, ¶ 2)

In 1972, Sydney Marland, then Commissioner of Education, modified this definition of giftedness, which is previously quoted above and included specific areas of potential ability which became the accepted federal definition.

In 1978, Marland’s definition (as cited in Stephens and Karnes, 2000) was again modified as follows:

> [T]he term gifted and talented children means children and, whenever applicable, youth, who are identified at the preschool, elementary, or secondary level as possessing demonstrated or potential abilities that give evidence of high performance capability in areas such as intellectual, creative, specific academic or leadership ability or in the performing and visual arts and who by reason thereof require services or activities not ordinarily provided by the school. (Section on Federal Definition, ¶ 4)

This 1978 modification saw the exclusion of psychomotor ability as a category of giftedness. “Furthermore, the term ‘preschool’ was added along with ‘youth’ to include young children and adolescents” (Stephens & Karnes, 200, Section on Federal Definition, ¶ 4).

The U. S. Department of Education released a report in 1994, National Excellence: A Case for Developing America’s Talent. As a result, another new definition was adopted. “Children and youth with outstanding talent perform or show the potential for performing at remarkably high levels of accomplishment when compared with others of their age, experience, or environment” (p. 26). Stephens and Karnes (2000) noted that “this new definition eliminates the term ‘gifted’ which presently insinuates a formed and finished ability rather than a developing one” (Section on Federal Definitions, ¶ 8).

According to Jolly (2005), "disagreement over a definition of giftedness still permeates the field of gifted education today" (Section on contemporary definitions of giftedness, ¶ 1). However, "the federal government has issued its definition of giftedness, which individual states may follow, but are not obliged to do so" (Jolly, 2005, Section on Contemporary Definitions, ¶ 1). As of 2004, the law holds that:

> The term "gifted and talented students" means children and youth who give evidence of high performance capability in areas such as intellectual, creative, artistic, or leadership capacity, or in specific academic fields, and who require services or activities not ordinarily provided by the school in order to fully develop such capabilities. (P.L.100-297)

Nowhere in its definition of giftedness does the federal government mention the use of an IQ score as a factor in determining whether a child meets the requirements for gifted programming or not. However, Jolly (2005) reported that "such scores are still used as a criterion for identifying giftedness at the state level" (Section on contemporary definitions of giftedness, ¶ 2). Furthermore Jolly (2005) found that:

> In a 2000 survey, 37 states, including Connecticut, Georgia, Oklahoma, Florida, and Tennessee, all required either the 5%, 99th percentile, or two standard deviations above the mean on standardized tests of intelligence as part of the criteria for identifying students. Pennsylvania was the only state to reference an actual IQ score of 130 or above. Other prevalent characteristics noted in state definitions included specific academic ability, creativity, leadership, and visual and performing arts (Section on Contemporary Definitions of giftedness (¶ 2).

As research in gifted education continues, it can be assumed that the federal government and state education departments will continue to review and amend existing laws to ensure that schools develop and implement appropriate programs for those students who meet the criteria. In order to meet federal and state mandates and enhance their programs, schools need to incorporate into their curricula methods of accelerating their gifted students. In addition, schools could implement programs to adequately address the needs of those students who possess a

unique talent. A description of the various methods of acceleration, commonly used by schools for educating the gifted, follows.

1.4 METHODS AND ISSUES CONCERNING ACCELERATION

Pressey (1949) described acceleration as the way in which children "progress through an educational program at rates faster or at ages younger than conventional" (p. 2). Subsequently, seventeen methods of acceleration have been used by schools to enhance programs for the gifted and talented. Southern and Jones (2004) included "one additional practice which is the result of separating early entrance to kindergarten from early entrance to first grade, and consider them as two distinct practices" (p. 5). For the purpose of this study, these 18 acceleration options for educating the gifted and talented will be discussed.

In general, children enter kindergarten before the first grade. Entry into kindergarten usually requires the child to have reached a minimum age predetermined by a district or state policy. For example, Southern and Jones (2004) reported that "entry to kindergarten will be allowed for prospective students who will achieve the age of five years on or before September 30 of their entry year" (p. 5).

In this method of acceleration, students that show exceptional ability can enter into these programs earlier than their peers. Those identified are still subject to district and state guidelines concerning qualifications which can vary from state to state. Similarly, early admission into first grade is another educational type of acceleration used by schools for its gifted students. "This practice can result from either the skipping of kindergarten, or from accelerating a student from kindergarten in what would be the student's first year of school" (Southern & Jones, 2004, p. 5).

Grade skipping, continuous progress, and self-paced instruction have been used by schools as options for their gifted programs. Generally, when a student is placed in a classroom setting above the chronological age of his peers, he or she is considered to have skipped a grade. Students may skip a grade during the course of a current school year, but it is usually implemented at the beginning of the year. Continuous progress occurs when a "student is given content progressively as prior content is completed and mastered" (Southern & Jones, 2004, p.5). Again, the material to be mastered by the student is above the chronological age of his peers. Southern and Jones (2004) found that "self-paced instruction is a sub type of continuous progress acceleration" (p. 5). In this method of acceleration, the student masters instructional activities at his or her own pace; whereas, in continuous progress, the student works directly under teacher supervision and timelines.

Subject matter acceleration and partial acceleration "allows students to be placed in classes with older peers for a part of the day (or with materials from higher grade placements) in one or more content areas" (Southern & Jones, 2004, p. 5). This type of acceleration can be offered in various ways. For example, services may be offered outside of school in addition to the regular education program. This can be accomplished through summer school or after school programs.

Combined classes "allow younger students to interact academically and socially with older peers" (Southern & Jones, 2004, p. 5). Curriculum compacting involves limiting the amount of drill and practice activities and the amount of time spent on introducing a lesson. "The time gained may be used for more advanced content instruction or to participate in enrichment activities" (Southern and Jones, 2004, p. 5). This type of acceleration does not usually lead to grade skipping. Telescoping curriculum, however, provides the gifted student the

opportunity to complete a course of study in less time than his peers. For example, a student may complete a year long course in a semester's time period or complete six years of elementary school in four or five years.

Mentoring occurs when a student works with an expert in a particular field of study to provide the student with advanced knowledge in that field. Extracurricular programs provide gifted students the opportunity to complete coursework for credit through other institutions of learning during after school hours or during summer break. Similarly, correspondence courses also provide students another way to complete courses outside the regular curriculum via the internet, television, distance learning, etc. Concurrent or dual enrollment allows students to "take a course at one level and receive credit for a parallel course at a higher level (e.g., taking algebra at the middle school level and receiving credit at both the middle school and high school level or taking a high school chemistry course and receiving credit for a university course upon successful completion)"(Southern & Jones, 2004). School districts also refer to this program as college in the classroom. Along with these types of programs, AP courses provide students the chance to receive college credit for passing a standardized test at the end of the course. Similarly, credit by examination offers a student the chance to earn credit by completing a mastery test in a particular subject area. Acceleration in college affords the student the opportunity to begin an "advanced level of instruction at least one year ahead of normal" (Southern & Jones, 2004, p. 6). Advanced level of instruction can be offered in addition to other accelerative techniques, such as dual enrollment and credit by examination or by determination of college teachers and administrators" (Southern & Jones, 2004, p. 6). Finally, early entrance into middle school, high school or college affords a student the opportunity to complete 'two or

more majors in a total of four years and /or earns an advanced degree along with or in lieu of a bachelor's degree" (Southern & Jones, 2004, p.6).

It can be assumed that schools incorporate at least some of the above methods of acceleration in their gifted programs. Students who excel in a specific category such as linguistics, mathematics, music, spatial ability etc. benefit from the use of such techniques. However, research is providing evidence that the following is an additional area where talented students can also benefit from acceleration. An examination of the relationship between information technology and gifted and talented ensues.

1.5 COMPUTER TECHNOLOGY AND THE TALENTED

According to Johnson and Eisenberg (1996) there is a general consensus that "government officials, school boards, and the general public all seem to have finally seen the light and acknowledged the message that technology can play an important role in the education of our young" (¶ 1). However, just how much of an impact technology has on student achievement has been the subject of much discussion. Furthermore, fueling this debate is the argument concerning the issue of funding schools for computers, internet hook-up etc., and the public's demand for accountability. "Increased funding is accompanied by increased accountability. Educators are being asked to show something for the investment" (Johnson & Eisenberg, 1996, ¶ 2). As this argument unfolds, the most important question facing America's schools today is what do students need to know in order for them to compete in a global economy that is rapidly moving from an industrial society to an information technology society, especially in the United States and other developed countries. According to Nugent (2001):

> In the transition from the industrial age to the information age, the 21st century has brought with it new challenges for the educational needs of the nation's youth. Information-intensive and technology-driven jobs encompass 60% of America's job market (Jukes, 1997). Over the last decade, over half of the new jobs created in the United States have evolved from new technologies (Jukes). Occupational futurists predict that in the first decade of the 21st century, eight out of every ten jobs will be information-intensive (Jukes; Naisbitt & Aburdine, 1990). The National Science Foundation, (1997) estimates that by the year 2010, one-fourth of all new jobs will involve technology. (¶ 1)

Additionally, "enormous changes are occurring in technology, from the internet to the integration of biotechnology, information technology, and nanotechnology. What will today's students need to know and be able to do in order to be successful in the world in which they will live?" (Daggett, 2005, ¶ 1). As the United States and the world progress into the 21st century, the rate of change impacting jobs and the economy will increase exponentially. The U.S. Department of Labor reported that "the rapid spread of computers and information technology has generated a need for highly trained workers to design and develop new hardware and software systems and to incorporate new technologies" (Section on computer systems analysts, 2005, ¶ 1). Daggett contends that "U.S. society and the world in general are also undergoing fundamental change" (2005, ¶ 1). As evidence of this rapid change, he reported the following:

> *Of the 391 countries in the United Nations, only 22 percent existed as nations 50 years ago.
> *100 years ago, the difference between the richest and poorest nation in terms of personal wealth was 50 to one; today it is 390 to one.
> *When Bill Gates retired as CEO of Microsoft in 1998, 23 years after he founded the company, he was worth more than all the gold in Fort Knox, more than the GNP of China, more than the 100 poorest nations in the world.
> *Singapore became an independent country in 1965. Before that it had hoped Malaysia would take it over, but that country said no, deciding that absorbing Singapore would make Malaysia poorer. In 2001, Singapore is the ninth wealthiest country in the world in terms of wealth per person. The U.S. was 10th, and Malaysia was 82nd.
> *To achieve a 25 percent penetration rate in U.S. homes, it took 35 years for the telephone, 26 years for television, 16 years for personal computers, seven years

> for the internet and three years for personal digital assistants (PDAs). (Daggett. 2005, ¶ 2)

As the world's economy changes, businesses need students to possess the skills needed to enter into a workforce that is based on information technology. In addition, Ardern (1998) stated that:

> As we approach the 21st century, change is constant both in our jobs and in our personal lives. There has never been the level of change there is today. It has become as far-reaching as it is rapid, hitting all sectors of society all over the world. Business competition and technological enhancements have accelerated the pace of change over the last decade. Organizations are changing and within those organizations the information resources and information management processes are changing as well. With the changes to information management come requirements for new job skills. (Ardern, 1998, ¶ 5)

In order for this to occur, schools must change the fundamental ways in which they teach students. Daggett (2005) reported that:

> "The academic skills demanded by many entry-level jobs are at a higher level than the academic skills required for postsecondary education. Some of those skills are not only more rigorous but also different for the skills needed for success in postsecondary education" (¶ 2).

Ironically, the call for this change in the way America educates its students to meet the ever changing landscape of information technology has not come from within the education community. Daggett (2005) argued that "our schools continue to focus on getting students ready for college as the ultimate academic preparation, despite the fact that for two decades business has led the charge for higher academic standards because schools are turning out young adults without the academic skills to succeed in the workplace" (¶ 2). In addition, the business community has found many state and federal politicians, who champion school accountability to be willing allies in this movement. Daggett (2005) found that "More dialogue on how to educate the future U.S. workforce is occurring between corporate leaders and politicians than is

taking place among educators" (Section on a Changing Concept of Literacy, ¶ 1). To support Daggett's claim, the United States Department of Labor reported that "in order to maintain a competitive edge and operate more efficiently, firms will keep demanding computer specialists who are knowledgeable about the latest technologies and are able to apply them to meet the needs of businesses." (Section on Job Outlook, 2005, ¶ 2). Furthermore, Lin added that:

> For many years, educators and workforce trainers have struggled with the problem of teaching non-technical people to use information technology. In August 1997, the National Science Foundation asked the Computer Science and Telecommunications Board (CSTB) of the National Research Council to address the subject of information technology literacy. The rationale for such a study was that the increasing importance and ubiquity of information technology in daily life make it essential to articulate what everyone needs to know and understand about information technology. Such an articulation would be an essential first step toward empowering all citizens to participate in the information age. (Lin[b], 2000, ¶ 2)

However, the "essential first step" that Lin mentioned is not enough to meet the growing demands by U.S firms for an information technology literate workforce. It is not only the rapid change of pace in the field of technology that is creating the problem, but the ever increasing complexity and sophistication of computer and information systems that places additional pressure on schools and society to meet the needs of businesses. There is a need for a highly skilled workforce to earn advanced degrees in computer science. "Individuals with an advanced degree in computer science or computer engineering, or with an MBA with a concentration in information systems, should enjoy highly favorable employments prospects" (United States Department of Labor, Bureau of Labor Statistics, 2005, Section on Job Outlook, ¶ 5).

Current research has identified various methods schools can implement to meet these challenges. Schools today are beginning to look at alternative ways to incorporate differentiated instructional practices into the classroom to match student abilities to their modality of learning. Sternberg and Grigorenko (2004) found that:

> Many students could learn more effectively than they do now if they were taught in a way that better matched their patterns of abilities. Teaching for successful intelligence provides a way to create such a match. It involves helping all students capitalize on their strengths and compensate for or correct their weaknesses. It does so by teaching in a way that balances learning for memory, analytical, creative, and practical thinking. (¶ 1)

Sternberg and Grigorenko (2004) stated that "there is no one definition of intelligence" (¶ 3). In general this theory proposed that people have the ability to recognize the areas in which they excel and the areas in which they are weak. "In other words, people find their own unique path to being intelligent. Successfully intelligent people adapt to, shape and select environments" (Sternberg and Grigorenko, 2004, ¶ 3).

To expand upon this theory to include the education of the gifted, Heller and Schofield (2000) stated the following:

> Whereas until fifteen or twenty years ago the field was dominated by one dimensional giftedness concepts and corresponding IQ measurements, a large majority of more recent models are based on multidimensional or multifactorial psychometric concepts of intelligence e.g. Gardner's (1985) theory of multiple intelligences or approaches from information theory and cognitive psychology e.g. Sternberg's (1985) triarchic intelligence model. Other models still include elements from socialization theories, e.g. Monks (Monks et al., 1986) extended Renzulli model. Furthermore we agree with Sternberg's demand that (1990, p. 96): "We need to think in terms not only of multiple components of giftedness, but (also) of multiple kinds of giftedness". 'Giftedness' is thus defined as the individual cognitive and motivational potential for, as well as social and cultural conditions of, achieving excellent performances in one or more area/s such as in mathematics, languages, or artistic areas with regard to difficult theoretical vs. practical tasks (Heller, 1989, 1992). 'Talent' can be defined as a domain-specific gift or ability, e.g. 'scientific ability' as competence for scientific expertise in the fields of psychology, medical sciences, or physics. (p. 123)

With this expanded notion of the nature of giftedness, it is imperative that schools recognize the need to identify the academic areas where students are weak and where they excel. Additionally, with the rapidly changing U.S. and world economies as the transformation of

society moves toward an ever increasing dependence upon information technology, the problem exists that America's schools will not have developed enough highly skilled individuals in the area of computer technology. Although a review of the literature provided limited documentation in the relationship between giftedness and technology usage, there is enough to suggest that a population of students exists in schools today that excel above the norm in this area. Cross (2004) found that "the social and emotional development of gifted students can be influenced by many factors. Genetics, experiences, learning, family values, perceptions, and interactions all contribute to the development of gifted children. Under the heading of experiences is students' use of computers" (¶ 1). To support Cross's findings, O'Donnell Dooling observed a technology lesson at Woodbury Middle School in Woodbury, Connecticut. During the lesson, the teacher had identified "Famous Persons" to assist other students who may be experiencing difficulty. O'Donnell Dooling (2000) described part of the lesson:

> After taking a few minutes at the beginning of the period to explain some computer technology skill that students will need to use that day, computer teacher Jeff Turner moves around the room to monitor the students' work. When students ask him questions, he usually counters with another question to encourage problem solving. Sometimes he refers students to one of the project's Famous Persons-students who have emerged as tech experts in the skills needed to complete that day's work. Famous Persons, who are sometimes students with special learning needs or who have struggled in traditional academic subjects, rotate as the need for specific expertise. (¶ 2)

Furthermore, in the Woodbury study, O'Donnell Dooling explored several themes which included the level of teacher proficiency with computer technology. In response to this, she found that both computer and regular teachers reported that "in some cases, the students may know more than the teachers. Both classroom teachers and computer teachers acknowledged the broad spectrum of teachers' computer skills as well as the discrepancy between the technology

skills of the teacher and those of some students." (2000, Section on What the Teachers Said, ¶ 2). During a similar classroom observation, Siegle (2004) found:

> Susan's science teacher has just purchased five Palm handhelds with temperature probes. He plans to ask his students to develop experiments that test the effectiveness of different types of insulations. Susan can barely contain herself as she waits for him to unpack the new instruments. Later, when he has trouble installing the probe software, Susan volunteers to stay during lunch and help solve the problem. She quickly discovers the error her teacher has been making and remedies it. Susan might be classified as gifted in technology. (¶ 1)

In addition to this, Peck, Cuban and Kirkpatrick (2002), reported:

> An 18 year old senior with long brown hair and a thoughtful, engaging manner, Jason Swift does not fit the prominent cultural stereotype of the bespectacled, socially awkward 'techno geek'. Nonetheless, Flatland High School's tech coordinator, teachers, and other students all rely on his substantial technical and computer expertise, almost entirely self-taught, to help solve various computer problems. (¶ 2)

Findings from these three studies tend to indicate that teachers, technology coordinators and administrators are presently using informal methods to identify computer talented students in their classrooms. Furthermore, O'Brien et al. (2005) conducted a similar classroom study and reported that "two distinct categories of students emerged: one group whose members specialized in programming and a second group whose self-identified strengths were problem solving and high-level applications of software. We labeled these two groups as 'programmers and interfacers' respectively" (Findings section, ¶ 5).

The literature also suggested that schools need to implement programs which focus on this population of students who exhibit extraordinary talent in the use of technology. Feldhusen and Sayler (1990) reported that:

> Ideal instruction for the gifted seems to involve higher level content which matches or nearly matches their achievement levels, faster paced instruction, and enrichment which extends the boundaries of study or investigation to topics not typically addressed in the regular mainstream curriculum. Ideal instruction is challenging and gives gifted youth opportunities to test the limits of their talent and ability through daily interaction with other gifted youth. (¶ 2)

Similarly, Siegle has expanded upon the notion of ideal instruction to include a specific population of technology talented group of students. Educating these students will require schools to provide an advanced level of technology education. This could be accomplished within the school's walls as well as outside the school. According to Siegle (2004):

> Like any student with a gift, technologically gifted students need to have their gifts recognized and nurtured. Doing so may require outside assistance from someone with more technological expertise than the regular classroom teacher or even the gifted education specialist has. Of course, technological talent cannot be developed if technology is not available. Advanced technologies beyond their school may be necessary to develop technologically gifted students' potential to its fullest. This may require providing elementary students with access to high school and college laboratories. It may also require finding mentors in the community with access to the needed skills and equipment to feed these students' inquisitive nature and appetite for new knowledge and skills. With recognition and support, the talents of technologically gifted students can grow and prosper. (Conclusion Section, ¶ 1)

Failure to address this potential problem now may produce difficult consequences for America's economic progress in the future. Recently, the U.S. Senate Judiciary Committee adopted a proposal that would provide U.S. employers workforce relief by reducing the procedures needed to gain H-1B visas and green cards. In a news release the Software & Information Industry Association (SIIA) supported this measure and reported that:

> SIIA supports the proposal because it will provide U.S. companies with much-needed access to H-1B visas already approved by Congress and by amending certain visa counting procedures to address the urgent demand among IT companies in our country, said Wasch. Despite concerns that the number of additional H-1B visas was cut in half from the Chairman's original proposal, SIIA believes that the proposal represents an interim solution for immediate U.S

> workforce needs while also providing necessary revenue for the Federal Government. Both of these objectives are consistent with the goal of positioning the U. S. for continued global leadership in innovative technology. (2005, ¶ 2)

Furthermore, the news release supports what the above review of the literature has suggested with regard to a shortage of workers entering technology jobs with advanced skills. The SIIA stated:

> For the U.S. information technology (IT) industry to remain world leader in technological innovation, U.S. companies must be able to attract and retain the best talent from around the world. As a result of caps on temporary visas for highly educated workers and the lack of green card availability, the industry is currently losing the battle to expand domestic workforce talent. SIIA also supports this legislation because it will provide critical interim relief to meet demands that threaten to become crippling to the U.S. IT industry in the very near future. (2005, ¶ 3)

The fact that the government has to loosen the restrictions on visas and green cards to ensure that there will be an adequate supply of skilled workers in the technology industry is troubling if not alarming. In essence, one can interpret the above statement by the SIIA as saying that America's schools are failing to provide adequate technology education that will educate students capable of excelling in this area. Particularly, schools are failing to identify and implement accelerated programs for those who display exceptional talent giftedness in this area.

Finally, after reviewing the literature, the research tended to support the notion that a gender gap developed in computer technology interest as students progressed through school. This gender gap seems to be non existent in the primary grades. McLester (1998), found that "though girls and boys begin with a level playing field where technology is concerned, showing equal enthusiasm and competence in computer-related school classes, in the upper-level elementary years girls gradually lose interest in digital pursuits: a trend that accelerates as they

move on into high school, college and careers." (¶ 2). To support these findings, Christensen, Knezek and Overall (2005) reported that:

> Data gathered from 10,000 Texas public school students in Grades 3-12 over the years 2000, 2001, 2002 and 2005 were analyzed to replicate findings first discovered as a byproduct of evaluation of a large scale U.S. Department of Education Technology Innovation Challenge Grant (1). Initial findings were that girls in Grades 4 and 5 reported enjoying computers more than boys. Detailed trend analysis determined that although boys and girls begin first grade with few or no differences in attitudes toward computers (Collis, Knezek, Lai, Miyashita, Pelgrum, Plomp, & Sakamoto, 1996), by Grades 4 and 5, girls are more positive in their enjoyment. Starting about Grade 6, girls' self-reported perception of computers begins to become less positive than boys, and by Grade 8 becomes significantly lower than boys. (¶ 1)

As girls begin to lose interest in computers as they get older, schools and society as a whole must find and develop strategies to reverse this trend. Cooper and Weaver (2003) stated that "the tough issue with which society must come to terms is that computer anxiety inequitably affects girls more than boys. Studies from around the world have identified a higher degree of computer anxiety in girls than in boys and significantly more negative attitudes about the computer in girls than in boys" (p. 14). This study will not delve deeply into the reasons why these differences exist. However, these findings have clear implications for schools. "Regardless of cause for gender differences in attitudes toward technology, it appears that teachers are in a position to closely monitor equity in the educational setting, and the relative newness of technology's integration into the curriculum affords a unique opportunity to start from the beginning" (Christiansen et al., 2005, Section on Implications for Educator Professional Development, ¶ 1).

After reviewing the literature, the conceptual framework for this study is based on the evidence that a group of students now exists who display exceptional ability in the area of computer technology. The literature has also suggested that teachers and administrators can

assist researchers in identifying characteristics and patterns of behaviors that these students possess and correspond to the various definitions of giftedness. This researcher will identify specific attributes displayed by this group of students who should be considered exceptionally talented in the area of technology usage. After a review of Pennsylvania's definition of giftedness and examining the findings of Terman, Gallagher, Renzulli, and Gardner, it can be assumed that certain students display outstanding and creative ability in the area of computer technology. This population meets the state's multiple criteria in addition to an IQ score which includes the following areas: these students are well above their peers in achievement level, they acquire and retain technology skills more rapidly, they possess a certain amount of technology expertise in this area, and they display it at various age levels. Most importantly is the point that their behaviors can be documented, observed, validated or assessed; however, this is not being done in today's schools. "We found a small number of limited technology identification scales and there was a paucity of research-based studies on this kind of talent" (O'Brien et al., 2005, Section on computer technology talent, ¶ 1). Furthermore, O'Brien et al. (2005) determined that "overall, the majority of the research in this area has been qualitative and anecdotal. Studies that were quantitative focused on computer use, rather than on technology talent. There were some intriguing possibilities for defining, identifying, and serving students with computer technology talent; however, this seems to be a road less traveled" (Section on Literature Summary, ¶1). In addition to this, Bloom and Sosniak (1981) found that:

> Schools can and do influence talent development, sometimes positively and sometimes negatively. All of the individuals we studied attended elementary and secondary schools and college and beyond. These individuals had remarkably different school experiences through high school. Some were straight A while others barely met the requirements for graduation. Some were involved in many extracurricular activities, but others rushed to get out of school each day and away from an unhappy situation in their lives (p. 93).

These findings indicate that talented students can not be stereotyped into any specific category. The literature suggested that within the walls of America's schools exists a group of computer talented students who fit the description in Bloom and Sosniak's study, and schools need to find ways to influence their talent development in positive ways. To summarize, the conceptual framework for this study includes the following:

- Beginning with the work of Terman and followed by the works of Gallagher, Renzulli, Gardner and others, the research strongly suggested that there are multiple categories of intelligence with regard to identifying the gifted and talented.
- The literature had shown that over the past 25 years, schools have increasingly become technology enriched environments.
- Students who display an unusual talent in technology are being informally identified by administrators and teachers. However, specific behaviors of these students can be observed and documented.
- The case can be made that schools need to become centers of talent development and provide specific programming and methods of acceleration for this population of technology talented students.

The goal of this research is to identify a unique profile of technology talented students in order to assist schools in developing challenging individualized programs for this special group of students. In so doing, it is assumed that these students will reach their maximum potential and will graduate from high school better prepared to excel in the high tech world of the 21st century. Finally, the literature has strongly suggested that the time is now for society and schools to come together to meet this challenge. "If computer technology is ignored as a domain of talent, one might hypothesize that a noticeable group of high potential students are not receiving needed services to develop their potential" (O'Brien et al., 2005, Conclusion section, ¶ 1). Failure for educators, researchers, politicians and business leaders to travel together still further down this road may lead to harmful effects for the U.S. economy in the 21st century.

2.0 METHOD

A review of the literature indicates that a pressing issue facing America's public schools is how do adequately educate today's computer talented students to compete in a high-tech global economy. With this, the following four developments have dramatically influenced and challenged the traditional school environment over the past 25 years. First, schools have become technology enriched environments especially with computers. Second, students today have increasingly more access to technology both at home and in the school setting and are spending much more time working with computers. Third, teachers across all subject areas are being prepared to incorporate the use of computers and technology into their lesson plans. Finally, while the power of computers and the rapid growth of technology continue to expand at an exponential rate, it can be assumed that computers will play an even larger role as public education progresses into the 21st century. Within this context, there is evidence that a unique group of students exist who display an exceptional talent with regards to computer use. Freehill (1961) reported that:

> "genius implies an exalted kind of mind which leads to original work of such quality that it is permanent and has nearly universal influence. Talent is used to suggest less incomparable ability and narrower cleverness. This special fitness may or may not be original, may or may not have universal effect, and is of noticeably less transcendent proficiency" (pp. 82-83).

However, these students' knowledge and ability in working with computers are several steps above other students. Along with this, it can be assumed that in this computer technology

enriched environment, teachers are informally identifying these students who excel in using computers. For example, some of these students are assigned to assist average and lower achieving peers when working with computers. "By observing the techniques and strategies that pupils use to tackle problems, teachers may pick up on gifts that do not come to light through more formal assessment procedures. It is important to acknowledge that these pupils may wish to hide the extent of their gifts" (Qualifications and Curriculum Authority, 2001, ¶ 3). In addition, these students have been called upon to troubleshoot problems for students and teachers when they are experiencing computer technology difficulties. These students may stay after school and work on the computer with technology coordinators or teachers.

Furthermore, teachers and technology coordinators are in a position to observe that these students may be spending a majority of their time working with computers in a structured classroom setting and unstructured settings such as homerooms, study halls, before and after school, etc. In this rapidly changing computer technology enhanced environment, schools today need to development educational programs that formally address the needs of these students. By providing such programs, these students will be better prepared to enter into four-year college computer programs, two-year training programs or straight into the workforce after graduating from high school.

This study attempted to create a unique profile of technologically talented students. In doing so, schools will be better prepared to implement programs specific to this groups needs. Data for this study were gathered from professional staff members who observe students in a compute technology setting. By interviewing the technology coordinators and teachers, a portrait of these students' attributes can be developed. "The purpose of the focus group is to

stimulate people's thinking and elicit ideas about a specific topic" (Salant & Dillman, 1994 p. 29). In addition, according to Cohen, Manion and Morrison (2000):

> The participants interact with each other rather than with the interviewer, such that the views of the participants can emerge-the participants' rather than the researcher's agenda can predominate. It is from the interaction of the group that the data emerge. Focus groups are contrived settings, bringing together a specifically chosen sector of the population to discuss a particular given theme or topic, where the interaction with the groups leads to data and outcomes. (p. 288)

Furthermore, because the building principals are in the best position to identify professional staff members who teach and use computers and their technology on a regular basis, they were asked to identify the teachers who would be invited to participate in the focus groups. According to Salant and Dillman (1994) "members of focus groups are carefully (but not systematically) selected because of some characteristic they have (p. 64). In addition, "selection is based on judgment rather than according to a systematic method that would give everyone in the study population a known chance of being chosen" (Salant & Dillman, 1994, p.64). Finally, the researcher will have a focused interview protocol for the teachers and technology coordinators who participate in the study. However, it is the goal of this research to record and document the participants' personal experiences which will bring to light common characteristics this group of students possesses. In addition, this research will shed light on schools' environments that enhance technology skills in students. Given the opportunities, certain students, who may or may not be academically adept, are now "showing off" a unique ability in computer use. Finally, during the past 25 years, the basic structure and organization of the junior/senior high school has remained the same. Students and teachers still operate on a daily bell schedule where students move from class to class receiving instruction in core and electives courses in order to meet the mandated graduation requirements. Within this structured setting, it

is the teachers who are discipline-specific experts in their certified fields of Math, English, Science and Social Studies and students have generally accepted their role as learner. However, many teachers are not "experts" in computer use and technology. Computer talented students have demonstrated in many instances that they are several steps above the teacher as well as their peers in this area. While some teachers have accepted this role reversal, for others it has created a feeling of awkwardness and uneasiness in the classroom. The researcher examined the implications this role reversal is having on public education in his interviews with the teachers.

2.1 STATEMENT OF THE PROBLEM

What student attributes have been observed by junior high school level teachers, senior high school level teachers and technology coordinators that identify an exceptional ability displayed by a population of students that can be considered computer talented?

Research questions

1. What environmental factors influence the development of computer technology talent in the school setting?
2. In which subject areas do computer talented students seem to excel?
3. How do computer talented students tend to use computers in an educational setting?
4. How do computer talented students tend to use computers in a recreational setting?
5. What social skills do computer talented students exhibit in the general educational setting?
6. What leadership skills do computer talented students exhibit in the regular classroom setting?

7. What, if any, differences have teachers observed between male and female students with regards to computer technology talent?
8. At what age levels do junior-senior high school level teachers begin to observe exceptional computer technology talent?

2.2 PARTICIPANTS

Five schools from five suburban school districts located in western Pennsylvania were chosen as the setting for this study. These schools were geographically close to where the researcher resided. The following data on these schools is based on Standard & Poor's (2004) public school profiles (2004).

School "A" housed grades eight through twelve and had a total student population of 517. This school was also predominately white which make up of 96.7%. School "A's" median household income is $61,268 and its economically disadvantaged population which is based on the number of students who receive either free or reduced lunch is 6.8%. Its student per teacher ratio is 15.8 (Standard & Poor's School Matters, 2004, Overview Section). Three teachers and the technology coordinator agreed to participate in this study. The teachers taught all grade levels eight through twelve and subjects they taught included math, English, accounting introductory and higher level computer classes.

School "B" housed grades nine through twelve with a total student population of 624. This school's median household income is $78,923 and has a 10.4% economically disadvantaged student population. Students are predominately white which make up 96.2% of the population.

Its student per teacher ratio is 16.3 (Standard & Poor's School Matters, Overview Section, 2004). Two teachers and the technology coordinator agreed to participate in this study. The teachers taught all grade levels nine through twelve and the courses they taught included computer applications, accounting, and a SAT preparation course.

School "C" housed grades seven through twelve. It services 332 total students. Its economically disadvantaged population is 47.6% and its median household income is $47,444. Its white population makes up 100% of its student body and its student per teacher ratio is 12.3 (Standard & Poor's School Matters, Overview Sections, 2004). Three teachers and the technology coordinator agreed to participate in this study. The teachers taught all grade levels seven through twelve and the courses they taught included computer applications, advanced computer applications, health, keyboarding, multi media and accounting.

School "D" serviced 430 students in grades seven through twelve. It is predominately white at 94.7% and its median household income is $51, 768. Its student per teacher ratio is 13.4 (Standard & Poor's School Matters, Overview Section, 2004). Three teachers and the technology coordinator agreed to participate in this study. The teachers taught all grade levels seven through twelve and the courses they taught included calculus, advanced computer applications, word processing, algebra and accounting.

School "E" housed 418 students in grades eight through twelve. Its white population make up is 99.3% of the student body. This school has an economically disadvantaged population of 43.3% and its median household income is $50,454. Its student per teacher ratio is 13.3 (Standard & Poor's School Matters, Overview Section, 2004). Four teachers and the technology coordinator agreed to participate in this study. The teachers taught all grade levels

eight through twelve and the courses they taught included journalism, computer technology, web design, computer science I, keyboarding, accounting, and anatomy.

2.3 PROCEDURES

The procedures for this study were as follows:

1. The researcher made an initial contact by phone to each building principal. The purpose and focus of the study, the amount of time needed, and the amount of staff required are explained during this communication. Also, it was communicated to each principal that this study was voluntary and that any staff member who initially agreed to participate could opt out at any time.
2. The principals, who agreed, received a letter. This letter required their signature, granting the researcher permission in writing to conduct the study starting in May of 2007 (see appendix A).
3. When permission letters were signed and returned, the researcher contacted each principal by phone to set a time and date for the interviews. The researcher conducted the focus groups at the scheduled dates and times. A script was read to the group explaining the purpose of the study (see appendix B). Participants were told that their role was voluntary and that they could opt out at any time. The researcher conducted the focus groups with the teachers using a focused interview protocol (see appendix C). The researcher took notes and recorded the focus group sessions.

4. The researcher also set a convenient time to meet and interview the technology coordinators. Again, a script was read to each one of them explaining the purpose of the study and their right to opt out at any time (see appendix D). The researcher had the technology coordinators share their experiences with students they deem computer talented. A focused interview protocol was used with the technology coordinators (see appendix E). The study was explained and the option to participate voluntarily was communicated to each technology coordinator. The interviews lasted between one half to one hour.
5. The focus groups and interviews were recorded and the researcher also took notes during the discussions. The researcher wrote a summary of the interviews after listening to the tape recorded interviews and reviewing the written notes. The summary was mailed back to each teacher and technology coordinator with a note asking them to review the summary and delete or add any information to the interview (see appendix F), mail back any corrections to the summaries. A self addressed stamped envelope was included for their convenience. None of the participants returned a corrected summary. From the data, a profile of students who were deemed exceptional in computer technology was developed that identified common characteristics of these students.
6. Chapters three and four of this study include the results and implications for policy and practice for schools to create adequate programs to educate computer talented students.

2.4 DATA COLLECTION AND ANALYSIS

After receiving permission from each of the five building principals, the researcher visited the schools on a prearranged date to meet with the focus groups of teachers and interview the technology coordinators. The conversations were tape recorded and the researcher took personal notes during the discussions.

After collecting the data for each school, the researcher summarized the teacher discussions from each school by listening to the tapes and reviewing the notes. The researcher then compared the results across the five schools and prepared a summary of the findings. The summary of the results comparing the five schools can be found in chapter three with accompanying tables. From these findings, the researcher drew from the discussions similar descriptor statements relative to each research question. Based upon the number of similar descriptor statements given by the teachers and technology coordinators, the researcher rated the evidence as follows. Since there were twenty participants in the study, nine or more similar descriptor statements given by the teachers and technology coordinators for each research question yielded an evidence rating of "exemplary." Six to eight similar descriptor statements yielded an evidence rating of "strong." Three to five similar descriptor statements yielded an evidence rating of "some." One to two similar descriptor statements yielded an evidence rating of "limited."

Finally, the researcher used the similar descriptor statements that were identified as exemplary and discussed these as the basis for developing a profile of students who display exceptional talent in computer technology. This discussions and implications for policy and practice can be found in chapter four.

2.5 LIMITATIONS OF THE STUDY

This study was exploratory in nature in that very little research had been conducted into identifying computer talented students. It was limited in the size, grade levels and number of schools being examined. Also, three to four teachers along with the technology coordinators in five schools was a very small sample when trying to create a profile of a specific group of students such as those believed to be computer talented. According to Salant and Dillman (1994) focus groups "typically involve 8 to 10 people" (p. 29). The schools being studied vary in size and grade level. No elementary schools were studied which may also have students who can be identified as computer talented. The grade levels of the students studied ranged from grades seven to twelve. Schools "A" and "E" were made up of grades eighth through twelve. School "B" contained students in grades nine through twelve, while schools "C" and "D" housed grades seven through twelve. All schools were predominately white which virtually excluded minority students who may have fit the profile. Finally, the researcher was the current Junior Senior High School Principal at School "D".

2.6 DEFINITION OF TERMS

Acceleration-Access to higher level learning activities and skill development than typically provided in regular education to students of the same age. The pacing, complexity, and depth of planned coursework are modified as indicated by individual needs. Acceleration may include: planned course compacting/telescoping, subject acceleration, specially designed instruction,

credit by examination or performance, interdisciplinary planned courses, distance learning course, higher education level courses, independent or self-directed study.

Chapter 16-State Board of Education regulations for special education for gifted students that became effective December 9, 2000.

Computer Talent-An exceptional ability in the use of computer technology. This ability includes above average skill in the use of various software programs as well an in depth knowledge of the hardware components of the computer system.

Creative-productive Giftedness-Describes those aspects of human activity and involvement in which a premium is placed on the development of original material and products that are purposefully designed to have an impact on one or more target audiences. This form of giftedness accounts for a significant number of students who meet the criteria for gifted programs (Renaulli & Reis, 2000, p.470).

Genius-An extreme form of brightness Freehill, 1961, pp. 82-83).

Descriptor statements-Statements used to describe characteristics of and exceptional talent displayed by computer talented students.

GIEP-Gifted Individualized Education Program-A yearly written plan describing the education to be provided to a gifted student.

Gifted Education-Chapter 16, 16.1 defines gifted education as specially designed instruction to meet the needs of a gifted student that is conducted in an instructional setting, provided in an instructional or skill area, provided at no cost to the parents, provided under the authority of a school district, directly, by referral or by contact, provided by an agency, individualized to meet the educational needs of the student, reasonably calculated to yield meaningful educational benefit and student progress, and provided in conformity with a GIEP.

Gifted student-A student who is exceptional under section 1371 of the School Code (24 P.S. 13-1371) because the student meets the definition of "mentally gifted" and needs specially designed instruction beyond that required in Chapter 4 (regulating to academic standards and assessment). This term applies only to students who are of "school age" as defined under 11.2 (relating to school age).

Intelligence Quotient (I.Q.)-A measure of intellectual aptitude at a given point in time based on comparison of children of the same chronological age. It is one of the many ways to measure a student's academic potential.

Interpersonal Intelligence-The ability to understand other people (Gardner, 1997, ¶ 6)).

Intrapersonal Intelligence-the ability to understand yourself, of knowing who you are, what you can do, how you react to things, which things to avoid, and which things to gravitate towards (Gardner, 1997, ¶ 7).

Kinesthetic Intelligence-Form of intelligence in which individuals display a high degree of bodily kinesthetic ability (Gardner, 1997, ¶ 4).).

Linguistic Intelligence-The ability to use language either native or foreign to communicate with other people (Gardner, 1997, ¶ 1).

Logical Mathematical Intelligence-A form of intelligence that includes working with and understanding numerical quantities and operations such as the work mathematicians perform (Gardner, 1997, ¶ 2).).

Mentally Gifted-Outstanding intellectual and creative ability the development of which requires specially designed instruction, programs or support services, or both, not ordinarily provided in the regular education program (22 Pa. Code § 16.1, 2004, p. 6).

Multiple Intelligence-Gardner's theory that holds that rather than one or two intelligences, all human beings have several intelligences.

Naturalist Intelligence-The human ability to discriminate among living things (plants and animals) as well as sensitivity to other features of the natural world. (Gardner, 1997, ¶ 8).).

Schoolhouse Giftedness-Also referred to as test-taking or lesson-learning giftedness. It is the kind of most easily measured by IQ or other cognitive ability tests and for this reason it is also the type most often used for selecting students for entrance into special programs (Renzulli & Reis, 2000, p. 369).

School Wide Enrichment Model-A systemic set of specific strategies for increasing student effort, enjoyment, and performance, and for integrating a broad range of advanced-level learning experiences and higher order thinking skills into any curricular area, course of study, or pattern of school organization (Renzulli, 2005, p. 82).

Spatial Intelligence-the ability to represent the spatial world internally in your mind (Gardner, 1997, ¶ 3).

Talent- Term used to suggest less incomparable ability and narrower cleverness (Freehill, 1961, pp. 82-83).

3.0 RESULTS

Data for this study were collected by using two types of interview techniques. First, the researcher held five focus groups comprised of teachers from five public school systems in Western Pennsylvania. Second, individual interviews were conducted with five technology coordinators from each district. Since the building principals observe and work directly with the teachers and technology coordinators on a day to day basis, the researcher asked the principals to identify the teachers and technology coordinators who would be qualified to discuss the behaviors and characteristics of students who display exceptional talent in computer use. The teachers and technology coordinators were then asked to volunteer to participate in the study. Focus groups provided teachers with a forum which allowed them to share their perceptions of and experiences with students they deemed to be computer talented. It also provided the teachers with an opportunity to agree or disagree with what they have been observing in the classroom. The focus groups consisted of two to four teachers and lasted approximately one to one and a half hours. Three of the focus groups consisted of three teachers. The other two focus groups consisted of four and two teachers each. The researcher met with the teachers and technology coordinators to discuss what they were observing in the classroom with regards to students who they would identify as computer talented. It should also be noted that one of the schools selected in the study was one in which the researcher was himself the junior/senior high school principal. Although each school was chosen randomly, the researcher took into account various

demographic information pertaining to each. The researcher's intent was to select schools that differed in size, resources and demographics. The total number of teachers that participated in the study was 15. Five technology coordinators agreed to participate in the study. Summaries of the results of the study were constructed for each individual school. In addition, a summary of the results compiled from all five schools was developed.

3.1 SUMMARY OF RESULTS

3.1.1 School A

3.1.1.1 Research Question One

What environmental factors if any influence the development of computer talent in the school setting?

The three teachers who made up the focus group in School A described a technology enriched environment in which they teach and interact with their students on a daily basis. While teaching a variety of courses, which included accounting classes, math classes, and a variety of introductory and higher level computer courses, the teachers reported that they had very little, if any, difficulty with access to computers in the school. Furthermore, they stated that the average time they use computers in their lessons per week ranged from 30% to 99% of their instructional time. The technology coordinator reported that the school contained anywhere from 300 to 350 computers. This included the individual classrooms, the library, labs and mobile labs which were available to the teachers and students.

Within this high school, a summary of specific environmental factors identified by the teachers and technology coordinator which influence computer talent in the school included the following. Although hardware components of the computer and software programs were taught and available to students, the teachers stated that advanced opportunities in these areas could be better provided at the local career and technology center (CTC). It was discussed that the CTC could provide these students more hands on opportunities that the school could not. However,

two factors prohibited students from attending the local CTC for a half day curriculum. The students, who the teachers deemed computer talented and advanced academically, did not want to give up the opportunity of taking the academic courses in their home school. They believe these courses will better prepare them for success in college. One of the teachers stated that "if they are a better student, they don't want to go to the Vo-tech." The teachers reported the students and parents held the stereotypical belief that the CTC would not challenge them academically and thus was not an appropriate academic setting for learning advanced technologies or receiving higher level college preparatory subjects.

Another environmental factor identified by the teachers was the opportunity to allow these students to work on advanced group projects which would benefit the school and allow students to gain a sense of pride from the accomplishment. The teachers gave examples that these students liked to work on the school's new computerized football score board. The students would add more video and graphics to enhance the visual effect of the scoreboard. They also created labels for the teachers and students to wear on dress down days for local charities. Finally, helping the technology coordinator also creates an environment which fosters computer talent. However, because of their exceptional skill with computers, the technology coordinator noted that he does not like to give too much latitude to these students when it comes to direct access to the district's network for security reasons.

3.1.1.2 Research Question Two

In which subject areas do computer talented students seem to excel?

The teachers in this school were quick to point out the fact that although some of the computer talented students were also advanced academically, this was not always the case. Although the

stereotypical picture of the computer geek emerged, for the most part, the majority of students deemed exceptional in this area were described by the teachers as typical high school students.

Academic subjects identified by the teachers included math, music and writing. These students also displayed an exceptional amount of creativity in their work. One teacher noted that "the students I am thinking of were all very creative. They were in the arts, they weren't afraid to explore and try different things." Although math was identified, it was not the only subject in which these students excelled. It was reported that one student in the school was currently writing an online book but was also exceptional in math. It was also found that the best computer programmers were not always "the best math students but the best problem solvers." They tended to be logical and divergent thinkers who put things together well. Along with this, when they experience difficulties with a particular lesson or problem, they could reverse their thinking or backtrack and figure out where they went wrong. One of the teachers pointed out that "they think logically and put things together well. When they get stuck they can come back and find out where there problem was."

3.1.1.3 Research Question Three

How do computer talented students tend to use computers in a formal educational setting?

Computer talented students tend to become bored very quickly with the regular classroom assignments. Work assigned to the class as a whole does not seem to challenge them. Lectures tend to be boring for them. One teacher reported that during lectures, that some of them "don't know how to behave." Computer talented students have a tendency to disregard any directions from the teacher and want to go directly to an assignment. On many occasions, they prefer to work individually. Furthermore, they enjoy the hands on activities that the computer provides. In addition, they prefer to work one on one with the computer. They also prefer figuring things

out for themselves. Their knowledge with computers is very often well above the knowledge and skills required for a regular assignment. Although they are creative and bright, grades do not seem to be the sole motivating factor for them. In fact, it was reported that in some cases, their grades do not indicate their actual knowledge in a subject area. One teacher stated that "grades are not a motivating factor for them. They find satisfaction intrinsically in what they've accomplished."

Computer talented students also have more confidence than their regular classroom peers when working with computers. Thus, they are not afraid to try something new. Again, they are confident that they can accomplish any task put forth to them on the computer. However, because of this confidence, some of them may procrastinate, believing that they can get a week long assignment done in one day. The technology coordinator stated that "some think they can get it done in one day. Others take their time and have better work habits." To build upon this sense of confidence, a teacher reported that he tries to find different ways to get them to be more creative.

The teachers did not notice any difference in a preference for software programs versus the hardware components of the computer. Some students took pride in building their own computers while others preferred to explore the various software programs available to them. Generally, the teachers could not see a noticeable difference. As a matter of fact, the teacher reported that "students today seem to see the value in both hardware and software. They seem to be curious and know the value of each and how each can be of value to the computer."

3.1.1.4 Research Question Four

How do computer talented students tend to use computers in a recreational setting?

The teachers and technology coordinator in this school reported that they have observed computer talented students involved in challenging game sites. The games contained in these sites were generally higher level games which included puzzles, mazes, brain teasers, etc. "Not the violent games." These types of games require the students to think out of the box. Thus, it was reported that these students tend to be able to think more divergently. Generally they visit these sites when their regular classroom assignments are completed. Furthermore, the more challenging the game, the more pride the students got in figuring out the solution. One computer game involved two students competing against each other by throwing "rocks" at one another. This game involved higher order thinking skills in that the participant had to judge and estimate exact angles in order to hit the target. It was also noted that the students tend to become very competitive in this setting. The technology coordinator added that "I could hear them cheering when they did good."

3.1.1.5 Research Question Five

What social skills do computer technology talented students exhibit in the general educational setting?

Teachers in School A reported that students who are exceptional in computer use are very comfortable working within a technology enriched environment. With this, they like to help others who may not be as skilled as they are when working with computers. They tend to stay out of the high school cliques. While they enjoy helping fellow students, they also enjoy helping the teachers as well. Some teachers in the school are struggling to keep up and learn the new computer technology. These students are willing to assist but they do not flaunt their talent in the face of the teacher. They also can identify other students who are at their level with regards to computer talent. They tend to be competitive with each other but with the regular students,

they tend to be socially average. "Most of them are fairly social," indicating that the teachers couldn't determine a difference between their social skills and the other students.

3.1.1.6 Research Question Six

What leadership skills do computer talented students exhibit in the regular classroom setting?

As mentioned above, when discussing their social skills, the teachers observed that computer talented students tend to want to help their teachers and their fellow students when they are encountering problems. They like to volunteer their assistance when they observe someone having difficulty. "They like to show what they can do and tell you that you don't have to worry about that they will take care of it." Very often the technology coordinator is not always available to fix technical problems for the teachers. During these times, the computer talented students are ready to assist. One teacher stated that "they like nothing better than to be in that setting."

They willingly take on additional tasks when asked to do so. They like to take ownership when asked to do a project above and beyond the normal classroom assignment. Again, this gives them a sense of confidence. Other students come to rely on them. When this occurs, this tends to build their confidence more and seems to make them more responsible.

The technology coordinator reported that in experience, these students and their unique talent seem to just jump right out at him. Again, grades are not the most important motivating factor to them. Two middle school students were helping others in class with their assignments and were not concerned that their own work was not getting done. They would complete their work on their own time. One student would help everyone else but himself.

As far as projects are concerned, these students show leadership by going above and beyond on classroom projects. For instance, they will add music, video or graphics to a presentation when it is not required.

3.1.1.7 Research Question Seven

What differences have been observed between male and female students regarding computer talent?

In the area of computer talent, the focus group in School A seemed to agree that the "boys tend to do better than the girls." Although it should be noted that the girls have the ability when working with computers, they tend not to want to spend the time on the computer. They do not seem to want to apply themselves as much as the boys do. Boys are more interested in the computers, but when a girl does exhibit such talent, she can give the boys a run for their money. In addition, the teachers reported a ratio of 10 to 1 of boys over girls when it comes to computer talent.

However, the technology coordinator in this school tended to disagree with the teachers in this area. A year ago, he would notice that boys were more proficient than girls. Today, he sees the girls trying to excel just as much as the boys. Furthermore, girls want to compete with the boys and want to show them up. "Although boys tend to be better with the technology, girls are better creatively and think things out better than the boys." Finally, he reported that five years ago a girl would not have been in the advanced computer classes but more and more girls are taking these classes today.

3.1.1.8 Research Question Eight

At what age levels do junior senior high school level teachers and technology coordinators begin to observe exceptional computer talent?

Ninth grade was reported to be the age at which the teachers began to notice such talent. "The six graders and seventh graders really seem like they don't want to branch out." Computer talented students tend to begin to become more mature and witty at this age. Teachers can also determine who is using computers extensively at home. These students can set up their own networks. By the time they are seniors, the technology coordinator knows of their exceptional skill and has to monitor them closely.

Another teacher reported that he sees such talent begin to develop in the eighth grade. In the sixth and seventh grade students tend not to want to branch out when working with computers. In eighth grade, the elite students want to try things that push their ability. As far as computer programming, this talent was identified by the tenth grade year. Again, the teachers can determine who is using computers at home on a wide scale. Also, at this age, the students tend to be more mature. They also talk and act like adults with a witty sense of humor. "They actually think they are grown up." They are not interested in the normal school drama and again tend to stay out of high school cliques.

3.1.2 School B

3.1.2.1 Research Question One

What environmental factors influence the development of computer talent in the school setting?

This high school system provides access to 250 computers to its 600 high school students. The school contains two business labs, one writing lab and one technology arts lab that also offers CAD programming. In addition, each core department, English, Science, Social Studies and Math has access to ten computers while the teachers and students also have access to two mini labs. In all, there is approximately one computer for every three students.

The two teachers in this focus group reported that they spend almost 100% of their time incorporating computer use into their weekly lessons. The subjects they teach include computer applications, accounting and SAT preparation course. During the course of the interview, the researcher got the sense that the teachers work closely and collaborate on curriculum with regards to computer technology and computer use. These teachers shared a connecting computer lab and the researcher observed students moving freely between both labs. The technology coordinator spends about two to two and a half hours of direct instructional time with the students. In addition, he also provides teacher in service programs and grant writing for the district. Because of the enriched technology environment and time spent with the students the teachers reported that they have had in the past and have presently students, who they would deem computer talented.

Within the classroom setting the teachers felt that it was important to find ways to foster creativity in these students. There was also a sense that it was important to allow these students to work more independently than the other students. Furthermore, they felt that subject area teachers need to feel comfortable with these students in their classrooms. The focus group teachers have observed a sense of anxiety that arises in some teachers when students display skills on the computer that are well above their knowledge. The teachers reported that some "know more about computers than we do and they let us know that." In general however, the

teachers stated that these types of students tend not to "flaunt or draw attention to themselves because of their unique talent."

An additional environmental factor that fosters computer talent was the importance for schools to promote the positive aspects of new technologies. With the increased access that students now have to such things and MP3 players, IPODs and cell phones, schools are wrestling with policy on limiting and restraining technology use. Although these technologies provide students opportunities to violate the acceptable use policy, such as cyber bullying, schools need to find ways in which teachers and students can live with technology. Schools can control computers but because of their size, they have very little control over IPODs and cell phones both of which a majority of students bring to school with them daily. It was also reported that podcasting now provides a tremendous opportunity in which students who are on homebound or on vacation can access teacher lectures and assignments.

Finally, this school works closely with local businesses which hire computer talented students to design websites. Additional opportunities lie with partnering with local colleges and universities to assist schools in providing enrichment to these students.

3.1.2.2 Research Question Two

What academic subject areas do computer talented students seem to excel?

The teachers reported that the students they identified as talented in computer technology were very good mathematically, although academically they were "not the highest" in the school. In addition to this, they exhibited good problem solving skills in that they could determine the quickest and easiest way to complete a task. It was also noted that these students can multi-task by opening a web browser and at the same time work with an excel spreadsheet. They want to explore other web sites they think are well designed and try to go one better. With other talented

students in this area, they tend to be very competitive. Unfortunately, one teacher stated that "a lot of them feel unchallenged."

Another subject area in which the teachers thought these students excelled was art. This could be seen in their unique web page designs. Along with this, the teachers noted that these students possessed good spatial reasoning skills. When designing a web page, they tend to exhibit more analytical thought while working independently. They want to get right to the task assigned and tend not to need to read any directions given. They did not ask many questions and if they did, they were higher order questions that the other students in class would not think of asking.

3.1.2.3 Research Question Three

How do computer talented students tend to use computers in an educational setting?

These students seem to get classroom projects and assignments done well ahead of the other students in class. Often, it was reported that many "do not utilize their full potential because it's so easy for them." Computer technology comes easily to them and they can fulfill the classroom requirements quickly. They like to be told what needs to be done and get the task completed quickly. When finished, this gives them the opportunity to explore other places on the computer. At these times, the teachers attempt to provide them opportunities for enrichment. For example, they assigned the best student in the school to design the school's web site. "It took him no time to do it and it looks unbelievable." In addition to this, they also had him involved in a school wide television production.

It should also be noted that many of these students feel unchallenged in the formal educational setting. There is potential to be fostered in these students but is not being addressed

by the schools for lack of challenging and enriched assignments. In addition, the teachers reported that these students know more about computers and they let the teachers know it. They tend to want to prove this to the teachers and other students. They do this by proving that they can get around the school filters on the network.

It should also be noted that these students tend to prefer the software programs of computers over the hardware components. As a matter of fact, the teachers reported a 70-30 ratio preference for software over the hardware components of the computer. Today, software programs are a novelty to the students, similar to any new toy. Their interest in hardware is limited to the fact that they want speed and increased memory capacity. Also, students tend not to be so concerned of how computers work as they are interested in how fast they go, similar to a car. There still are a select few who are interested in the hardware. In the past, when computers were more of a novelty to these types of students, they were more interested in the hardware components.

3.1.2.4 Research Question Four

How do computer talented students tend to use computers in a recreational setting?

The teachers described a student they identified as the best computer student in the school as also "the busiest kid in the school." They observed him always doing something. Whether it was helping other students or taking pictures for the website, he is constantly doing something throughout the school day.

As far as recreational websites, these students tend to favor the sites that have video games on them. Graphics seem to attract and keep their attention. The teachers reported that the students enjoy "anything that has graphics and music in it." In addition, the technology coordinator has observed them going to news and sports sites in their free time. Also, it was

observed that many of them like to go to ebay and look for hardware that would enhance their home computers by making them faster and increase memory capability. When talking about computers and technology, they tend to know the language and speak it routinely to one another.

3.1.2.5 Research Question Five

What social skills do computer talented students exhibit in the general educational setting?

The teachers were quick to point out that these students can not be stereotyped. One teacher stated that "I wouldn't call them your typical computer geek." Most of them exhibit average normal social skills for high school students. They seem to be more mature for their age and want to distance themselves from the high school drama. However, the teachers were quick to note that it is important to remember that they are still kids. There was nothing to indicate that these students could be placed into any one personality type such as introverts or extroverts. The teachers reported working with both types of students. In fact, the technology coordinator reported that he has worked with students who were shy, socially average and those students who tended to be extroverted. In the past, you may have had the computer geek. However, observing these students today in a social setting, teachers do not notice any difference between them and the other students. Because of the increased access to computers and technology, all types of students are drawn to it.

3.1.2.6 Research Question Six

What leadership skills do computer talented students exhibit in the regular classroom setting?

Within this school's environment, these students are open and willing to help their fellow students not as skilled as they on the computers. The teachers reported that "on a rare occasion

they won't help another kid." As a matter of fact, teachers reported that they would offer to help and very often were more than willing to help others. With this, these students earned a reputation in the school that they are unique when it comes to using computers and technology. As such, other students know who they are in the school. They tend to be proud of the work they do and proud of their reputations. They like to troubleshoot technology problems and often offer to help the teachers. They also tend to like to work on their own machines.

The teachers recalled one unique example of leadership displayed by a computer talented student. In this instance, an 11th grade student took it upon himself to create a senior slide show for the graduating senior class. It was reported that he did this on his own, completely transparent from the teachers and administration. He took the pictures and compiled the slides while adding music and graphics to the presentation.

3.1.2.7 Research Question Seven

What differences have teachers and technology coordinators observed between male and female students with regards to computer talent?

The teachers reported that up to this point, they have observed only boys who display what they would deem exceptional computer talent. In fact, they noted that it was "exclusively boys" who displayed such talent. When asked why they believe that only boys display such talent, they were not sure of the answer. They stated that by the time they get the students at the high school, the talent is already there and attributed this to widespread use at home.

The group noted that it is not that the girls do not possess the ability in this area, but they seem to lack the interest when it comes to working with computers. Boys just seem to have the affinity when it comes to computers. They have seen potential but not the interest on the part of the girls.

3.1.2.8 Research Question Eight

At what age levels do junior senior high school level teacher and technology coordinators begin to observe exceptional computer talent?

Exceptional computer talent was already present in these students by the time they entered the high school. The talent seems to emerge during the middle school years. These students were designing web pages while in the middle school. The teachers compared this talent as similar to that of an athlete of the same age such as a football player. Coaches begin to see talent develop in student athletes during this time. Similarly, teachers begin noticing computer talent emerge while these students are in middle school. Just like an exceptional athlete, the reputation of these students begins to get noticed.

Also during this time, teachers start to see that these students tend to be more comfortable when working with adults. The teachers reported that they try to find time to work with these students and try to give them more things to do such as updating the school's web page. Because these students are already deemed talented before they reach the high school the teachers attributed this again to home access and widespread computer use in the home. One particular student, who was identified during his time in the middle school, had access to computers at home at an early age. The high school teachers knew of this student and knew what he was capable of doing even before he entered the high school.

3.1.3 School C

3.1.3.1 Research Question One

What environmental factors influence the development of computer talent in the school setting?

This junior/senior school contains 250 computers that are available to the students during much of the day. There are two permanent labs as well as one mini lab. There is one mobile lab in the building, but it is currently not working. The three teachers who participated in this focus group reported that their average weekly computer use ranged for 30% to 100%, depending upon which courses they were teaching. The subjects these teachers taught included computer applications, advanced computer applications, health, keyboarding classes, multi media, accounting and various social studies classes. These teachers regularly use the library to have students use computers to do research. They also have students do Power Point presentations in addition to using computers to present new material in class.

Within this environment, some of the reported environmental factors that influence computer talent included the following. First, the teachers reported that there seemed to be a need for more computers in the school and more programs available to the students. Also, it was noted that these programs are available at the vocational technical school, but advanced students in computer technology are failing to take advantage of this opportunity. Many of these students convey to the teachers that they believe there academics will suffer if they attend the vocational school for a half day curriculum. The technology coordinator stated that there is a need to try to find opportunities to get these talented students to the vocational school at least part of the day. She stated that "schools need to adapt their schedules to be more accommodating."

Students are getting very adept at communicating with each other using the computers and other forms of technology. The teachers reported that "their communication on the computer is fascinating." This was occurring because the current generation of students in schools today, have always had computers in their lives. When they were born, they were born into a technology enriched environment. Schools need to be aware that along with computers,

these students now have access to IPODs and cell phones and regularly carry them to school. Schools need to find a way to live with these new technologies.

Finally, it was reported that the students identified as computer talented are finding it much easier to find ways around the school's computer security system. They are getting better at just about everything on the computer. They are very clever at using proxy servers to gain access to restricted sites. It was also noted that the home access has a big effect on computer talent over the past couple of years.

3.1.3.2 Research Question Two

Which academic subject areas do computer talented students seem to excel?

The teachers in this school did not believe that these students excelled in any one particular academic subject area. However, they pointed out that there are always one or two students who just get it right when writing computer programs. These students are consistent in the area of programming. They tend to be meticulous in their work and are competitive with others when it comes to their grades. For example, when they receive a grade of 95%, they question why they did not get 100%. Along with this, they tended to get upset when things didn't go there way. They may have written a computer program, and it worked; however, the assignment did not include everything the teacher required. They tended to want to do things their own way.

The teachers noticed that these students also get classroom projects done in less time than the other students. One teacher stated that "these students can work on their own which makes it a little easier for the teacher." Their time management seems to be much better. They are better researchers on the computer. They are well organized and tend to utilize their time well. They can piece bits of information together better and faster than the other students. From a research aspect, when they get done earlier, they then go back and look for more sources. Where four sources are required for a research paper, they will go above and get six.

3.1.3.3 Research Question Three

How do computer talented students tend to use computers in an educational setting?

One teacher reported that when he gives a formal assignment in class, he has the students ask each other questions before any of them come to him for help. He noticed that the better

computer students can explain things in a different way than other students do. They can present material to another student in a way that they can understand.

They almost always want to work on their own which makes it much easier for the teachers to attend to the other students when working on the computers. In this setting, other students seem to gravitate towards them for help when the teacher is busy helping another student.

The teachers, at times, found it tough to grade formal assignments for these students. For example, these students will like to go above the requirements for a Power Point presentation. They add extra effects and graphics which, places them at a higher level. However, the teachers do not want to grade the other students lower because they have met the requirements of the assignment.

The teachers also stated that very few students know anything about the hardware components of the computer. These teachers reported that they do not even teach the hardware aspects of the computer anymore. The students who are interested in the hardware are encouraged to attend the vocational school, which is better equipped to meet their needs. The students in this school seem to enjoy the software aspects of the computer. When it comes to hardware, the students just seem to want speed on the computers. One teacher gave the example of his senior year in high school. During this time, he built his own computer for college with the help of his high school computer teacher. He used it his first year of college and then needed something faster, so he just bought one. It was much easier. The students today see it the same way. The technology coordinator reported that the students she has observed enjoy the software. She added that "not too many are into the technical part of the computers." Students even complain about learning the html codes. They do not want to learn the codes, but instead they

just like to get right to the assignment. Years ago, computers were a novelty. Today, students want speed on the computers. They are not interested in what makes it work, only that it works and works fast.

3.1.3.4 Research Question Four

How do computer talented students tend to use computers in a recreational setting?

During study halls and free time, these students like to visit the teachers and technology coordinator to spend some extra time on the computers. The school does permit the students to access certain academic sites. These sites contain higher order thinking games that most average students can not do. The computer talented students enjoy visiting these websites, but the average students seldom do. When logged on to these sites, the students tend to get competitive with one another. These sites include games like puzzles, brain teasers and mazes. When playing these games, the students display unique spatial ability. When they finish formal assignments early, they also take the opportunity to visit these sites. In addition, the teachers reported that some of these students are very clever accessing sites they are not supposed to be accessing. One student absolutely crushed the web page. Although the teacher did not catch him, he knows the student who is responsible.

The technology coordinator noticed that in the past, these students were more self motivated to come into the labs during study halls. They would work on and troubleshoot the machines. Generally, these students had a good work ethic and were work oriented. Today, she has seen less and less of this behavior. She stated that "if students do not get a grade for it, they are not interested in the work." There are, however, two girls taking an advanced computer course with her through independent study. They are working on a kindergarten orientation

project for the school district. She stated that “they are willing to do the extra work.” They tend to be more creative and confident when working with computers.

3.1.3.5 Research Question Five

What social skill do computer talented students exhibit in the general educational setting?

Generally, the teachers and technology coordinator noticed no discernable difference in regards to social skills among these students. They have worked with all types of students that included those which were introverted, socially average and students they described as extroverts.

Although there are those students who come in and zone everybody out while working on the computer, they also mentioned a computer talented girl whom they described as a “social butterfly.” The technology coordinator also agreed that you have the computer geek, but socially, there are students talented in computers who are socially average. She remembered that she taught two brothers who would design their own computer games at home. They were not very social. Although they would not talk or open up to the other teachers or students, they would converse with her during the day. She stated that up until a couple of years ago, they would visit her at school and keep in touch with her.

3.1.3.6 Research Question Six

What leadership skills do computer talented students exhibit in the regular classroom setting?

The teachers reported that they will use computer talented students as team leaders when assigning a difficult group project. One teacher will explain the assignment to students they deem talented and then the student will explain it to the other students in the group. In this

situation, these students take on the leadership role. In other situations, they start out working individually and then form informal groups with the most talented students taking command.

These students will help the average students in the class. They are willing to share their expertise. In most cases, it was observed they are more than willing to assist teachers and other students. In some situations, they may want to help other students too much. If they give too much assistance to the other students, then these students lose the opportunity to learn the material.

These students are very comfortable when working with computers. It was agreed that this comfort level is brought to school from home. The teachers could determine who has home access and which students use computers extensively at home. They can also be critical of the teacher's use of technology in the classroom. At times, students will suggest a better way of doing something or presenting material in class. Teachers noted that this can get annoying.

3.1.3.7 Research Question Seven

What differences have teachers and technology coordinators observed between male and female students with regards to computer talent?

It was generally agreed upon that the boys were more willing to try new things on the computers. They seemed to be the students who were more adventurous and willing to take risks. One teacher added that "they'll push the envelope." They will search for more sites and go to more places they are prohibited from accessing. In this school, the teachers reported that upon examining the discipline violations, there seems to be a nine to one ratio of boys violating the acceptable use policies as compared to the girls. It was also noted that the girls have the ability, and when a girl does exhibit such computer talent, she is just as skilled as the boys. Also, boys

tend to excel in the technical areas of computer talent where the girls exhibit more creativity in this area.

As far as electing to take advanced computer classes, boys tended to choose to take these classes more than the girls. They noticed that if a girl has the choice to take an advanced computer class or a home economics class, they will choose the home economics class. However, the technology coordinator noted that "if the girls were interested, they were just as good as the boys."

One teacher in the focus group disagreed as far as the discipline policy is concerned. He noticed that he has seen no difference and stated that he sees the girls violating the acceptable policy just as much as the boys.

3.1.3.8 Research Question Eight

At what age levels do junior senior high school level teachers and technology coordinators begin to observe exceptional computer talent?

The teachers and technology coordinator in this school noticed the overall skills of the students seem to be lower as they come up from the elementary. They felt that the elementary curriculum does not seem to focus on the area of computer and technology use. They reported that "at the elementary, there are no formal computer classes." Because of the home access students have to computers, they have more knowledge about how they work but they have had little formal training. Because of this, the teachers have had to spend more time on "breaking bad habits" that the students have developed. However, after the first week of school, teachers seem to sense who is going to excel in this area.

The technology coordinator has noticed computer talent as early as eighth grade. However, she concurred that because there is an increase in home use, students are learning bad

habits before they enter the junior high school. Even the computer talented students develop bad habits. At times, she would pull them out of study halls to help them work on developing appropriate skills on the computers.

3.1.4 School D

3.1.4.1 Research Question One

What environmental factors influence the development of computer talent in the school setting?

This junior senior high school with a population of 435 students and 35 teachers contains approximately 200 computers. There is one full time lab and a mobile lab. In addition, there are three full time classroom computer labs and a library with forty computers available to students on a daily basis. Each teacher has a computer in his or her classroom. The special education teachers have laptops and there is wireless capability in the building.

The three teachers in this focus group teach a wide variety of courses which include accounting, advanced computer applications, scientific calculus, word processing and business math. On an average weekly basis, they incorporate computer use into lessons anywhere from 60% to 100% of the time. These teachers were confident that within this setting, they have identified students who display unique talent in computer use.

The teachers discussed several factors that they believe influence computer talent in the school. First, a separate programming track should be created for these students. This would allow them flexibility in scheduling courses. These students are often found in between the academic, business and vocational technical tracks that the school offers. A separate track for them with a program of study to meet their individual needs would give them the opportunity to

enhance their knowledge of technology and computer skills. They can be assigned projects that would benefit the school while enabling them to show off their talents. It was suggested that they be allowed to take ownership of the schools web site with certain limitations. In addition, these students like to be depended upon for certain chores or projects. A special club could be formed for them in which they could work together on school projects which in turn would showcase their talent. The teachers felt it was important to show these students that they could be trusted within a technology enriched environment. In turn, this creates an opportunity for them to develop their computer skills. One teacher noted that it is important to "give them some ownership of some things like the web site."

The teachers also noted that within this school, there is a stigma that the vocational technical school is no place for academics or technology. However, the local vocational school provides the latest programs in software and hardware programs. It seems that the stereotype that the vocational school is a placement for the lower academic students still permeates the school's atmosphere. Currently, there are eight schools affiliated with the local Career and Technology Center. Together these schools could provide the resources available to provide advanced opportunities for this group of students while keeping them updated on the latest developments in computer technology.

Individually, the school also needs to keep pace with these latest developments in computer technology. The teachers understood that every school must operate within the limits of the district's budget. However, a sufficient portion of the budget needs to be allocated to updating computers and technology. This gives computer talented students access to all different types of technology and hardware programs. By doing so, the schools technology environment remains enriched which directly influences the development of computer talent.

3.1.4.2 Research Question Two

In which academic subject areas do computer technology talented students seem to excel?

Within this school, these students were identified as strong in the area of math. However, this was not the only subject area that the teachers reported in which these students excelled. They were also described as very good problem solvers. In addition, they tend to be more analytical and creative in their thinking than their average peers. They are persistent when working on an assignment and those who are adept at programming very often resist any help from the teachers. They have the ability to go back, rethink and find their mistakes in a program. They also described these students as intuitive self learners who are not afraid to try new things. For example, one teacher asked a student to make a computer generated video presentation for her. Even though the student admitted that he never did this before, he was still willing to try. They also pay attention to minute detail. The teachers were also able to discern the fact that these students have prior knowledge in the area of the computer that they have gained from home. Some of these students come from affluent homes which have provided enriched opportunities for them.

3.1.4.3 Research Question Three

How do computer talented students use computers in and educational setting?

If assignments and class projects are not challenging enough for them, they tend to get frustrated easily. They do not like lectures nor do they like being given directions and prefer to do the assignment on their own. In fact, the teachers have noticed that some of the students "roll their eyes" during lectures. They take pride in completing assignments that challenge them. In addition, a teacher reported that "if something goes wrong, they don't give up. They want to

figure it out." For instance they take pride in the fact that they can break into the school's computer network. "They are not shy or afraid to try new things."

Computer talented students do like to help others when working on classroom assignments. Many times, the teachers learn new things from them. However, they can be critical of the teacher when he or she makes a mistake. When working on formal classroom assignments, one teacher likes to group them with the weaker students because they like to help out. In a formal setting, the teachers reported that they do not always know how they are thinking when figuring out a computer program. They tend to think differently than other students when finding a solution to an assignment. One of the teachers described a student as "creepy" in his ways with regards to his problem solving skills.

As far as a preference for hardware or software programs, the teachers in this focus group agreed that they have observed an equal number who enjoy and are skilled at both aspects of computer technology. They tend to see that it is important to understand both.

3.1.4.4 Research Question Four

How do computer talented students tend to use computers in a recreational setting?

Again, teachers noted that these students bring to school a vast knowledge of the computer technology from prior home usage. They like to work on computers during free time such as study halls and homerooms. Many will ask for a pass to come and visit the teachers and work on the computers. They like doing the general maintenance on the computers such as cleaning them. They get excited about taking them apart and putting them back together.

The teachers have also observed them going to sites that provide challenging higher order thinking games. One teacher noticed them playing "impossible quiz," a game consisting of 110 questions that is supposed to be impossible to beat. He stated that these students enjoyed "doing

something with their brain." During this time, he stated that these students do not give up and try very hard to beat this game. Generally, they like knowledge games. They gravitate towards games that push them to think very hard.

3.1.4.5 Research Question Five

What social skills do computer talented students exhibit in the general educational setting?

The teachers agreed that this type of student can not be categorized as introverted or extroverted. They have observed that some are shy, some are socially average and some are extroverted. They have also noticed that when average students who are not as skilled as they on the computer are experiencing difficulty, they want to lend a hand. They are generally good academic students who tend to be on the mature side. "The quieter ones tend to be the programmers." Some want to go onto the social sites such as Myspace but the school's security system prevents this. Some have a tendency to lose themselves on the computer by zoning out the rest of the world.

3.1.4.6 Research Question Six

What leadership skills do computer talented students exhibit in the regular classroom setting?

The regular students or the students who are not as skilled on the computer know who these students are in school. They tend to want to do the technology coordinator's job, and at times, they have to be reigned in. In almost every case, they are more than willing to help others who are having trouble. During a group project, they are the students who take charge. The teachers have also noticed that they can speak the technology language to another student who is just as talented as they are with computers.

3.1.4.7 Research Question Seven

What differences have teacher and technology coordinators observed between male and female students regarding computer technology talent?

In the past, it was agreed upon by the focus group that the boys dominated in this area. Today, however, these teachers have observed that girls are now showing more interest in computers and the technology the school has to offer. One of the teachers mentioned that today, "the girls are coming on." The teachers who teach ninth grade students have noticed that girls are showing unique ability in computer use, especially exhibiting higher order creative thinking skills. It also was noted that the girls tend to be able to create things such as a transition points in a video presentation better than the boys. In addition, teachers have observed an increase of girls taking programming classes. One teacher stated that in the past the programming classes were almost exclusively boys. However, today the girls are coming on strong in this area. Girls who display exceptional talent with computers tend to be better readers. As such, they read the directions for a programming assignment and then want to get right into it.

Finally, one teacher found it interesting that he has observed that boys are better with the technology aspects of computers, while the girls tend to exhibit more creativity with graphics and video productions.

3.1.4.8 Research Question Eight

At what age levels do junior senior high school teachers and technology coordinators begin to observe exceptional computer talent?

The focus group all came to the general consensus that students who exhibit exceptional computer talent begin to show that talent in the ninth grade. By this time, these teachers can determine which students are several steps above their regular peers. By the time they reach the

tenth grade, they usually want to take the advanced computer and programming classes. The teachers also noted that by this time, “you can tell the ones who use computers at home.”

3.1.5 School E

3.1.5.1 Research Question One

What environmental factors influence the development of computer talent in the school setting?

The teachers and students in School E have access to two mini labs on each of the school’s two floors. There is also one teaching lab along with a word processing lab. In addition, each teacher has access to two computers in his or her room. The math and science departments have their own mobile labs. The school also provides a CAD lab with twenty computers available. All in all, this school contains about 200 computers for 400 students in grades 8 through 12.

During the week, the four teachers in this focus group reported that they use computers in their lessons anywhere from 15% to 90% of the time. Courses taught by these teachers include journalism, computer technology, web design, computer science I and II, keyboarding, accounting and anatomy and physiology I and II.

The teachers felt that it was also important to create an environment which allows these students the opportunity to show off their computer skills. Teachers need to reverse the learning situation and feel comfortable with the fact that these students are more skilled than they may be with computers and technology. Furthermore, teachers need to show respect for this talent which in turn makes these students want to do more in class.

3.1.5.2 Research Question Two

In which academic subject areas do computer talented students seem to excel?

Within this school setting, the teachers have observed that students who display exceptional talent in computers seem to excel in other subjects as well. However, the teachers reported that these students excel in different subject areas including not only math but music and art. More importantly, it was discussed that these students use computers to accentuate other subject areas. They like to apply and push their unique ability to the limits. One teacher stated that "if these students like something they take it serious. If not, they shut down." They tend to demonstrate higher order thinking skills including exceptional spatial reasoning. Computers just seem to stimulate these students to learn. They seem to have a drive to use the computers in the classroom. In addition, computer talented students exhibit divergent thinking skills when working on classroom assignments. Furthermore, these students tend to be able to branch out in their problem solving skills, whereas the regular students do not seem to possess this ability.

3.1.5.3 Research Question Three

How do computer talented students tend to use computers in an educational setting?

When given formal assignments, the teachers have observed that some students deemed exceptional in this area want to dive right into the assignment while others tend to procrastinate. Some students like to work under pressure and pull an all-nighter the day before the project is due. They do not like authoritarian structure. These students do not like a rigid learning atmosphere. The computer talented students want to explore projects and find solutions on their own. One important observation made by the teachers was that these students tend to be "under motivated" unless the assignment is something they like and something that challenges them. If these students like something, they take it seriously, if not, they tend to shut down. These

students are always trying to think how to use the computer more effectively. When finished with formal assignments, they like to do other things on the computers. They tend to be self starters who like to work independently.

In this school, the computer talented students tend to prefer the software programs now available to them today. However, it should be noted that the more talented a student is on the computer, the more they tend to be interested in the hardware components. Over time, the teachers, noticed that over the last ten to fifteen years, the interest has been in the software rather than in the hardware. Today, the challenge for them seems to be in the software programs. In addition, availability of hardware is now limited in this school. The teachers felt that this needs to be addressed because in the real world, an understanding of the hardware components is just as important as the software programs.

3.1.5.4 Research Question Four

How do computer talented students tend to use computers in a recreational setting?

These students tend to gravitate towards the social web sites such as AIM or Myspace. They are also very adept at researching topics that interest them on the computers. One teacher described them as "reading researchers." In addition, "they are constantly reading and searching for new sites." They like to explore and spend time playing computer games. These games are usually ones in which the player has to use higher order thinking skills. Such games include "Break Away", "Take over the World" and "Halo". In addition, they also like sudoku, mahjong and chess. The teachers noted that when playing these games with other exceptional students, they tend to be very competitive.

Other times, it was noted that these students will spend quiet time on the computer when finished with a formal assignment. One teacher described them quiet "A" driven individuals.

3.1.5.5 Research Question Five

What Social Skills do computer talented students exhibit in the general educational setting?

There was no one personality type that the focus group could assign to these students. In their words, the teachers noticed that these kids "run the gamut." Throughout their experiences, they have seen students who have been introverts, extraverts and those who have been socially average. They tend to like to help others less skilled than they are with technology. Some tend to be quiet towards their peers but open up more to the teachers.

3.1.5.6 Research Question Six

What leadership skills do computer talented students exhibit in the regular classroom setting?

These students tend to be very motivated and get gratification out of helping others not as adept as they with computer technology. Also, they go out of their way to help the teachers when they are experiencing problems. In doing so, the teachers noted that this boosts their self esteem and their self worth. They offer to teach the teacher and get pride out of doing so.

3.1.5.7 Research Question Seven

What differences have teachers and technology coordinators observed between male and female students regarding computer talent?

In this school, it was observed that boys seem to be more interested in the computers overall because of the hands on activities. The teachers compared this to science classes in which boys tend to be more interested because of the hands on lab activities. However, this observation was based only on interest. When there is interest, girls seem to do just as well as the boys.

Furthermore, it was noted that girls tend to exhibit better spatial ability when working on computer assignments and projects. "When it comes to spatial ability, girls seem to do quality work." They seem to be more conscientious with their work than the boys. Boys tend to just want to get the assignment done.

3.1.5.8 Research Question Eight

At what age levels do junior senior high school teachers and technology coordinators begin to observe exceptional computer talent?

Generally speaking, the focus group agreed that computer talent in these students begins to emerge between the second semester of their eighth grade year and their ninth grade year. One teacher noted that "play becomes more mental than physical in the upper grades." During this time, they have observed higher order thinking skills being displayed by this group of students. They tend to also be more organized in their thinking. There also tends to be more progression and maturity beginning in the second semester of their eighth grade year into the ninth grade.

3.2 SUMMARY OF RESULTS ACROSS THE FIVE SCHOOLS

This chapter includes a comparison of the data that were collected among the five junior senior high schools in Western Pennsylvania. The total number of participants in this study was 20 which included teachers and technology coordinators chosen by the building principal who could identify characteristics of students who display a unique talent in computer use. After summarizing the data collected from the five public schools studied, the researcher categorized the findings for each research question by comparing descriptor statements from the five focus

groups and technology coordinator interviews. Similar descriptor statements drawn from the interviews were then grouped together. The number of similar responses provided was then rated on a four point scale. Similar responses that ranged from nine or more were given an exemplary evidence rating. Next, similar responses that ranged from between six and eight were given a rating of strong evidence. The number of similar responses that ranged from three to five indicated that some evidence existed with this category. Finally, the number of similar responses below three indicated that limited evidence existed to support this category (See Tables 1 through 8). A qualitative analysis of the data across the schools for each research question follows.

3.2.1 Research Question 1

Which environmental factors influence the development of computer talent in schools?

Six factors were identified by the teachers and technology coordinator that they believed influenced the development of computer talent in school (see Table 1). The most important factor was the amount of time teachers incorporate or use computers in their lessons. The number of similar responses given in this category was eight, which indicates that there is strong evidence to suggest that the time teachers use computers in their lessons influences computer talent. The responses given also included advanced group projects which benefit the school.

The next factor that the teachers felt influenced computer talent was an enriched technology environment. The number of similar responses reported was seven, which indicated that strong evidence exists that a technology enriched environment influenced computer talent (see Table 1). An enriched environment included a sufficient number of computers in the

school, computer programs available and keeping up on the latest in computer technology. The teachers and technology coordinators in each of the five schools generally agreed that they had sufficient access to computers and technology on a daily basis.

Table 1 Environmental factors that influence the development of computer talent in schools

Descriptor Statement(s)	Number of similar responses	Evidence rating
Teacher use of computers in lessons. Advanced group projects.	8	3
Enriched school technology environment.	7	3
Set policies that promote positive use of technology and foster creativity.	6	3
Show these students respect and trust. Be comfortable with them in class.	4	2
Prior home use.	4	2
Attend vocational technical school for advanced classes.	3	2

*Scale

Type of Evidence	Number of Similar Responses	Evidence Rating
Exemplary Evidence	Nine or More	4
Strong Evidence	6-8	3
Some Evidence	3-5	2
Limited Evidence	1-2	1

Policies that promote the positive uses of technology in schools were next identified as an important factor. The number of similar responses was six, which suggested again that strong evidence exist that school district policies affect the development of computer talent in schools (see Table 1). It was also noted that these policies should promote creativity and allow computer talented students the opportunity to show off their abilities.

Building trust and showing these students respect along with creating a comfortable atmosphere in the classroom yielded an evidence rating of two. In addition, access to and the use of computers at home and attending the local vocational technical school for advanced computer classes also yielded an evidence rating of two.

3.2.2 Research Question 2

In which areas do computer talented students seem to excel?

By far, the teachers and technology coordinators who participated in the study indicated that these students have the ability to think logically, divergently and analytically. They also stated that these students have unique spatial ability and are the best problem solvers in their schools. The number of similar responses was 19, which yielded an evidence rating of four (see Table 2). It should be noted that this was the highest amount of similar responses found in the study.

Other characteristics identified by the teachers indicated that these students enjoy working independently, have strong mathematical ability, like to compete with one another and enjoy exploring other web sites while on the computer. However, the number of similar responses for these three characteristics was five, which yielded an evidence rating of only two (see Table 2).

Table 2. Academic areas in which computer talented students excel.

Descriptor Statement(s)	Number of Similar Responses	Evidence Rating
Logical, divergent, analytical thinkers. Possess good spatial reasoning. Good problem solvers.	19	4
Work independently. Self learners. Resist help from the teacher.	5	2
Strong mathematical ability.	5	2
Competitive. Like to explore on the computer.	5	2
Meticulous, persistent, pay attention to detail.	4	2
Well organized. Make good use of their time.	3	2
Art.	3	2
Music.	2	1
Can multi-task on the computer.	2	1
Not strong in any particular area.	2	1

*Scale

Type of Evidence	Number of Similar Responses	Evidence Rating
Exemplary Evidence	Nine or More	4
Strong Evidence	6-8	3
Some Evidence	3-5	2
Limited Evidence	1-2	1

Other characteristics attributed to these students indicated that they were meticulous, persistent, pay attention to detail, well organized and they made good use of their time. Art and Music were other subjects in which some of the teachers felt they were strong. It was also mentioned that they could multi task and were not necessarily strong in any particular subject areas.

3.2.3 Research Question 3

How do computer talented students tend to use computers in an educational setting?

There were ten similar responses given which indicated that computer talented students do not like lectures and authoritarian structure. They enjoy working independently and at their own pace. Ten similar responses were given to support this notion which yielded an evidence rating of four (see Table 3).

Other responses which yielded evidence ratings of two or three indicated that these students take pride in a challenge, prefer software programs over hardware, grades do not seem to be important for them and they become bored quickly if not challenged.

Some other characteristics mentioned by the teachers included such things as these students think differently, go above on assignments, procrastinate and they can be critical of the teacher at times. These characteristics had evidence ratings of one (see Table 3).

Table 3. Computer use by computer talented students in an educational setting

Descriptor Statement(s)	Number of Similar Responses	Evidence Rating
Do not like lectures. Do not like structure. Work independently.	10	4
Take pride in a challenge. Confident.	6	3
Prefer software over hardware. Only concerned with speed and memory.	5	2
Grades not a factor for them. Potential not being tapped.	5	2
Need to be challenged. Become bored quickly.	4	2
Prefer hardware components.	3	2
Think differently. Can explain things differently to other students.	2	1
See the value of both software and hardware.	2	1
Go above on assignments	2	1
Enjoy helping others.	2	1
Procrastinate	2	1
Can be critical of the teacher at times.	1	1

*Scale

Type of Evidence	Number of Similar Responses	Evidence Rating
Exemplary Evidence	Nine or More	4
Strong Evidence	6-8	3
Some Evidence	3-5	2
Limited Evidence	1-2	1

3.2.4 Research Question 4

How do computer talented students tend to use computers in a recreational setting?

The teachers and technology coordinators gave nine similar responses to the interview questions pertaining to this research question (See Table 4). They indicated that computer talented students enjoy going to web sites that offer them the opportunity to engage in challenging games. These games require them to use higher order thinking skills and included such games as chess, mahjong, puzzles and mazes. The nine responses given yielded an evidence rating of four.

Other activities that these students like to do in their free time in class is to spend quiet time on the computer, explore, research and attempt to access prohibited sites. However, these areas only gained evidence ratings of only one's and two's.

Table 4. Computer use by computer talented students in a recreational setting

Descriptor Statement(s)	Number of Similar Responses	Evidence Rating
Enjoy challenging games such as puzzles, mazes, chess, brain teasers.	9	4
Like to spend quiet free time on the computer.	3	2
Very competitive with one another.	3	2
Think differently. Think out of the box.	2	1
Like to explore and research on the computer.	2	1
Graphics and videos get their attention.	2	1
Self motivated.	1	1
Like to access prohibited sites.	1	1
Tend to speak the technology language to one another.	1	1
Stay busy.	1	1
Enjoy doing general maintenance on the computers.	1	1

*Scale

Type of Evidence	Number of Similar Responses	Evidence Rating
Exemplary Evidence	Nine or More	4
Strong Evidence	6-8	3
Some Evidence	3-5	2
Limited Evidence	1-2	1

3.2.5 Research Question 5

What leadership skills do computer talented students exhibit in school?

Exemplary evidence was found which indicated that these students enjoy helping their teachers and fellow students who are less skilled than they on the computer. Thirteen similar responses were given to support this finding which gained an evidence rating of four (see table 5).

Strong evidence suggests that these students like to take charge during group projects. Teachers use them as student leaders when working in groups. Seven similar responses support this and there is an evidence rating of three.

These students enjoy troubleshooting problems on the computers. They can also speak a similar technology language to other students who are as skilled as they. Other students know of their talent and come to rely on them for assistance (see Table 5).

Table 5. Leadership skills exhibited by computer talented students in school

Descriptor Statement(s)	Number of Similar Responses	Evidence Rating
Enjoy helping teachers and fellow students.	13	4
Take charge of group projects. Used as student leaders. Do extra work.	7	3
Like to troubleshoot computer problems.	5	2
Others rely on them. Other students know who they are.	4	2
Comfortable working in technology environment	1	1
Can speak the technology language to one another.	1	1

*Scale

Type of Evidence	Number of Similar Responses	Evidence Rating
Exemplary Evidence	Nine or More	4
Strong Evidence	6-8	3
Some Evidence	3-5	2
Limited Evidence	1-2	1

3.2.6 Research Question 6

What social skills do computer talented students exhibit in school?

Teachers and technology coordinators across all five schools agreed that these students cannot be categorized into any one personality type. Some are shy and introverted, some are extroverted and some are socially average. Ten similar responses were recorded in this area which indicates exemplary evidence of this (see Table 6).

These students also tend to be mature for their age, have a witty sense of humor and enjoy helping others. It was also noted that these students tend to stay out of cliques and the school drama.

Table 6. Social skills exhibited by computer talented students in school

Descriptor Statement(s)	Number of Similar Responses	Evidence Rating
Can not be categorized into any one personality type.	10	4
Enjoy helping others less skilled as they.	4	2
Some are quiet towards fellow students but open to teachers.	3	2
Mature for their age. Witty sense of humor.	3	2
Some tend to zone out while on the computer.	2	1
Stay out of school cliques and school drama.	2	1
Good academic students.	1	1
Don't flaunt their ability.	1	1
They can identify other students who are computer talented.	1	1

*Scale

Type of Evidence	Number of Similar Responses	Evidence Rating
Exemplary Evidence	Nine or More	4
Strong Evidence	6-8	3
Some Evidence	3-5	2
Limited Evidence	1-2	1

3.2.7 Research Question 7

What differences have been observed between male and female students regarding computer talent?

There was even disagreement among the teachers and technology coordinators in this area of study. Ten responses were recorded in which the teachers observed only boys whom they identified as computer talented. However, ten responses were also recorded in which other teachers have observed an increase in girls over the past several years in this area (see Table 7).

It should be noted that there were five responses which stated that the girls have the potential but in many cases, not the same level of interest as the boys do when it comes to computer use. Furthermore, five responses were given in which the teachers stated that girls exhibit better spatial ability and are more creative (see Table 7).

Table 7. Differences between male and female students regarding computer talent

Descriptor Statement(s)	Number of Similar Responses.	Evidence Rating
Teachers have seen only boys who are computer talented.	10	4
There is an increase of girls who are computer talented.	10	4
Girls have better spatial ability. Girls are more creative.	5	2
Boys violate computer policy more than girls. Willing to try new things.	4	2
Girls have potential but not the interest.	3	2
Girls are more conscientious in their work.	1	1
Boys just want to get assignments done.	1	1
Girls violate computer policy just as much as the boys.	1	1

*Scale

Type of Evidence	Number of Similar Responses	Evidence Rating
Exemplary Evidence	Nine or More	4
Strong Evidence	6-8	3
Some Evidence	3-5	2
Limited Evidence	1-2	1

3.2.8 Research Question 8

At what age levels do junior-senior high school teachers begin to observe exceptional computer talent?

Exemplary evidence suggests that teachers begin to notice such talent between the second semester of the eighth grade year and the ninth grade year. Sixteen similar responses were given to support this observation (see Table 8). Furthermore, five responses were given in which the teachers attributed computer talent to home access. It was also noted that four responses stated that these students are mature and more comfortable working with adults.

Table 8. Age at which junior senior high school teachers and technology coordinators begin to observe exceptional computer talent.

Descriptor Statement(s)	Number of Similar Responses	Evidence Rating
Between second semester eighth grade and ninth grade.	16	4
Gained computer skills from home use.	5	2
Mature, comfortable working with adults.	4	2
No formal training in the elementary schools.	2	1
Sixth and seventh grade students do not want to branch out on the computer.	1	1

*Scale

Type of Evidence	Number of Similar Responses	Evidence Rating
Exemplary Evidence	Nine or More	4
Strong Evidence	6-8	3
Some Evidence	3-5	2
Limited Evidence	1-2	1

4.0 IMPLICATIONS FOR POLICY AND PRACTICE

The results of this study, a profile of students who display exceptional talent in computer technology developed from the observations of junior high teachers, senior high teachers and technology coordinators in five public school systems, are discussed in this chapter. The data for this study were collected by interviewing focus groups of teachers in five public schools located in Western Pennsylvania. The technology coordinators were interviewed face to face with the researcher. The researcher believed that these professionals were in the best position to observe, identify and discuss characteristics attributed to students who are talented in computer technology. To support these data collection techniques, in his report to Congress, Marland (As cited in Stephens & Karnes, 2000, Section on Federal Definition, ¶ 3) stated that "children and talented children are those identified by professionally qualified persons and by virtue of outstanding abilities are capable of high performance." The researcher analyzed the data within and across the five schools. The results of the study can be found in chapter three. Findings from this study indicated that there was general agreement among the teachers and technology coordinators that:

> A group of students do exist within schools who display a unique talent in computer technology.
>
> Teachers and technology coordinators were in a position to observe certain behaviors exhibited by these students.

Based upon the evidence gathered, a profile can be developed that describes unique characteristics that can be attributed to these students.

Schools can use this profile to implement programs which develop and enhance the skills of students who are identified as computer talented.

Table 9. Summary of similar descriptor statements about computer talented students which yielded exemplary evidence.

Descriptor Statement(s)	Number of Similar Responses
Logical, divergent, analytical thinkers. Possess good spatial reasoning. Good problem solvers.	19
Computer talent emerges between the second semester of the eighth grade and the ninth grade.	16
Enjoy helping teachers and fellow students.	13
Do not like lectures. Do not like structure. Enjoy working independently.	10
Can not be categorized into one personality type.	10
Teacher have only seen boys who are computer talented.	10
There is an increase of girls who are computer talented.	10
Enjoy challenging games such as puzzles, mazes, chess, mahjong.	9

The data were categorized by each of the eight research question. Descriptor statements were drawn from the discussions of each interview. Similar descriptor statements were then grouped together. Based upon the number of similar descriptor statements, the evidence was rated as either "exemplary", "strong", "some" and "limited evidence" and a numerical value was assigned to category of similar descriptor statements (see Tables 1 through 8). In this chapter, only the number of similar descriptor statements which were rated as "exemplary" is discussed. From these descriptor statements emerged a profile of students who display unique ability when using computer technology. In the review of the literature, Lazaer (As cited in Brualdi, 1996, Section on Authentic Assessment, ¶ 2) found that "it is important that a teacher create an 'intelligence profile' for each student. Knowing how each student learns will allow the teacher to properly assess the child's progress."

During the interviews, the teachers and technology coordinators where asked to identify subject areas in which computer talented students seem to excel. From the data collected, 19 similar statements were drawn from the discussions, which indicated that these students are able to think logically, analytically and divergently (See Table 9). They also have exhibited higher spatial reasoning than their average educational peers with regards to computer talent. Although math and other subjects such as music and art were also mentioned and discussed, overall, these students were identified as the best problem solvers.

Supported by the literature, this has implications for classroom teachers. Feldhausen and Sayler (1990) found that "ideal instruction for the gifted seems to involve higher level content which matches or nearly matches their achievement levels, faster paced instruction, and enrichment which extends the boundaries of study or investigation to topics not typically addressed in the regular mainstream curriculum" (¶ 2). Although this study did not attempt to

identify this group of students as gifted according to any state or federal guideline, there are strong implications for schools to implement and promote special programs similar to that for the gifted for these students because of their unique computer talent. Along with this, Siegle (2004) stated that "like any student with a gift, technologically gifted students need to have their gifts recognized and nurtured" (Conclusion Section, ¶ 1). Furthermore, O'Brien et al (2005) studied a similar group of students and found that "nearly the entire group mentioned logic, problem solving, and programming as part of their technological strengths" (Section on Programmers, ¶ 2). In addition, they reported that "these students also rated themselves high on spatial thinking." (O'Brien et al 2005, Section on programmers, ¶ 2).

Teachers and technology coordinators were asked to describe how computer talented students use computers in an educational setting. Ten similar descriptor statements were drawn from the interview which stated that these students do not like the lecture format of instruction (See Table 9). In addition, they do not like structure and prefer to work independently with little or no direction from the teacher when given a formal classroom assignment. These students ask few questions, and if they do, they tend to be higher order questions. It should be noted that the higher order questions that these students asked helped the teachers identify them as exceptional in computer technology.

A review of the literature indicated that schools needed to find ways to help all students achieve. In his Schoolwide Enrichment Model, Renzulli (2002) outlined a method for schools to accomplish this. He argued that schools and teachers needed to provide opportunities to assure that each student "achieve his or her maximum potential" (p. 82). Similarly, Siegle (2004) suggested that "advanced technologies beyond their school may be necessary to develop technologically gifted students' potential to the fullest" (Conclusion section, ¶ 1).

When working in a recreational setting, teachers and technology coordinators observed that these students enjoy web sites that provide challenging games. A recreational setting was defined as those times when students are on the computer during homeroom, study halls or those times when they finish classroom assignments ahead of the other students in class. These games require the individual to use higher order thinking skills. The teachers also observed that students who were not as skilled on the computer normally do not visit these web sites. Nine similar descriptor statements were given to support this observation (See Table 9). These games included such things as puzzles, brain teasers and mazes. They also seemed to enjoy games such as chess, sudoku, and mahjong. Computer talented students usually play these games with other students who are as skilled as they are. The teachers noticed that they can get very competitive against each other when playing these challenging games.

To support these findings, Feldhusen and Saylor (1990) found that "ideal instruction is challenging and gives gifted youth opportunities to test the limits of their talent and ability through daily interaction with other gifted youth" (¶ 2).

Teachers and technology coordinators were asked to identify if they observed any leadership skills displayed by students who possess unique computer talent. From the interviews, 13 descriptor statements were recorded that indicated that these students enjoy helping teachers and fellow students who are less skilled than they in computer technology (See Table 9). Similarly, O'Brien et al. (2005) identified a group of students whom they described as "interfacers." They found that these students "enjoyed helping their teachers and peers at school with their computer technology problems" (Section on Interfacers, ¶ 1). Furthermore, Peck, Cuban and Kirkpatrick (2002) identified a student they deemed as computer talented. They

found that “tech coordinators, teachers and other students all rely on his substantial technical computer expertise, almost entirely self-taught, to help solve various computer problems” (¶ 2).

With regards to social skills, the majority of teachers and technology coordinators agreed that the stereotype of the “computer geek” does not exist in their schools. These students can not be classified into any one personality type. Some may be introverted, extroverted or socially average. Watching them in the halls or at lunch, the teachers couldn’t tell the difference between them and the other students. Ten descriptor statements indicated that these students could not be categorized into any one personality type (See Table 9).

Peck Cuban and Kirkpatrick (2002) described a computer talented student as “an eighteen year old senior with long brown hair, and a thoughtful engaging manner, Jason Swift does not fit the prominent cultural stereotype of the bespectacled, socially awkward ‘techno geek’ ” (¶ 2). With regards to gifted education, Renzulli (2005) found that “the Achilles heel of gifted education has been its inability to adequately include children who do not fall into the nice, neat stereotype of good test takers and lesson learners-ethnic minorities, underachievers, children who live in poverty, and young people who show their potential in nontraditional ways” (p. 80).

The teachers and technology coordinators were asked if they had noticed a difference between computer talent and gender. Were there more boys than girls that exhibited computer talent? Perhaps there were more girls than boys who possessed such talent. Perhaps they observed no difference in computer talent and gender.

The data seems to indicate that there is disagreement in this area of the study. There were 10 similar descriptor statements that indicated that some of the teachers and technology coordinators had observed that only boys exhibited such talent. However, an equal number of descriptor statements indicated that other teachers and technology coordinators who participated

in the study noticed an increase in the number of girls who are displaying computer talent (See Table 9). When girls show an interest in computer technology, they have an equal amount of ability and are just as skilled as the boys. Those girls that they have identified as computer talented were just as skilled as the boys and just as competitive.

The researcher found limited research on the relationship between computer technology talent and gender. McLester (1998) found that "though girls and boys begin with a level playing field where technology is concerned, showing equal enthusiasm and competence in computer-related school classes, in the upper-level elementary years girls gradually lose interest in digital pursuits: a trend that accelerates as they move on into high school, college and careers" (¶ 2). Similarly, Cooper and Weaver reported (2003) that "the tough issue with which society must come to terms is that computer anxiety inequitably affects girls more than boys" (p. 14). Although the potential for computer talent exists in girls, schools must create equal opportunities for girls to advance in computer technology. To support these findings, Christiansen et al (2005) stated that "regardless of cause for gender differences in attitudes toward technology, it appears that teachers are in a position to closely monitor equity in the educational setting, and the relative newness of technology's integration into the curriculum affords a unique opportunity to start from the beginning" (Section on Professional Development, ¶ 1).

The final research question attempted to determine a specific age at which teachers and technology coordinators begin to observe exceptional computer talent emerge in students. Sixteen similar descriptor statements indicated that the teachers and technology coordinators observed that computer talent begins to emerge between the second semester of the eighth grade and the ninth grade (See Table 9). Some of the teachers indicated that the emergence of

computer talent at this age is similar to the emergence of athletic ability, which also begins to get noticed at about the same time.

Current research yielded little or no evidence to suggest that computer talent emerges at this particular time. However, Marland (as cited in Stephens & Karnes, Section on Federal Definition, ¶ 4), stated that "the term gifted and talented children means children and, whenever applicable youth, who are identified at the preschool, elementary, or secondary level as possessing demonstrated or potential abilities that give evidence of high performance."

Out of this study, an important question arises for schools. Can school districts enhance the development of students who exhibit exceptional talent in computer technology? Currently, it can be argued that there are certain schools that have focus on certain areas of talent development. These schools tend to consistently develop specific talents in students. One example of this talent development is in the area of athletics. There are schools which have football programs that are successful from year to year. Another area of this talent development is in areas of music and the arts. There are also certain schools that are well known to have programs which foster talent development in music, drama, dance etc. What are these schools doing on a consistent basis to foster these talents? In addition, can schools become centers for talent development in the area of computer technology? From the data collected in this study, a profile emerged which indicated that certain characteristics can be attributed to students who possess unique computer skills. A summary of descriptor statements, which yielded exemplary evidence, is presented in Table 9. Schools could use this profile to develop curricula which provide unique learning opportunities for these students and enhance computer talent. A summary of this profile includes the following characteristics.

Computer talented students seem to possess higher level thinking skills in addition to higher spatial reasoning. Thus, they tend to be very adept at solving complex problems. Accordingly, teachers should adapt their lessons to provide challenging opportunities to these students.

It was reported by the teachers and technology coordinators that these students do not like the traditional lecture method of instruction. Teachers should adapt lessons and provide instruction which permits them to work independently in a less structured setting.

Computer talented students enjoy playing higher level thinking games which provide opportunities for them to push the limits of their ability. These students should be permitted to engage in web sites which provide such opportunities. Also, competition on assignments, projects, games etc., should be encouraged.

Opportunities should be provided which allow them to assist teachers and other students not as skilled as they are when working with computer technology. They could be permitted to work with the technology coordinators during the course of their school day. They like to trouble shoot technical problems that teachers and students encounter when working with computers.

When identifying these students, they should not be stereotyped into any one personality type. For the most part, they are socially average and function as such during the course of their school day. The teachers and technology coordinators reported that the stereotypical "computer geek" is more the exception than the rule.

Although computer talent has been a male dominated area in the past, teachers need to provide opportunities which encourage girls' interest. When there is interest shown by girls in this area, they exhibit the same amount of skill as the boys.

Programs should be implemented and designed so as to address computer talent during the eighth and ninth grade years. Numerous methods of acceleration are discussed in chapter one, in the review of the literature. Where schools begin to track students into advanced math, english, science, and social studies programs, they should also provide advanced computer technology classes for these students which are well above the regular curriculum.

APPENDIX A

LETTER TO PRINCIPAL

Name of Principal
Street number
City, state, zip

April, 2007

Dear Principal,

This is a request for several of your teachers and building technology coordinator to participate in a study to identify a profile of technologically talented students in your school.

My name is James Cekada and I am a Doctoral Student in the Education Department at the University if Pittsburgh. Dr. Charles Gorman, a faculty member in the School of Education, is serving as my advisor and is directing my research.

I am attempting to identify a set of attributes/behaviors unique to those students who display an exceptional talent in computer use. Since the early 1990's, public schools have become more increasingly inundated with computers. In addition, teachers and students use and interact with

computers on a daily basis. In light of this, it is my belief that a certain group of students are being informally identified by teachers and technology coordinators as exceptional.

Sometime in April or May, I would like to meet with a group of three to four teachers for approximately an hour that you identify and would be willing to share their stories and experiences about these students. I would also like to interview your technology coordinator one on one for about an hour to share their experiences they have had with these students. Enclosed is a set of questions I would use to lead the discussion with the teachers as well as a set of interview questions for the technology coordinators. However, the conversation is open ended and not strictly geared toward these questions. **I want to hear their stories and experiences they have had with these students**

The stories I receive are valued pieces of information and will be kept strictly confidential and no students will be identified by name during our meetings. In addition, you and your staff will not be traceable or identifiable in the study. If you and your staff wish to participate in this study please sign below and return to me by fax at 814 536-4025.

Sincerely,

James F. Cekada Jr.

Signature/Date:_____

I agree to have my teachers and technology coordinator participate in your study. I understand it is voluntary and I may withdraw my consent at any time.

APPENDIX B

SCRIPT TO BE READ TO THE FOCUS GROUP OF TEACHERS

Hello, my name is James Cekada. I am Principal of Conemaugh Valley Junior Senior High School and a graduate student in the School of Education at the University of Pittsburgh. I am conducting research in an attempt to develop a profile of attributes or behaviors unique to students who display an exceptional talent in using computers. For that reason, I want to interview to gain your input into this area. The interview should last approximately one hour. Through your experiences as classroom teachers, librarians, etc. you can help us learn more about the specific behaviors or traits of these students through this discussion. I want you to understand that I have developed a set of structured questions to lead this discussion. However, **I want to hear your stories and experiences in working with these students.** Pleased be assured that your answers will be kept strictly anonymous and confidential, and your name will not appear in the study. In addition, responses will be kept under lock and key. No student will be referred to by his or her actual name. There are no foreseeable risks associated with this project nor are there any direct benefits to you and participation is completely voluntary on your part and you have the right to withdraw from this study at any time. Do you have any questions before we proceed?

APPENDIX C

INTERVIEW QUESTIONS FOR THE FOCUS GROUPS

1. Describe the access you and your students have to computers during the school day? (i.e. labs, library computers, individual classrooms, mobile labs, etc.)
2. During the week, how much time on average do you use computers in your lessons? (i.e. weekly percentage of time).
3. Through your past and present experience in working with students what are some general characteristics that computer talented students seem to possess?
4. Describe your experiences working with these students in the formal educational setting.
5. In which academic subject areas do these students seem to excel? What unique problem solving skills do they possess?
6. Describe your experiences working with these students in an informal setting when working on the computers? (i.e. homeroom periods, library, study halls, before and after school).
7. Describe any unique leadership skills displayed by computer talented students? (i.e. Do they voluntarily help or offer to help other students not as skilled on the

computer? Do they volunteer to assist you in troubleshooting or servicing the computers? Have they ever offered to help "fix" your computer?)

8. Describe how these students socially interacted with you? Other teachers? With their peers? (i.e. are they outgoing, socially average or have they a tendency to be introverted and keep to themselves?)
9. Have you noticed a gender difference regarding computer talent? (do boys seem to excel more in this area than girls or vice versa. Or is there no difference?)
10. In the junior senior high school environment at what age levels do you notice students displaying such talent? Do some of them come from the elementary level already several steps above their peers?
11. In regards to computers, do students seem to excel and be more interested in the area of software programs or the hardware components of the computers.
12. Is there anything else you would like to share that you think would help us in developing a profile of this particular group of students? (i.e. any unique or humorous stories or experiences you would want to share?).

APPENDIX D

SCRIPT TO BE READ TO THE TECH COORDINATORS

Hello, my name is James Cekada. I am Principal of Conemaugh Valley Junior Senior High School and a graduate student in the School of Education at the University of Pittsburgh. I am conducting research in an attempt to develop a profile of attributes or behaviors unique to students who display an exceptional talent in using computers. I would like to interview to gain your input into this area. The interview should last approximately one hour. Through your experience as technology coordinator you can help us learn more about the specific behaviors or traits of these students through this interview. Understand, that I will be asking structured questions to lead this interview. However, **I want to hear your stories and experiences in working with these students.** Pleased be assured that your answers will be kept strictly anonymous and confidential and your name will not appear in the study. No student will be referred to by his or actual name. There are no foreseeable risks associated with this project nor are there any direct benefits to you. This interview is completely voluntary on your part and you have the right to withdraw from this study at any time.

APPENDIX E

INTERVIEW QUESTIONS FOR THE TECH COORDINATORS

1. Describe your school setting with regards to the number of computers students have access to during the school day? (i.e. labs, library computers, individual classrooms, mobile labs, etc.)
2. During the school week, how much of your time do you interact directly with the students in an informal as well as a formal setting? (i.e. weekly percentage of time).
3. Through your past and present experience in working with teachers and students, describe in general students who you would deem exceptionally talented in the use computers?
4. During this time, do you normally observe these students working on formal educational projects? Describe your experiences working with these students in this setting.
5. Have you observed these students working informally with computers? (i.e. homeroom periods, study halls, before and after school). Describe your experiences working with these students in this setting.

6. Have you noticed any unique leadership skills displayed by computer talented students? (i.e. Do they voluntarily help or offer to help other students not as skilled on the computer? Do they volunteer to assist you in troubleshooting or servicing the computers? Do they tutor other students on their own time?)
7. During your experience, how do these students socially interact with their teachers? With their peers? With you? (i.e. Are they outgoing, socially average or have tendency to be introverted and keep to themselves?)
8. Have you noticed a gender difference in computer talented students? (Do boys seem to excel more in this area than girls or vice versa. Or is there no difference?)
9. Working in the junior senior high school environment at what age levels do you notice students displaying such talent? Do some of them come from the elementary school already several steps above their peers?
10. In regards to computers, do students seem to excel and be more interested in the area of software programs or the hardware components of computers?
11. Is there anything else you would like to share that you think would help us in developing a profile of these students? (i.e. Any unique stories or experiences you would want to share?)

APPENDIX F

SUMMARY LETTER TO PARTICIPANTS

Dear Teacher/Technology Coordinator,

Enclosed is a written summary of our discussion for my dissertation study. Please review at your leisure and make any deletions or additions in the margins. To return, I have enclosed a self addressed stamped envelope for your convenience. Again, I want to thank you for participating in the study and apologize for coming in so late in the school year. I truly enjoyed talking with you and gaining your valuable input. If you have any questions, contact me at 814 535-5523 or email me at jcekada@mail.cv.k12.pa.us.

Sincerely,

James Cekada

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