INVESTEMENT IN SKILLS OR TEACHERS' PERCEPTIONS?: THE DIRECT AND INDIRECT EFFECTS OF COMPUTER USE ON MATH ACHIEVEMENT

by

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(Under the Direction of Linda Renzulli)

ABSTRACT

Past research notes the positive effects of computers on academic achievement. These outcomes may be a result of processes related to human capital investments. Or, an increase in academic achievement could be attributed to a theory of cultural capital, evident through teachers' evaluations. This research employs theories of cultural capital and teacher expectancy, while simultaneously considering human capital arguments. Drawing from the ECLS-K dataset and using OLS regression, the analyses examine the relationship between home computer-use as an element of cultural capital and academic achievement. This research tests teachers' evaluations as a mediator within this relationship. Findings indicate that teachers have an effect on student outcomes in relation to home-computer use. Academic achievement is improved with student cultural capital indicators and positive evaluations from teachers. The conclusion states that neither human capital nor cultural capital is solely responsible for producing increased academic achievement. Instead, both processes occur within the classroom.

INDEX WORDS: Cultural Capital, Human Capital, Academic Achievement, Teacher Expectancy, Teachers' Evaluations, Computer Use

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Chapter 1. Introduction

Access and use of computers does improve academic achievements (Huang and Russell 2006; Judge, Puckett, and Bell 2006). The process by which computer use transfers into improved educational outcomes, however, is not clearly understood. Research demonstrates that students who have access to, and use, computers consistently perform at higher rates than their non-using counterparts (Huang and Russell 2006; Judge 2005; Judge, Puckett, and Bell 2006). Such findings are usually interpreted to mean that using a computer contributes to a skill set which allows a child to perform better academically because s/he possesses greater knowledge and expertise. According to Becker, this line of thinking relies on an argument of human capital, as human capital consists of knowledge, skills, and expertise (1964). What remains unaddressed by research, however, is whether computer knowledge functions only as a form of human capital; or, if there are other confounding factors leading to this visible increase in academic achievements.

While human capital, by virtue of knowledge, skills, and expertise, may contribute to an increase in academic outcomes, another social process may be occurring within the confines of the classroom which simultaneously improves academic outcomes for students. For example, sociologists and educators have established the effect of teacher expectancy on student outcomes (Downey and Pribesh 2004; Fuchs, Fuchs, and Phillips 1994; Weinstein, Marshall, Sharp, and Botkin 1987). "Teacher expectancy" refers to the opinions, judgments, and expectations of students that teachers form and hold based on information from other teachers, an individual student's records, and other physical or visible student characteristics that are thought to influence students' academic performance (Brophy 1982; Brophy and Good 1974; Dusek 1985; Dusek and O'Connell 1973; Rosenthal and Jacobson 1968). In addition to, or in combination with, teacher expectancy, researchers have shown the effect of highly valued cultural capital on both students' educational outcomes and teachers' evaluations of students. Bourdieu's (1979) conception of cultural capital refers to the tastes, preferences, knowledge, habits, and lifestyle which differentiates "high brow" culture from that of other social classes and leads to more favorable perceptions and attention from teachers because these are values shared by teachers themselves.

Within the literature on teacher expectancy and cultural capital, however, there is a paucity of research, examining the role that technology plays in teachers' expectations and in defining cultural capital. Thus, an examination of cultural capital, relying on insights from theories of teacher expectancy, and how these two frameworks relate to computer use within the classroom, can fill gaps in these literatures. Doing this expands overall knowledge regarding the association of academic outcomes, teachers' expectations or evaluations, and cultural capital. By examining computer use as a marker of cultural capital rather than a human capital indicator, I am able to expand literatures of cultural capital and teacher expectancy through the consideration of computer-use.

There are two primary holes within the cultural capital and teacher expectancy literature that I will address in this paper. First, researchers have only focused on more traditional, yet often differing, definitions of cultural capital. Such definitions include partaking in cultural activities (e.g. frequenting museums, attending ballets) (DiMaggio and Mohr 1985; Farkas, Grobe, Sheehan, and Shuan 1990; Kalmijn and Kraaykamp 1996; Katsillis and Rubinson 1990; Lamont and Lareau 1988) and how long a student has studied the arts as a measure of cultural capital (Aschaffenburg and Maas 1997; De Graaf, De Graaf, and Kraaykamp 2000). In addition, measures of cultural capital have been seen as a form of proxy for socio-economic status; such as whether or not a student has a particular place to study (Teachman 1987) and ways in which students communicate (Farkas, Grobe, Sheehan, and Shuan 1990). I suggest, however, that researchers should rethink how they measure cultural capital. Current research neglects the inclusion of other forms of cultural capital such as computer use within these cultural capital scales, or as an isolated factor. This omission is problematic because previous research may not be taking into account an alternate form of inequality and status measure that has real consequences for students in the classroom. If computers are indeed functioning as a cultural capital indicator, students with both access and knowledge will then be capable of demonstrating another component of cultural capital to their teachers while students on the other side of the digital divide will be increasingly left behind. My analysis will demonstrate how computers are functioning for students, the role they are playing in relation to students' academic achievement, and the ways teachers evaluate their students based on their perceptions of their students.

Second, by focusing on computers as just a human capital skill, researchers have ignored the ways in which teachers play a role in combining their expectations, student cultural markers and actual student achievement to evaluate and encourage students. Informing the teacher expectancy literature with insights from the cultural capital literature, while simultaneously considering access to computers and technology, provides a more complete picture of how teachers evaluate students in their classroom.

Answering questions of how cultural capital plays a role within the classroom, with the inclusion of computers in a newly operationalized form, adds to both teacher expectancy and academic achievement literature. By joining these literatures together it is possible to fill the gaps pertaining to cultural capital left by previous researchers. Tying areas of cultural capital, using new components and measures of cultural capital, and teacher expectancy together will allow me to develop a more complete picture of how teachers are assessing students through formal evaluations and how these evaluations relate to actual academic achievements within the classroom. By doing so, both the direct and indirect effects rather than just the direct effects of computers on student outcomes are addressed, as the majority of past educational research only considers the direct effects of access to, and use, of computers on academic achievement (Huang and Russell 2006; Judge, Puckett, and Bell 2006) and largely neglects alternate explanations.

Chapter 2. Background

Digital Divide(s) and Human Capital

The digital divide is a term originally referring to a gap between the "haves" and "have-nots" of digital technology. Initially, the heavy-use of the term, in the mid-nineties, resulted in political concern, sparked by President Bill Clinton, who formed incentives for large businesses and corporations to donate computers and other forms of technology to poorer communities and schools (Lacey 2000). This created an immense concern for those individuals who lacked access to technology, specifically within the realm of education (Attewell 2001).

More recently, however, a second divide has been noted by researchers who contend that while providing access to computers is an important first step, it must also be coupled with the *use* of the computer. Furthermore, the use of the computer, in order to be relevant in terms of acquiring actual knowledge and skills, must be geared towards educational gains in order to be effective for the individual who is being served. Therefore, it is not enough to simply place computers within the walls of a classroom or the houses of the poor; they must also be accompanied by a body which is savvy enough to use, and teach others how to gain from such implements of technology.

It is not merely within the classroom, however, where findings and improvements within academic achievement occurs. Arguably, students who have access to, and use, computers at their private homes will be better off than those who do not, as they have additional time to hone and develop their technological skills, and will most likely be able to draw from parents who have a basic understanding of computers (Judge, Puckett, and Bell 2006), thus conquering the second divide. Access to technology and computers within the classroom has become a focus for educators and administrators alike as the prominence of computers within society increases. A movement to increase access to such resources within the classroom is derived from the logic that computers are an asset, from which students can benefit academically.

Educational research has suggested that students who have increased access to computers within the classroom, and at home, are more likely to have higher test results than students who lack computer access (Huang and Russell 2006; Judge, Puckett, and Bell 2006). These findings propose a correlation between access to computers and academic achievement which emphasizes a human capital function of computers. This line of research purports the correlation between students' access to technology and educational outcomes is one where knowing how to use and operate a computer transfers into actual progress and knowledge within the classroom.

Human capital refers to actual knowledge, skills and expertise which an individual possesses, and how this knowledge informs daily activities, specifically those of work and labor (Becker 1964). Becker's (1964) analysis on human capital, and the returns which result from human capital investment, focuses on wages and earnings of those individuals who are within the formal labor market. Becker's conception of human capital relies on the idea that inputs can be transferred into present and future outputs. Using this conceptual framework, educational research can measure the ways in which varying investments in knowledge, skills, and expertise become visible through academic achievement.

For the purposes of studying individuals who are not yet housed within the formal labor market, such as non-working age students, it is necessary to measure their human capital gains through an arguably parallel measure – academic achievement. Academic achievement can function in much the same manner for students as wage and earning gains operate for labor market participants, as it is indicative of success and prestige. Drawing from Becker's initial argument, students who are achieving at higher levels within the classroom are most likely to be those who are reaping greater returns on their investment in human capital.

Because human capital focuses on skills, knowledge, and expertise which are highly valued in the classroom, these acquisitions are thought to assist with classroom performance and subsequently facilitate an increase in student performance and outcomes. In addition, sociologists have analyzed the effects of education and credentials, from a human capital approach, examining future characteristics of life, including social aspects such as attitudes regarding gender equality, civic knowledge, and social and cultural capital. Their findings suggest a modest effect of “credential effects” (Kingston, Hubbard, Lapp, Schroeder, and Wilson 2003), thus leaving room for a more comprehensive analysis of educational outcomes and social processes which contribute to an increase in academic achievement.

Analogous to human capital studies which assign credit solely to actual knowledge, skills, and expertise, research on the relationship between education and computers has been somewhat one dimensional. A great deal of educational research that focuses on computers and technology, views the relationship as a social problem – referring to the digital divide – and have been brought to light by politicians and the media (Natriello 2001). Such a limited focus adheres to a general argument of human capital, as it indicates that politicians associate computer use with improved academic outcomes. But, the research findings are consistent with public rhetoric which contends that access to, and frequent use of technology does improve academics for students (Huang and Russell 2006; Judge 2005; Judge, Puckett, and Bell 2006), thus perpetuating the argument that computer knowledge and skill functions as human capital. The positive correlation between computer access or use and overall academic outcomes for students suggests that students may indeed be garnering skills which are transferring into a greater body of knowledge which makes them more likely to succeed academically than their technologically disadvantaged counterparts. Relying only on a theoretical understanding of human capital to explain an improvement in academic achievement, however, leaves room to investigate alternate forms of social processes.

Chapter 3. Theory

Cultural Capital

Cultural capital has become a focus of educational research, and has been so since Pierre Bourdieu crafted his theoretical framework with an eye toward education (1973). Bourdieu intended to shed light upon differential educational outcomes, stating that accumulated cultural capital can be exchanged for both power and status. A gain in cultural capital will lead to cultural advantages, particularly within the educational sphere.

Bourdieu distinguishes between three types of cultural capital: an embodied state, an objectified state, and an institutionalized state (Bourdieu 1986). For the purposes of this research, as it concerns students' academic achievement, I will consider only the embodied state as a measure of cultural capital.[1] An embodied state emphasizes an individuals actions, ways of thinking, and character (Bourdieu 1986). Embodied capital refers to both ascribed and achieved characteristics. Examining achieved characteristics is crucial; it presumes that the students possess control over these characteristics. And for students, in order to fully capture an illustration of embodied cultural capital, examining the cultural activities in which they participate and attend is necessary. Housed within the segment of the embodied state of cultural capital is linguistic capital, also a relevant component for this research. Linguistic capital refers to communication; however, Bourdieu most likely did not anticipate rapid changes in forms of communication and technologies available to students, and how these should also be considered when examining cultural capital.

Bourdieu's discussion of cultural capital's relevance on education focuses on the ways in which children succeed easily in an educational setting. He cites parents as a key factor in

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[1] The objectified state is indicated through ownership of cultural objects. The institutionalized state is traditionally associated with credentials and qualifications relevant in the labor market (Bourdieu 1986).

preparing students to enter formal education, as they are primarily the conduits which provide the cultural attitudes and knowledge necessary for student success (Bourdieu 1986). Cultural capital is class dependent, and predicted through social class embedment (Bourdieu 1979). Early socialization in the home is a key step in the formation of cultural capital according to Bourdieu.(1979). Children who are capable of translating their learned cultural knowledge into the classroom will experience more success than students who cannot exhibit such cultural expertise or do not possess the same cultural capital. Cultural knowledge becomes a crucial element of predicting success within an educational environment (Bourdieu 1979). When children enter and proceed through institutions of formal education, however, their previous socialization is expected to demonstrate valued cultural capital. Bourdieu's conception of cultural capital would predict that those students who possess and exhibit it will be more likely to succeed educationally, and will be apparent in their academic outcomes.

A definition of cultural capital within the classroom relies on explicitly including student attributes that will contribute directly to teachers' expectations, emphasizing contextual importance of classroom characteristics. Therefore, only those cultural components relative for classroom cultural capital are included in conceptions of cultural capital. Often, relevant cultural capital indicators are constructed based upon what the teacher or authority figures would deem worthy. Thus, the other students within the classroom may not find such indicators to be a factor in determining whether or not a student would make a suitable friend or classmate; but, if a teacher deems certain characteristics as necessary for creating a better student within the classroom. Frequently, scholars have created cultural capital conceptions and frames within the classroom from tastes that reflect upper class preferences and cultural knowledge. Doing this confirms the notion that upper-class cultural capital is the most important because it will translate into future successes.

Conceptions of cultural capital are formulated using values from the middle class, "high-brow culture," and norms which guide hegemonic notions of cultural capital, as conceptualized by Bourdieu. The relationship between the classroom environment and conceptions of cultural capital notably reflect and highlight the environmental value. For example, many researchers include measures of attendance and participation in culturally approved activities, such as museum and ballet attendance, dance and music class participation, etc. (see, for example Aschaffenburg and Maas 1997; DiMaggio 1982; Dumais 2002; Roscigno and Ainsworth-Darnell 1999). Thus, by demonstrating an accepted type of cultural capital for the classroom, a student may be able to influence the ways in which teachers' view them as future successes or failures within their classroom.

Existing educational studies of the effects of cultural capital are somewhat inconclusive and rather ambiguous. Findings that indicate cultural capital as a positive determinant of academic achievement have been empirically supported by looking at outcomes such as grades and educational attainment (DiMaggio 1982; DiMaggio and Mohr 1985; Farkas, Grobe, Sheehan, and Shuan 1990; Kalmijn and Kraaykamp 1996). Other studies, however, did not find support for the way cultural capital transfers into the classroom; and was thought to have no effect on student outcomes such as academic achievement within the classroom (Katsillis and Rubinson 1990; Robinson and Garnier 1985). What seems most problematic, however, is the lack of a consistent definition of cultural capital and a distinct difference in the operationalization of a cultural capital variable or set of variables; and thus, cultural capital has been defined largely by the data available to the particular researcher (Dumais 2002; Kingston 2001)

Elements of cultural capital include preferences, tastes, inclinations, and “linguistic and cultural competence” (Bourdieu 1979). The inclusion of linguistics in this definition and conception of capital is indicative of multiple components of communication which are useful, and necessary, within society. For instance, linguistics may not be limited to literal verbal communication skills. Rather, these can be contrived to be such things as communication knowledge and savvy, concerning recent technological developments our society has experienced. This translates into such things as cellular telephones, computers, and other forms of technology; thus, digital communication and skill level should also be included in the Bourdieuian model of “linguistic and cultural competency” but has not been fully considered before. Some studies use an additive scale of “educational resources” in analyses, which utilize a list that may include possession of a computer, among other resources such as books, encyclopedias, and pocket calculators (see, for example Roscigno and Ainsworth-Darnell 1999). The listing of such resources on equal footing, however, is problematic as it does not isolate computer use and undermines its importance.

Computers have become such a fixture in society, through their growing prominence within daily activities that they are treated as a component of cultural capital within educational settings. And, if students spend more time on the computer it emphasizes their interest in improving capital to which educators assign worth, due to the necessary aspects of technology use within society. Consequently, an addition to Bourdieu’s concept of cultural capital within the educational setting is conceptualized and operationalized in an effective way to handle new lines of research. By including new components to cultural capital, researchers can focus on the specific aspect of access to computers which has yet to be fully explored. Thus, technology and computer use will function as indicators of cultural capital. In traditional analyses, when examining the effect of computer use on achievements, researchers might hypothesize that: *An increase in home computer use will positively affect students' academic achievements.* This line of reasoning, however, does not help disentangle the human capital and cultural capital components of computer use on school achievement. Therefore, I consider *how* computer use affects achievement. The academic achievement level which a student already possesses may continue to have an impact on their evaluations, thus leading to multiple sources which affect achievement rates (human capital) and access to computers (cultural capital). In addition, there may be a different type of social process which is occurring, that looks similar when considering the academic outcomes of students, as they are increasing regardless of the means. In this scenario, the argument contends that computer use is the driving force, and academic achievement is affected by incorporating the teacher's evaluations as a possible mediating effect. In both scenarios, the evaluations and achievement rates of the individual students are increasing:

A newly operationalized definition of cultural capital based upon conventional formulations of a cultural capital scale, which highlights additional educational components, such as home-use of computers can be formulated and take into consideration the possibility that all indicators of cultural capital may be more indicative of outcomes than solely traditional measures or solely computer use. The empirical construction of cultural capital which is frequently cited in research has not included more recent additions to our initial conception of the Bourdieuian cultural capital (DiMaggio 1982; DiMaggio and Mohr 1985; Dumais 2002; Farkas, Grobe, Sheehan, and Shuan 1990; Kalmijn and Kraaykamp 1996; Katsillis and Rubinson 1990; Lamont and Lareau 1988). Specifically, what is not considered by educational researchers includes the effects of recent technological advances which have permeated both homes and classrooms across the United States.

By coupling the concepts of cultural capital with an evaluative process occurring in the classroom, it is possible to disentangle human capital from cultural capital. In order to adequately assess cultural capital processes in the classroom, the evaluations from teachers are necessary to contribute in gauging the indirect effects of cultural capital on academic achievement. If direct effects are the only effects observed in the classroom then there will solely be support for a human capital effect of computers. If an indirect process, where teacher evaluations mediate the relationship between cultural capital (and computer use) and academic achievement is observed then support for cultural capital exists. Moreover, both direct and indirect processes may be occurring; therefore, both human capital and cultural capital are responsible for increasing academic achievement.

Teacher Expectancy: A Test of Cultural Capital

For this analysis, I will use a theory of teacher expectancy to inform the theoretical frame of cultural capital. Teacher expectancy provides explanations for the teachers' evaluations and simultaneously confers credit to an argument of cultural capital because it accounts for the indirect effects on academic achievement. The evaluations from teachers will function as the indirect measure and provide further support for this social process. Without the combination of theoretical structures, only human capital accounts for a direct relationship between computer use and academic achievement.

A theory of teacher expectancy resonates strongly with that of the self-fulfilling prophecy originally crafted by Robert Merton (1968). Merton created his theory, based on the Thomas Theorem, which purports that individuals respond to both the actual aspects of a situation and the assigned meaning of the situation: "If men define situations as real, they are real in their consequences" (Merton 1968: 475). Thus, defining the situation is a crucial element in predicting outcomes and developments. Merton is given credit for coining the term "self-fulfilling prophecy" based around Thomas's principle. Merton points to examples within the realm of education and how an example of a self-fulfilling prophecy operates: "Consider the case of the examination neurosis. Convinced that he is destined to fail, [an] anxious student devotes more time to worry than to study and then turns in a poor examination. The initially fallacious anxiety is transformed into an entirely justified fear" (1968: 477). In the scenario outlined above, the student can justify the outcome of a bad exam score on his prior fears, thus "proving" he was right all along.

The first premise of Merton's self-fulfilling prophecy begins with a *false* definition of a situation. This false definition causes a change in behavior; thus, the final component, results in the original false definition coming true for the individual. Merton deems this outcome the "reign of error," as the actual events leading to the outcome are cited as proof. For a theory of teacher expectancy, relying on the original tenets of Merton's self-fulfilling prophecy, the role of the teacher in defining the situation is both important and pronounced. In a theory of teacher expectancy, teachers define situations for their individual students based on how they perceive their students to perform. Essentially, teachers create expectations for their students prior to witnessing academic prowess. Performance expectations are manufactured based upon a number of student characteristics, such as gender, race, performance of siblings, and information from other teachers (Braun 1976; Brophy 1982; Brophy and Good 1974; Dusek 1985; Finn 1972; Jussim 1989; Rosenthal and Jacobson 1968). The majority of teachers' expectations appear to be derived from ascribed characteristics.

Perceptions of student ability, on the part of a teacher, can be both accurate and inaccurate; however, regardless of the accuracy, teachers often receive the outcomes initially expected (Dusek and O'Connell 1973; Rosenthal and Jacobson 1968). Teachers' perceptions have the potential to shape teachers' behavior, which subsequently affects student outcomes. Differing from Merton's original self-fulfilling prophecy, the agency is reallocated to a teacher in this theory, despite the fact that it largely operates through the student. The student is not removed from the process, as students form opinions regarding their own work based upon their teachers' expectations, which can have real effects on their academic work. Thus, students come to hold similar expectations for themselves, which reflects the original premises of Merton's self-fulfilling prophecy.

Teacher expectancy theory suggests that as teachers form expectations, based on perceptions of their students, students' performances will live up to their expectations. Based on this assumption, this theory predicts that students who are recipients of more positive expectations from their teachers will be more likely to perform better, academically, than those students who are expected to perform at lower levels. In order to assess teachers' expectations, outside of interviewing teachers, the evaluations teacher's fill out for their students serve as helpful indicators.

Teachers possess knowledge of individual student abilities and experience first-hand the differing levels of these abilities that exist within their classroom. Moreover, teachers often have access to individual test scores, in addition to awareness of more obvious elements such as actual class participation and comprehension on a daily basis. The knowledge and access to individual student information to which a teacher is privy, may also affect the ways in which classroom expectations are effected; therefore, evident computer abilities could manifest themselves as cultural signals, much in the same way other signals are communicated to teachers (see, for example Clifford and Walster 1973; DiMaggio 1982). Because computer use may appear in the form of cultural capital, I expect that computer use alone will also have an effect on teachers' expectations and evaluations.

Educational literature on teacher expectancy has demonstrated an apparent correlation between expectations which teachers hold regarding individual students and their actual academic performance, as measured through test scores and evaluations (Brophy 1982; Brophy and Good 1974; Dusek 1985; Entwisle and Webster 1973; Jussim 1989). Because teachers have such a profound and influential role on the students whom they educate, it is imperative to discover the nature in which their evaluations are generated. Because teachers' perceptions and expectations have such an impact on students' educational outcomes, determining the relationship between computer use and teachers' evaluations is important.

Teachers may expect their students to be familiar with resources such as computers both within and away from the classroom, adding to the list of expectations which have already been demonstrated within educational research (e.g. student self-motivation, interest). Therefore, the expectation that students should be capable of using technology and computers is one which has arisen as dominant culture (Emihovich 1990) has encouraged, and become increasingly reliant upon, computer use. Computers have only entered the classroom in high numbers within the last two decades (Attewell 2001). This recent development may cause a change in the ways in which teachers evaluate students within their classroom, as student's access to computers may illustrate an element of Bourdieu's cultural capital.

The mediating effects of teachers' expectancies on academic outcomes have been documented; however, the focuses of studies have consisted primarily on the ways that the teacher treats the student during interactions. For instance, how long a teacher waits for a students' answer (Allington 1980), criticisms toward the student (Babad, Inbar, and Rosenthal

1982), providing differential amounts of feedback (Cooper 1979), and using arguably less efficient methods of instruction (Swann and Snyder 1980). Furthermore, my hypotheses are predicated on characteristics which are not ascribed, but achieved, moving in a relatively new direction for the theory of teacher expectancy. Drawing from this literature, it is apparent that this research is fairly consistent with other studies that have modeled how teachers can influence or have an impact on academic outcomes. Therefore, considering teacher-evaluations of students as working together with computer-use and affecting academic achievement, based on a teacher-expectancy theoretical approach, is consistent with educational research.

Chapter 4. Hypotheses

Based on previous research, I expect to find a direct relationship between elements of cultural capital (and computer use) and academic achievements. This relationship should result in an improvement in academic achievements with an increase in levels of cultural capital and frequency of computer use. In addition to these findings, I expect to see an indirect effect of teachers' evaluations on academic achievement. I will test a cultural capital explanation for the shown increase in achievement with computer use. By using a theory of teacher expectancy to help parcel out the effects of cultural capital, from that of human capital, I intend to demonstrate the role of cultural capital in students' academic achievement. Cultural capital will be evident and observed through the indirect effects of teachers' evaluations of their students. Therefore, I make three hypotheses:

H1. Teachers' evaluations will mediate the relationship between cultural capital and academic achievement.

H2. Teachers' evaluations will mediate the relationship between home computer use and academic achievement.

H3. Teachers' evaluations will mediate the relationship between the newly extended definition of cultural capital, which includes frequency of home computer use, and academic achievement.

Chapter 5. Data and Methods

Data for this analysis is taken from the Early Childhood Longitudinal Survey – Kindergarten cohort (ECLS-K) provided by the National Center for Education Statistics (NCES). The NCES randomly sampled and tracked students, and gathered information from their teachers, parents, and administrators since the sampled children entered kindergarten in the academic year of 1998-1999. Students were sampled, within specific ECLS-K schools, and many students are clustered within the same schools.[2] According to the NCES, 23 students on average are sampled from each ECLS-K school (NCES 2008). Data is collected from the students by a trained evaluator who can assess the students within the school. Parents are contacted over the phone in order to gather information regarding individual students. Teachers and school administrators are contacted, by the trained evaluators, within their schools in order to complete questionnaires and provide information (NCES 2008). The NCES is in the process of collecting eight waves of data from these surveys. Because the ECLS-K is a longitudinal study which has allowed for the collection of this information over the course of time it is easier to establish an argument of causality within the analyses, rather than simply providing a snapshot of one year, while simultaneously allowing for a conceptual understanding of the role that computers play in the lives of students.

Six waves of data are currently available for use; I use two in this study. I have included waves five and six in this analysis – data from the third and fifth grade years, respectively. The ECLS-K collected information about the students, parents, teachers, and school in the fall and spring of their kindergarten year (1998-1999), the fall and spring of first grade (1999-2000), the spring of third grade (2002), the spring of fifth grade (2004), and the spring of eighth grade (2007). Because the kindergarten cohort was a national random sample of

[2] For this analysis 1012 schools are included and 2906 students are housed within these schools.

kindergarteners, students come from both public and private schools, and have diverse racial and socioeconomic backgrounds. My decision to use the data from the sixth wave (fifth graders), is due to my expectation that students who are in later grades have received more exposure to computers and technology. Therefore, I expect that fifth graders will be more familiar with how computers function, and will have developed a larger skill set than children in lower grades. (The Guttman model assumes that students who have completed a certain skill level have completed all the levels prior) (Krus and Bart 1974). Achievement data is drawn from both the fifth and sixth waves of data, however, in order to control for prior achievement and test current achievement levels. While the sample of children in the fifth grade wave of data collection are representative of the children who were in kindergarten in 1998-1999, it is not representative of all fifth graders in 2003-2004.

In order to determine who should be included in this study I set up several theoretical and empirical constraints. Of the original 21,260 children who were sampled in their kindergarten year, 2,906 students are eligible for inclusion in my study. First, I included only those cases in which data is available at both the third grade and fifth grade level. Second, I included students who were in the fifth grade at the time of the study. Approximately ninety percent of the students included in this wave were in the fifth grade, while nine percent were in fourth grade, and one percent in third grade or another grade (e.g. sixth) (NCES 2008). Thus, these students are omitted from the analysis; any student who was in a grade other than fifth at the time when natural progression within school would place them in fifth grade cannot be included in this analysis. Third, only students in public schools are included in this analysis, as children in private schools would require a different theoretical frame. Because students in private schools often possess backgrounds of higher socio-economic statuses, they would be systematically different from those students in public schools, thus rendering them somewhat incomparable, particularly since I am interested in measures of cultural capital and its effects on achievement. Furthermore, students from private schools are also more likely to have missing data in this survey (NCES 2008). For instance, children who attend private schools are not eligible for free lunch as this is not an element of a private school structure. Data Elimination Process[3]:

All fifth graders → fifth graders who have cultural capital information → fifth graders who have math proficiency scores → fifth graders who have math evaluation scores → fifth graders who have data available for all controls = 2876.

Like many longitudinal datasets, there are cases which are lost over time, due to the transient nature of the student population; however, the systematic similarities among those students who moved do not appear to introduce a great deal of non-response bias in this particular analysis (Bose and West 2002). Many of the students who moved were difficult to gather subsequent data on, as their schools were not marked as initial participators in the ECLS-K study and thus had little or no vested interest in participating through questionnaires or evaluations for the teachers and administrators (Bose and West 2002). There is evidence that cases which remained in this study were more likely to be those that came from "white, food-secure, attending private schools, and were from two-parent, high socio-economic, non-poverty, English speaking households, with higher maternal education" (Bose and West 2002: 3). Despite these biases which were statistically significant, I do not expect the analyses to be substantively affected from student attrition, as reports indicate a high completion-rate of responses overall.

[3] Data elimination is based on a mark/markout (listwise deletion) command in STATA which eliminates data that does not meet the criteria for inclusion. Essentially, only those cases which have data available in all cells of interest will be used. Forcing an analysis would be problematic and preclude models from being compared to one another.

Variables

Dependent Variables

Math Proficiency Level

Academic achievement is measured through a proficiency level score for math. Typically, research which discusses academic achievement uses both reading and math achievement as dependent variables (Judge, Puckett, and Bell 2006); however, this study only analyzes math achievement as it relates to computer use. My purpose in this research is to demonstrate the relationship between computer use as an element of cultural capital, and math academic achievement. I expect math achievement to be the most directly affected by computer use due to the nature of computer programs geared toward students of this age.

Using academic achievement as a dependent variable will test for both the hypotheses of cultural capital and teacher expectancy. This variable denotes test scores that are based on the students' proficiency level. The NCES created tests for the purpose of measuring math achievement and did not rely on previously constructed state or federal standardized tests; although these scores are standardized because all students who participated in this study received the same test questions. Test scores for math range from 0-9 in each tested math area; thus, a total of nine areas were included in this test, compiled, and combined into one math proficiency score. A student receives a one unit increase for each subsequent level mastered (providing a score between 0 and 9). For example, these questions test students' knowledge on nine specific areas. These math areas and scores include (0) non-mastery of the lowest proficiency level, (1) number and shape, (2) relative size, (3) ordinality, sequence, (4) addition/subtraction, (5) multiplication/division, (6) place value, (7) rate and measurement, (8) fractions, and (9) area and volume. The proficiency score assumes that a student has mastered all of the levels prior to the score s/he received. For instance, if a student receives a math proficiency score of 6, we can assume that this student has also mastered levels one through five.[4] The NCES created a single variable, based on the highest level achieved by a student. Therefore, if a student demonstrates math achievement through the fifth topic area (multiplication/division) then the student's composite math proficiency score will be 5.

The math values are consistent from year to year, and therefore measure students' abilities in kindergarten, first grade, third grade, and fifth grade based on the same yearly criteria. Because I am interested in fifth grade achievement, responses in the lower-end of the math levels are very infrequent, which would be consistent with natural progress in school, as the distribution demonstrates a lower mean and shape for the third grade wave of data.

TABLE 1: VARIABLES OF INTEREST: DEFINITIONS AND DESCRIPTIVES

Variable	Description and Coding	Mean	SD
Dependent Variables			
Math Proficiency Level Achieved	Continuous: Proficiency level achieved by fifth grade student (ranges from 1-9, with a value of 3 being the minimum score received by a fifth grade student)	6.44	1.12
Independent Variables			
Home Computer Use	Ordinal: Four categories based on a week (never-use, 1-2 times a week, 3-6 times a week, daily-use). Categories have been divided into Much Use and Some/No Use.	Much .62 Some .38	Much .48 Some .48
Cultural Capital, Scale 1	Continuous: This is a scale which has been constructed using the following components, based on whether or not the child has: Attended a play, concert or other live show; visited an art gallery, museum, or historical site; visited a zoo, aquarium, or petting farm; attended an athletic event or sporting event in which the child was not a player; participated in dance lessons; been involved in organized athletic activities like basketball, soccer, baseball, or gymnastics; participated in organized clubs or recreational programs like scouts; participated in music lessons (e.g. piano, instrumental music or singing lessons); participated in art classes or lessons (e.g. painting, drawing, sculpturing); and participated in organized performing arts programs (e.g. children's choirs, dance programs, theatre performances).	0.32	0.19

[4] This is consistent with a Guttman model, which assumes that a student who has mastered a particular skill-level (in math) has passed all lower levels in the given subject area.

Cultural Capital, Scale 2	Continuous: This is a scale which has been constructed using all of the elements from the first cultural capital scale, and combining those with frequency of home computer use. Home computer use is based on the first independent variable, which was originally an ordinal level variable (never use a computer, use a computer 1-2 times a week, use a computer 3-6 times a week, use a computer daily).	0.38	0.17
Mediating Variables – Evaluation Measures			
Math Evaluations – Student Ability	Ordinal: Four categories based on whether or not student performs to the best of his/her abilities: Never, seldom, usually, and always. These categories have been divided into More Ability/Less Ability	More .88 Less .12	More .32 Less .32
Math Evaluations – Compared to other students	Ordinal: Five categories based on how a student is performing compared to other students at the same level: Far below average, below average, average, above average, far above average. These categories have been collapsed into two categories: Average and above, and below average.	Above .44 Below .56	Above .50 Below .50
Math Evaluations (used in sub-analysis)	Continuous: Math evaluation score received by a student from their fifth grade (math) teacher. This ranges from 1-5, allowing for differential values between questions, producing one score for each student.	3.50	0.70
Control Variables			
Student Level			
Gender	Dummy: Coded as 1 if female and coded as 0 if male	0.51	0.50
White	Dummy: Coded as 1 if white	0.64	0.48
Black	Dummy: Coded as 1 if black	0.09	0.29
Hispanic	Dummy: Coded as 1 if Hispanic	0.15	0.36
Asian	Dummy: Coded as 1 if Asian	0.08	0.27
Other	Dummy: This category includes American Indians and Non-Hispanic blends. Coded as 1 if true.		
SES	Continuous: This variable ranges from -2.21 to 2.54 and has been centered at the mean by the creators of the ECLS-K	0.05	0.74
Two-Parent/Sibling(s)	Dummy: Coded 1 if family structure is that of two-parents and any siblings	0.72	0.45
Two-Parent/No Sibling(s)	Dummy: Coded 1 if family structure is that of two-parents and no siblings	0.08	0.27
One-Parent/Sibling(s)	Dummy: Coded 1 if family structure is that of one-parent and any siblings	0.14	0.35
One-Parent/No Sibling(s)	Dummy: Coded 1 if family structure is that of one-parent and no siblings	0.04	0.20
Other Family Structure	Dummy: Includes all other family structure. Coded 1 if other family structure.	0.02	0.12
Prior Math Achievement	Continuous: Proficiency level achieved by student in the third grade (ranges from 1-9, with a value of 1 being the minimum score received by a third grade student)	5.53	1.11
Much Teacher Communication	Dummy: Whether or not the teacher talks to other teachers about individual students: 1-2 times a week, 3-4 times a week, or daily. Coded 1 if yes and coded 0 if only some/no communication	0.51	0.50
Some Teacher Communication	Dummy: Whether or not the teacher talks to other teachers about individual students: never, 1-2 times a month, or 3-4 times a month. Coded 1 if yes and coded 0 if much communication	0.49	0.50
School Level			

Percent Free Lunch	Continuous: This denotes the percentage of students who are eligible for student lunches within each school. This is a continuous variable ranging from 0-95 percent.	33.26	0.41
Percent Minority	Dummy: This is a dummy coded variable denoting whether or not the student attends a school that has a high or low percentage of minority students. The variable is coded as 50% or greater minority student population (1) and less than 50% minority student population (0).	0.29	0.45

N=2876

Independent Variables

Computer Use at Home: In order to extend cultural capital and teacher expectancy, I include the frequency of using a computer at home in my analysis as a primary independent variable of interest. Using this measure as an independent variable is appropriate, indicating a freedom of computer-use, away from the classroom, which can then be perceived by teachers when students demonstrate improved knowledge, skill, or familiarity with computers and technology within the actual classroom. This is an ordinal level variable denoting how much weekly access a student has to a computer at home which s/he is permitted to use: never (0), 1-2 times a week (1), 3-6 times a week (2), and daily (3). Parents provide answers to the question, "In an average week, how often does [child] use the computer?" (NCES 2008) The distribution of this variable illustrates that the majority of students used the computer once or twice a week (1,017) or three to six times a week (1,084). I also constructed the computer use variable as two dichotomous variables which combined daily use and 3-6 times a week as one dummy coded variable; and, never and 1-2 times a week were combined to create an additional dummy coded variable which would denote little-no use. Both measures of computer use were tested in analyses, and there is not a substantive difference between the two constructions. Therefore, to assist with the ease of interpretation the analyses use only the dichotomous communication variable.

Cultural Capital: Because cultural capital research points to the accumulation of cultural activities as necessary in order to gain cultural capital, I created two scales of cultural capital.[5] In order to test how theories of cultural capital operate within the classroom these two scales are designed to reflect differing definitions of cultural capital.

Cultural Capital, Scale 1 (no computer use): The first scale I constructed is based on traditional definitions and conceptualizations of cultural capital: attendance of cultural activities (e.g. museum visits, theatre attendance)[6] and participation in activities deemed as high-brow culture (e.g. partaking in dance classes, music classes, playing sports). Questions asked parents, "Outside of school hours in the past year, has [child] participated in…" (NCES 2008) for all cultural participation activities included in this scale. The participation aspect of this scale is important, as it functions as an indicator of duration of involvement with a given activity, rather than transitory exposure in the form of attendance (Roscigno and Ainsworth-Darnell 1999). My particular scale (α =.67) includes the following components, based on whether or not the child has: attended a play, concert or other live show; visited an art gallery, museum, or historical site; visited a zoo, aquarium, or petting farm; attended an athletic event or sporting event in which the child was not a player; participated in dance lessons; been involved in organized athletic activities like basketball, soccer, baseball, or gymnastics; participated in organized clubs or recreational programs like scouts; participated in music lessons (e.g. piano, instrumental music or singing lessons); participated in art classes or lessons (e.g. painting, drawing, sculpturing); and

[5] Scales were generated using the "alpha-generate" command in stata. This creates a scale that can be used as a single independent variable within the model. Stata also produces a Inter-Correlation Coefficient (the reliability of the scale) which suggests whether or not the elements included are a good fit when placed together in a scale. If inter-item correlation increases it suggests that the measures are truly measuring the same core concept.

[6] Attendance data was gathered from the fifth wave of data, when these students were in third grade, as this information was not available in the sixth wave. Using this wave, however, should not negatively affect the results, as it may denote prolonged exposure to culturally worthy activities, rather than fleeting exposure.

participated in organized performing arts programs (e.g. children's choirs, dance programs, theatre performances).

Cultural Capital, Scale 2 (computer use): My second cultural capital scale utilizes all of the components from the first scale; however, it also includes measures of home computer use. This scale ($\alpha = .72$) is based on my extended definition of cultural capital, which emphasizes computer-use as an element of cultural capital. The frequency of computer use at home is based on the initial independent variable, as explained above[7]. Essentially, the first two independent variables in this study are combined to form a third independent variable (scale) which will function to answer whether or not theories of teacher expectancy and cultural capital are indeed operating within the classroom.

Teacher Evaluations: In order to measure how cultural capital affects academic achievement, drawing from a theory of teacher expectancy, this analysis uses teacher evaluations for each fifth grade student, from their respective math teacher, as an independent and mediating variable. These evaluations asked teachers to respond to the question, "How often does this child work the best of his/her ability in mathematics?" Ordinal responses for this question include, never seldom, usually, and always (NCES 2008). Similarly, additional evaluation questions asked the teacher to respond to the question, "Overall, how would you rate this child's mathematics skills, compared to other children of the same grade level?" Five ordinal level responses included, far below average, below average, average, above average, and far above average (NCES 2008). These were subsequently collapsed into two categories: whether the student works above

[7] The independent variable "computer use" uses a dichotomized variable that is split into two categories: students who use a computer more often than 3 times a week and those who use a computer less than three times a week. To remain consistent with the other dummy variables included in this scale, however, it was necessary to recode the computer use component in this scale into two categories: no use or any use. In doing so, it remains consistent with the other cultural capital activities which ask whether a student has participated/attended (yes/no) in a specific activity in the last year.

average or whether the student works at average and below average. Substantively, there is not a difference between the ordinal distribution and the collapsed categories, so for the ease of interpretation only the collapsed dummy categories are included in this analysis.

An initial analysis, testing a separate evaluation measure, was also conducted prior to testing the effects of this evaluation measure. For the alternate analysis, evaluations asked the teachers to rate how well each student performs at a given level and task within math. Students were not consulted or tested before evaluations were completed by each teacher; however, because the teachers have access to students' test scores it is possible this may affect their judgment of the student's performance. Additionally, using this variable as an evaluation measure intended to get at issues of "teacher expectancy" is problematic because the evaluation questions appeared much like the achievement measure, implying this was merely an alternate way to objectively measure achievement. The NCES created the survey with built in prompts for the teacher, such as "This child makes reasonable estimates of quantities and checks for answers, for example, estimates the product in a problem such as $19.99 × .75 by mentally multiplying 20 × .8 = 16…" (NCES 2008). Responses range from 1 to 5 and teachers are expected to respond based on the current performance of each student: (1) not yet, (2) beginning, (3) in progress, (4) intermediate, (5) proficient, and not applicable. Teachers completed ten questions for each student, and each question is assigned a different value by the NCES, based on the difficulty of the task discussed within the question. The values are then combined, using a Rasch analysis, in order to create an individual score for each student.[8] NCES then created an Academic Rating Scale (ARS) in order to create a standardized evaluation scale. Therefore, the teacher evaluation variables that rely on questions asking whether or not a student works to the best of his or her

[8] A Rasch analysis does not supply a simple mean; but, provides a score which summarizes an individual standing on a variable based on criterion that orders other variables and creates one individual score (Ltd 2005-2006)

ability, or how a student is performing compared to his or her peers are more suitable variables based on this theoretical framework.

The idea that teachers form opinions of student progress and skill-level is consistent with the teacher expectancy literature, which suggests that teachers who have preconceived notions of student performance are more likely to evaluate their students in a way which is consistent with the information received (Rosenthal and Jacobson 1968), which is subsequently expected to affect the achievement level attained by the student. Because teachers have such access to their students' information, an endogeneity problem exists, which would be difficult to avoid. Despite this potential bias, I do not expect the substantive results to be greatly affected by this problem, and may be somewhat avoided by controlling for past achievement. Using teachers' evaluations as an independent and potentially mediating variable will demonstrate teacher *perception*, which is one of my primary goals of this research.

Control Variables

Student Level

Gender: The gender of the student is dummy-coded as (1) female and (0) male. Including gender as a control variable is necessary, as literature suggests that teachers evaluate boys and girls differently when considering cultural capital (see for example, Dumais 2002). Similarly, boys and girls often are thought to possess differential levels of knowledge regarding computers and technology, simply by virtue of their gender (Volman and van Eck 2001). For instance, boys are expected to spend more time than girls using computers (Volman and van Eck 2001).

Race: The race of each student has been separated into 5 categories and dummy coded. These categories include: non-Hispanic White, non-Hispanic Black, Hispanic, Asian, and Other (This category includes both American-Indians, and Non-Hispanic mix). The reference category is White.

Socio-economic Status (SES): This is a composite variable which has been constructed by the NCES, and is based on parent's education, parent's occupation, and household income. The NCES has constructed this variable as a continuous variable which ranges from -2.48 to 2.54; and, they have centered SES at the mean. Information regarding SES was gathered during the students' kindergarten year, and has not been recalculated for these data for the fifth grade year (sixth wave). Overall, it is expected that the SES of each student has not changed over the course of six years (Blau and Duncan 1967).

Family Structure: Family structure for each student has been separated into 5 categories and dummy coded. These categories include: two parents-no siblings, two parents-with sibling(s), one parent-no siblings, one parent-with sibling(s), and other-family structure. The reference category for this measure is a dual parent – with sibling(s) family structure. Including family structure as a control variable avoids assuming that all families are capable of providing an equal amount of time for the students in this study, as a dilution effect may occur in larger families that have more people interested in using this resource (Downey 1995)

Teacher Communication: This is an ordinal level variable which asks teachers how often they communicate with other teachers regarding individual students. Responses have been separated into 6 categories, ranging from (1) never, (2) once a month or less, (3) 2-3 times a month, (4) 1-2 times a week, (5) 3-4 times a week, and (6) daily. I have further collapsed teacher-communication into two dummy coded categories of "some communication" and "much communication." I ran models with the ordinal and the dummy variable; both produced substantively similar results and thus I used the dummy coded variable for parsimony. By controlling for teacher communication, I am addressing the notion that teacher-teacher communication is thought to have an impact on both evaluations and academic outcomes, according to theories of teacher expectancy (Rosenthal and Jacobson 1968). Additionally, by not including this variable, regardless of its significance within the analysis, the model would be mis-specified, due to the theoretical implications of its importance.

Prior Achievement: Prior achievement is based on math proficiency scores taken from the fifth wave of data, when the students were in the third grade. Controlling for past achievement is necessary, and is expected to be highly significant within the analysis, as students who perform at higher levels in the third grade are expected to be high performers in the fifth grade.

School Level

Percent Minority: This is a dummy coded variable denoting whether or not the student attends a school that has a high or low percentage of minority students. The variable is coded as 50% or greater minority student population (1) and less than 50% minority student population (0).

Percentage eligible for student lunch: This eligible-for-free-lunch variable denotes the percentage of students who are eligible for student lunches within each school. This is a continuous variable ranging from 0-95 percent.

Analytic Strategy

The analysis proceeds in three steps[9]. Using OLS regression, each of the following three analyses contains three sets of three nested models. Within these analyses I used the cluster command in STATA to adjust the standard errors to deal with non-independents in the data.[10]

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[9] A preliminary analysis measuring the relationship between extended cultural capital and teachers' evaluations (both student ability and compared to other students) reveals statistically significant results, indicating that extended cultural capital does have an impact on evaluations. Additionally, I controlled for academic achievement within these two models and found that the relationship remained significant. These findings lend support for the analytic strategy described because it suggests a complex relationship. This table (A1) can be found in the appendix.

[10] There were 1,012 unique schools in the data with each school having sampled range of 14 students to 1 student. The data is hierarchical in nature (students nested in schools). Preliminary analyses suggest that HLM may be an

The first set of nested models within each analysis tests the relationship between a varying independent variable of interest and academic achievement, introducing student level controls in the second model, and school level control variables in the third. The second set of nested models within each of the analyses tests the same relationship from the first set of nested models; however, it introduces the math evaluation variable that tests whether or not a student is working to the best of his/her ability as a mediating variable. The third set of nested models includes the math evaluation variable that asks about a student's progress compared to other students at the same grade level. These two math evaluation variables are introduced to the models in order to test hypotheses of teacher expectancy. Models two and three within the nested models introduce student measures and school measures, respectively.

In all three of these analyses, a reduction in the independent variable's coefficient is indicative of teacher evaluations functioning as a mediator in this relationship. A mediation test for each analysis demonstrates the degree to which teacher evaluations affect this relationship in conjunction with each independent variable of interest.[11] By testing for teacher evaluations as a mediating variable it is possible to bring together both teacher expectancy and cultural capital hypotheses.

The first set of analyses, in Table 2, depicts the relationship between a traditional measure of cultural capital and academic achievement. As noted above, the two sets of nested models introduce student level control variables first, followed by school level characteristics. The first analysis in Table 2 does not use teacher evaluations within the model, but is added in

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appropriate statistical method for analyzing math achievement because the interclass correlation is significant and explains 14% of the variance of math achievement between schools (ICC=.144).

[11] A soebel-goodman test measures the mediating effects of teacher evaluations on academic outcomes, while preserving the independent variable of interest. In doing so, it is determined precisely which percentage of the outcome is attributed to evaluations, and which is attributed to the independent variable.

the second and third analyses. A mediation test determines the degree to which the coefficient is reduced from this addition to the model.

The second set of analyses, in Table 3, illustrates the effects of home computer use on academic achievement. My purpose for including this analysis is to demonstrate the clear relationship which exists between computer use and academic achievement, in order to justify adding this measure to a scale of cultural capital. Again, the nested models introduce both student level variables and school level variables in models two and three in each of the three analyses. The second analysis is designed to portray the effects of teacher evaluations within the model. As stated above, a mediation test determines the specific effects of teacher evaluations within the model, as they relate to home computer use and academic achievement.

The third set of analyses, in Table 4, uses my newly developed cultural capital scale as the independent variable; this scale is a combination of the independent variables from tables 2 and 3. The analysis reflects the relationship between my extended conceptualization of cultural capital and academic achievement. It parallels the first two tables, in that it includes student level and school level characteristics in models two and three in each of the analyses shown, and adds both teacher evaluation variables as mediators in the second and third analyses.

Chapter 6. Results and Discussion

Table 2 reports a regression for students' math proficiency on traditional measures of cultural capital, as described above. The reader may note that Model 1 shows only the effects of cultural capital on academic outcomes; Model 2 introduces the effects of student level variables and Model 3 adds school level characteristics. These models, despite controlling for student and school level variables show a relationship between cultural capital and math proficiency levels. Models 1 through 3 examine the direct effect of cultural capital on math achievement. The analysis indicates that students possessing greater levels of cultural capital are directly benefiting academically. The strong relationship between cultural capital and academic achievement indicates that cultural capital may, in fact, offer knowledge, skills, and expertise in ways that can be tested academically**.** Across the models, however, statistical significance for cultural capital is marginally reduced, yet remains significant at the .05 level. The coefficient in Model 1 is .954, while Models 2 and 3 show a decline to .187 and .179, respectively. The effects of cultural capital on academic achievement is tested and modeled in research (see for example, Dumais 2002); however, including alternate variable measures produces a more complete picture.

Models 4, 5, and 6 mirror the first three models; however, I have added math evaluations that measure differential levels of student ability as a mediating variable in each of the three models. By adding these math evaluations, I can begin to test the indirect effect of cultural capital on math achievement thereby getting at the part of cultural capital markers that translate into achievement *through* teachers' perception of students versus the direct effect cultural capital has on learning. Similarly, models 7, 8, and 9 address math evaluations, based on how a teacher perceives a student compared to other students at that level. The results across models appear consistent until Models 8 and 9, where the inclusion of comparative math evaluations and control variables suggest they have more of an effect than the conventional scale of cultural capital. Therefore, both sets of models examine teachers' evaluations in two capacities: the first being whether or not a student is working to his or her own potential and the second being how a student is performing in the classroom compared to other students. Including both of these evaluation measures allows for a more complete picture of teacher expectancy operating within the classroom. In H*ypothesis 1* I suggested that teachers' evaluations will mediate the relationship between students' cultural capital and academic achievement. This analysis models the relationship between cultural capital and academic achievement, using teachers' evaluations as a mediator. The nested table indicates that math evaluations are highly consistent across models, whereas cultural capital loses significance once student level characteristics are included in the model. While statistical significance decreased in models 1 through 3 it persisted as an indicator of academic achievement; however, models 4 through 6 illustrate a slightly altered story, as the addition of math evaluations is the only difference between these two models. Further, two sub-analyses which test the mediating effects of student-ability math evaluations demonstrates a mediating effect, with 10.95% of the effects attributed to these math evaluations. Also, one which tests the mediating effects of student-comparison math evaluations demonstrates a mediating effect, with 38.20% of the effect attributed to the second set of math evaluations, providing support for my hypothesis that teachers' evaluations of their students mediate the relationship between cultural capital and academic achievement. Although only traditional measures of cultural capital are included in models 1 through 9; substantively, this conveys that the scale of cultural capital has a direct (human capital) effect as well as an indirect (cultural capital) effect through teacher expectancy to improve academic outcomes for students.

Table 2 OLS Regression of Academic Achievement Regressed on Conventional Cultural Capital

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Cultural Capital, Scale 1[a]	0.951***	0.188*	0.181*	0.847***	0.182*	0.176*	0.599***	0.155	0.144
Teacher Expectancy									
Math Evaluations - Student Ability				0.759***	0.305***	0.303***			
Math Evaluations - Compared to Others							1.076***	0.469***	0.472***
Student Demographics									
Female		-0.180***	-0.179***		-0.207***	-0.206***		-0.197***	-0.197***
Black		-0.245***	-0.221***		-0.229***	-0.214**		-0.244***	-0.209**
Hispanic		0.00344	0.0207		0.00369	0.0149		0.00473	0.0297
Other		0.175**	0.183**		0.161**	0.165*		0.114	0.124
Asian		-0.0181	-0.00775		-0.0222	-0.0153		-0.0372	-0.0220
Control Variables									
Individual Characteristics									
SES		0.189***	0.180***		0.183***	0.177***		0.163***	0.149***
Two Parent, No Sibling(s)		0.0261	0.0281		0.0382	0.0397		0.00693	0.0103
One Parent, Sibling(s)		-0.0156	-0.0134		-0.00461	-0.00318		0.0000614	0.00357
One Parent, No Sibling(s)		0.0580	0.0572		0.0574	0.0568		0.0712	0.0699
Other Family Structure		-0.224*	-0.221		-0.192	-0.190		-0.189	-0.184
Prior Math Achievement		0.618***	0.617***		0.600***	0.600***		0.526***	0.524***
Much Teacher Communication		0.00732	0.00429		0.00993	0.00783		0.0143	0.00961
School Variables									
50% Minority			-0.00941			-0.00409			-0.00780
Percent Free Lunch			-0.000727			-0.000535			-0.00123
Constant	6.136***	3.054***	3.084***	5.501***	2.894***	2.916***	5.781***	3.375***	3.426***
R-squared	0.0261	0.491	0.491	0.0738	0.498	0.498	0.250	0.524	0.525

N=2876

*p<0.05 **p<0.01 ***p<0.001 (Two Tailed)

[a] Cultural Capital includes only traditional measures.

The initial analysis of the relationship between cultural capital and academic achievement, though including a test for teacher evaluations, is not complete. The model neglects my extended definition of cultural capital, focusing solely on traditional measures. It does, however, provide statistical support for previous research which suggests that cultural capital has an effect on academic outcomes, controlling for socio-economic status, gender, and race characteristics. Table 3, however, demonstrates the relationship between students' home computer use and math proficiency, and the next set of analyses model the relationship between home computer use and academic achievement. The purpose of these analyses is to isolate computer use, before including it within the extended scale, in order to glean the effects computers have on achievement. Models 1, 2, and 3 depict the effects of computer use on math proficiency. As expected, findings are consistent with literature purporting that computer use increases academic achievement.

Model 1, within the nested models, specifies a direct relationship between computer use and academic achievement, which is parallel to that of human capital theories, indicating that computer use increases academic achievement. Model 2, however, suggests that gender, race and socio-economic status are highly significant, and statistical significance for computer use disappears altogether. In keeping with literature regarding computer access and use, females are significantly less likely than males to experience improvements in academic achievement, although computer use was expected to remain significant across all models. Similarly, individuals who enjoy higher levels of socio-economic status are more likely to reap benefits from computer use. These results are not surprising, as an increase in socio-economic status may also be indicative of conquering the second digital divide – access to resources which can effectively educate individuals who gain access to computers. In fact, Model 3 demonstrates that for every one unit increase in socio-economic status students will enjoy a .185 increase in their academic outcomes. Given the scale of academic achievement, which ranges from 1 to 9, an increase of .192 for every unit increase in socio-economic status is a substantial increase. Also indicated within these models, is the significant negative effect of “other family” structures. These structures include any arrangement which is not specified within the other categories (e.g. two parents – with sibling(s), two parents – no sibling(s), one parent – with sibling(s), one parent – no siblings). Therefore, students in non-standard family arrangements appear to experience a negative relationship between computer use and academic achievement, which may imply that those students are encountering quite different home computer situations than those in more traditional household arrangements.

Models 4, 5, and 6 add the student-ability math evaluations as a mediating variable, but primarily indicate similar findings as the first set of nested models. Again, a mediation test reveals that 11.22% of the relationship can be attributed to teacher evaluations of students based on their abilities. And, a second mediation test examining student-comparison evaluations shows that 48.43% of the relationship can be attributed to teacher evaluations of students when comparing them with other students, thus confirming my hypothesis that teacher evaluations mediate a portion of the relationship between home computer use and academic achievement. Math evaluations remain highly significant across all three models, however, implying that evaluations are indeed driving a substantial percentage of academic achievement, as teacher expectancy theories would predict. Female students, again, are significantly less likely than their male counterparts to experience such positive outcomes. Black students are also negatively associated with positive academic outcomes, placing black, female students in double jeopardy.

Similar to Table 2, in Models 1 through 3, 4 through 6, and 7 through 9, higher levels of socio-economic status are highly correlated with increased academic achievement. Models 7, 8, and 9 show consistent results regarding black and female students, and both demographic groups return significant negative results. Asian students remain positively significant through Model 6 but Models 7, 8, and 9 demonstrate that when teachers compare a student to other students within the same grade Asian students are no longer statistically significant, though the relationship remains positive. Therefore, the mediating effects of the two separate types of math evaluations produce different results for Asian students, but illustrate largely similar stories for other demographic groups.

Table 3: OLS Regression of Academic Achievement Regressed on Computer Use

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Computer Use	0.216***	0.0596	0.0593	0.192***	0.0564	0.0562	0.111**	0.0398	0.0391
Teacher Expectancy									
Math Evaluations - Student Ability				0.785***	0.305***	0.303***			
Math Evaluations - Compared to Others							1.095***	0.468***	0.472***
Student Demographics									
Female		-0.172***	-0.172***		-0.199***	-0.199***		-0.190***	-0.190***
Black		-0.246***	-0.220***		-0.231***	-0.212**		-0.244***	-0.207**
Hispanic		0.000244	0.0199		0.000568	0.0141		0.00180	0.0289
Other		0.167**	0.177**		0.153*	0.159*		0.108	0.119
Asian		-0.0217	-0.00981		-0.0257	-0.0173		-0.0405	-0.0239
Control Variables									
Individual Characteristics									
SES		0.202***	0.192***		0.196***	0.189***		0.174***	0.159***
Two Parent, No Sibling(s)		0.0294	0.0317		0.0413	0.0430		0.00891	0.0125
One Parent, Sibling(s)		-0.0155	-0.0131		-0.00456	-0.00286		0.00000567	0.00377
One Parent, No Sibling(s)		0.0584	0.0575		0.0577	0.0571		0.0713	0.0700
Other Family Structure		-0.221	-0.218		-0.190	-0.187		-0.187	-0.181
Prior Math Achievement		0.617***	0.616***		0.600***	0.599***		0.526***	0.524***
Mrch Teacher Communication		0.00711	0.00373		0.00974	0.00728		0.0141	0.00916
School Variables									
50% Minority			-0.0110			-0.00569			-0.00914
Percent Free Lunch			-0.000807			-0.000614			-0.00129
Constant	6.308***	3.076***	3.107***	5.631***	2.915***	2.940***	5.893***	3.397***	3.447***
R-squared	0.00876	0.491	0.491	0.0602	0.498	0.498	0.243	0.524	0.525

N=2876

*p<0.05 **p<0.01 ***p<0.001 (Two-Tailed)

Table 4 depicts the effects of a combination of cultural capital and computer use on students' math proficiency; this final analysis allows for a more thorough discussion of the two theories informing one another by statistically modeling the extent to which each theory is relevant for this particular discussion of cultural capital and teacher effects. This extended cultural capital definition reveals a strong statistical relationship with academic achievement across Models 1, 2, and 3, even once controls were added for student and school level characteristics. These results are somewhat expected, given findings from Tables 2 and 3; but the extended definition of cultural capital persists as a highly significant variable across all three of the nested models. These models provide evidence for a human capital hypothesis that states that students' academic achievement will increase with increased levels of cultural capital. These models depict a relationship between cultural capital and academic achievement; however, it ignores a potential confounding factor – evaluations students receive from their teachers. Models 1 through 3, which mirror 1 through 3 in Tables 2 and 3 in their structure, show strong, consistent, significant effects across all three models, whereas Models 1 through 3 from Tables 2 and 3 experience reductions and disappearances in statistical significance. There is a reduction in the coefficient between Model 1 and 2 in Table 4. The effects are reduced from 1.060 to .211, and Model 3 subsequently demonstrates a modest decline to .202. Despite the initial decrease, the Models do retain statistical significance. Given the scale of academic achievement, from 1 – 9, a reduction in a coefficient from 1.060 to .211 suggests that the scale of cultural capital I created is greatly influenced by control variables. These variables reduce the coefficient by more than half, so that students who have a greater amount of cultural capital will see a .202 increase in their academic achievement, according to Model 3. Substantively, this solidifies the relationship between conventional cultural capital scales and home computer use.

Models 4, 5, and 6 include student-ability math evaluations as a mediator, in an effort to complete the illustration of what is occurring within the classroom. Introducing student-ability math evaluations greatly reduces the coefficient from Model 1 to Model 4, and confirms my hypotheses that teacher expectancy works in conjunction with student illustrations of cultural capital within the classroom.[12] The mediation test for student-ability math evaluations reveals that these math evaluations account for 11.06% of the relationship between cultural capital and academic achievement, meaning that a portion of this relationship is an indirect effect of cultural capital. Furthermore, the second mediation test on student-comparison evaluations reveals that 38.52% of the relationship can be attributed to indirect effects through cultural capital. That slightly less than half of the variance is accounted for with a mediation effect, and the remaining portion is explained directly from the scale of cultural capital indicators lends further support to the idea that human capital alone cannot improve academic outcomes for students. My substantive interest in these models is based on my original theoretical argument and hypotheses which predicted how cultural capital leads to teacher expectations and affects how students are perceived as performing within the classroom. These results strongly imply that theories of human capital are not thorough enough to explain such classroom effects, and theories of teacher expectancy and cultural capital are necessary in order to fully explain the social processes which are occurring between students and teachers, as they relate to academic outcomes.

Furthermore, adding student level variables slightly reduces the statistical significance of cultural capital; and, gender, race, and socio-economic status remain statistically significant, consistent with Tables 2 and 3. The coefficient that displays this cultural capital scale drops from .652 to .172 in Models 7 and 8, and to .159 in Model 9. Math evaluations remain

[12] In a supplementary analysis (not shown here) I regressed evaluations on the extended definition of cultural capital. The analysis revealed a statistically strong relationship, providing further support for testing Models 16 through 18.

significant across all three sets of nested models and given the outcomes in Tables 2 and 3, these outcomes are largely expected. Again, the mediation effects of both math evaluation variables strongly indicate that students can benefit from increasing their levels of cultural capital for both direct and indirect effects leading to the same end – an increase in math achievement. Overall, an increase in math achievement, whether it be a result of direct, indirect, or both direct and indirect effects of cultural capital is beneficial for students. Findings in these models support *hypothesis 3*, which states students who demonstrate an increase in all elements of cultural capital, including computer use, will receive better evaluations from their teachers, subsequently resulting in increased academic achievement.

Table 4: OLS Regression of Academic Achievement Regressed on Extended Cultural Capital

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Cultural Capital, Scale 2[a]	1.057 ***	0.212 *	0.204 *	0.940 ***	0.204 *	0.198 *	0.651 ***	0.173	0.160
Teacher Expectancy									
Math Evaluations - Student Ability				0.757 ***	0.305 ***	0.303 ***			
Math Evaluations - Compared to Others							1.075 ***	0.469 ***	0.472 ***
Student Demographics									
Female		-0.180 ***	-0.180 ***		-0.207 ***	-0.207 ***		-0.198 ***	-0.197 ***
Black		-0.245 ***	-0.222 ***		-0.230 ***	-0.215 **		-0.244 ***	-0.210 ***
Hispanic		0.00343	0.0205		0.00367	0.0147		0.00469	0.0295
Other		0.175 **	0.183 **		0.161 **	0.165 *		0.115	0.124
Asian		-0.0182	-0.00785		-0.0222	-0.0154		-0.0372	-0.0221
Control Variables									
Individual Characteristics									
SES		0.188 ***	0.180 ***		0.182 ***	0.177 ***		0.163 ***	0.149 ***
Two Parent, No Sibling(s)		0.0262	0.0282		0.0383	0.0398		0.00699	0.0104
One Parent, Sibling(s)		-0.0156	-0.0135		-0.00463	-0.00321		0.0000386	0.00354
One Parent, No Sibling(s)		0.0585	0.0577		0.0578	0.0572		0.0716	0.0703
Other Family Structure		-0.223 *	-0.220		-0.192	-0.190		-0.188	-0.183
Prior Math Achievement		0.617 ***	0.617 ***		0.600 ***	0.599 ***		0.526 ***	0.524 ***
Much Teacher Communication		0.00724	0.00424		0	0.00778		0.0142	0.00956
School Variables									
50% Minority			-0.00916			-0.00385			-0.00761
Percent Free Lunch			-0.000725			-0.000534			-0.00123
Constant	6.039 ***	3.036 ***	3.066 ***	5.417 ***	2.876 ***	2.899 ***	5.723 ***	3.360 ***	3.412 ***
R-squared	0.0270	0.491	0.491	0.0745	0.498	0.498	0.250	0.524	0.525

N=2876

*p<0.05 ** p<0.01 ***p<0.001 (Two-Tailed)

[a] Extended Cultural Capital Scale (Conventional Cultural Capital + Computer Use)

Tables 2, 3, and 4 show considerably similar effects concerning their independent variable of interest; but, Table 4 shows that Models 4 through 7 have significant results for cultural capital, while the Models in Tables 2 and 3 lose significance once control variables are introduced to the models. Table 4 is the most comprehensive analysis of the three tables, providing support for an argument suggesting that both human capital and cultural capital work in concert to produce improved academic achievements. Moreover, the evidence for this is found in the part of the analysis demonstrating teachers' evaluations mediating this relationship. These results indicate that neither human capital nor cultural capital receive full credit for improving academic outcomes. Instead, both direct effect of investment in cultural indictors and indirect effects through teacher's perceptions of these investments are working in conjunction to advance student outcomes.

Chapter 7. Conclusion

The relationship between computer use and academic achievement has traditionally been thought to be a direct relationship: an increase in computer use leads to enhanced knowledge, skills, and expertise, which translates directly into academic achievements. The analysis I present here, however, offers a different perspective because it allows for alternate explanations of computer use increasing academic achievement. Access and use of computers continues to indicate academic improvements among students according to this analysis. In addition to these findings, however, results strongly point toward the teachers' role in student's academic achievement. Therefore, both arguments of human capital and cultural capital jointly work to produce an increase in academic achievements.

Combining theories of cultural capital and teacher expectancy offers insights into how the two work together, when taking computer use into account. Using a theoretical framework of teacher expectancy to inform that of cultural capital allows for a more complete analysis of how cultural capital is operating in the classroom. Cultural capital research has not fully incorporated themes of technology into its analysis. My extended definition of cultural capital draws from previous research (for example, Lamont and Lareau 1988; Roscigno and Ainsworth-Darnell 1999) and adds breadth to the concept of cultural capital initially put forth by Bourdieu (1979). This analysis allows for a more modern approach to analyzing cultural capital within the classroom.

The current literatures on cultural capital and teacher expectancy are not fully incorporated, and this analysis allows for the two to inform one another. The analysis relies on teachers' evaluations of their students to indicate whether or not cultural capital is contributing to the academic successes of their students. The scale of cultural capital itself does not immediately illustrate the theoretical argument put forth by Bourdieu (1979) because it includes computer use as a measure and other cultural indicators which may also be contributing directly to students' skill set. Therefore, including teachers' evaluations within the analysis specifically designates cultural capital as an academic achievement enhancer. The findings support both cultural capital hypotheses, and previous literature that suggests human capital arguments. What makes this analysis unique is the acceptance of both arguments working in concert because they should not be considered mutually exclusive.

Measuring cultural capital, using teachers' evaluations, was an important step in extending the literature, while simultaneously incorporating aspects of more modern culture, such as technology. These results, while suggestive of computer use as a measure of cultural capital, could be enhanced with a more comprehensive analysis of subject matter other than math. Disentangling computer use from the reading evaluations teachers complete could offer further insights to the ways in which computer use is affecting other classroom environments. Therefore, deconstructing the reading evaluations by excluding the computer-use measure included within the text that teachers view, and reconstructing the variable without this measure, could produce non-biased results that contribute more completely to this analysis.

Similarly, the constraints of the public-use dataset include missing information, or altered variables, on minority students and those in private schools. Such limitations allow for a statistical analysis, but one which only includes a portion of the actual story. Moreover, many of the variables within the public-use dataset are dichotomous and utilizing the private dataset for analyses would produce a more comprehensive picture of the social processes occurring within the classroom. The next step in this research is to gain access to the private-use dataset, and re-analyze this argument using both disentangled reading evaluations and non-simplified variables.

Further research on teacher expectancy and cultural capital is necessary and could address alternate phenomena which are transpiring in the classroom. This conceptualization of computer use, while important, may drive at larger issues which are leading to biased academic outcomes for some students, and not others. Therefore, the story behind these numbers may be indicative of larger social problems and broader issues which researchers must evaluate. Future research should navigate through classroom processes that suggest teacher bias that result from modern additions to homes and classrooms. The learning environments of children are constantly shifting as technology becomes a dominant tool in our lives. Research must recognize these changes and incorporate them into our theoretical arguments and empirical analyses.

Finally, this analysis relies heavily on quantitative data to tell the story of classroom interactions. This theoretical framework, however, is not limited to statistical interpretations and could be examined successfully through qualitative research. Entering the classroom and witnessing teacher-student interactions, and how teachers utilize personal student information, could considerably contribute to this line of research. Discussions with teachers may lead to further insights which suggest more complex answers than the coupling of cultural capital and human capital. Therefore, this study should be used as a starting point for future research that examines the relationship of these two literatures and the influences of computers and technology on students' learning.

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Appendix

Table A1: Logistic Regression of Teacher Evaluations Regressed on Extended Cultural Capital - Controlling for Math Achievement

	Model 1	Model 2	Model 3	Model 4
Variables	(Evaluation - More Ability)		(Evaluation - Compared to Others)	
Extended Cultural Capital	1.541 ***	0.847 *	1.551 ***	0.822 **
Math Proficiency		0.626 ***		1.162 ***
Constant	1.445 ***	-2.151 ***	-0.841 ***	-8.15 ***

* p<0.05 **p<0.01 ***p<0>001