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School Facility Age and Classroom Technology:

The Influence of Stakeholder Participation in the Technology Planning Process

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Abstract

This study begins by examining the relationship between public K-12 school facility age and student access to modern classroom technological resources; driven by questioning "newer equals better" assumptions. The method of analysis employed is multivariate cross-sectional regression. The unit of analysis is the individual school, by school type (elementary, middle, high). Academic school year 2004/05 data are used. The study geography is the Orlando, Florida area (Orange and Seminole Counties). The findings indicate that classroom technology measures, while positively associated with newer school facilities, have no statistically significant relationship with school facility age. Instead, however, having more participants involved in the school technology planning process is found to be the most statistically significant variable included in the model, in relation to greater measures of technology in the school classroom. These findings are intended relevant for educational facility discourse on school facility age and classroom technology.

School Facility Age and Classroom Technology:

The Influence of Stakeholder Participation in the Technology Planning Process

Newer built school facilities are often perceived to be "better" than older school facilities. Largely, this is due to the assumption that the newest facilities will possess the most current, and thereby the "best," technological resources available (Baum, 2004; Briggs, 2005; Gibson, 2009; Gurwitt, 2004). This "newer equals better" perception transfers into residential location choice and monetary housing value. In the 2005 Orlando, Florida metro area, newer schools are found to be significantly positively associated with higher home prices. When all other attributes are held constant, the 2005 monetary impact of a newer elementary school (built during the 1990s or 2000s) added $13,130.22 to average housing value, compared to schools built pre-1990s (Gibson, 2009).

A quality education is a life opportunity for children (Briggs, 2005). Classroom technological resources are known important factors on student achievements. Betts (1995) analyzes five years (1987-1992) of the Longitudinal Study of American Youth (LSAY), which surveys learning environments and assessments for seventh and tenth grade students. The survey takes place during 1987, at 52 different high and middle schools, in four different regions, and covered urban, suburban, and rural communities. The purpose of Betts' study is to investigate which specific school facility attributes are important to student achievements. Using multiple regression analysis, Betts finds that classroom technological resources and teacher qualifications are the most important influential school attributes on student achievements.

In a study of sixth grade student achievements in the Philadelphia school district, Summers and Wolfe (1977) find that student inputs such as socio-economic status (SES) tend to trump school resources, class sizes, and faculty quality (based on education level) when it comes to overall student achievements. However, they point out that the schools with more facility resources, smaller class sizes, and with higher faculty quality do tend to be in neighborhoods of higher SES make-up and produce greater student performance. They as well used multiple regression analysis in their study and they reported the results for sixth graders.

Cash (1993) compares 43 high schools in rural Virginia between 1991 and 1992 and finds that school facility conditions have an association with eleventh grade student achievements. Her study is later followed by Hines (1996) who compares 66 high schools in urban Virginia. Hines (1996) also finds that school facility conditions have an association with student achievements. Harter (1999) conducts a Texas statewide study of 2,860 elementary schools and finds that comparatively, the amount of money spent on school renovations has a positive association with fourth grade student achievements. Morgan (2001), using multiple regression analysis, looks at 139 elementary, middle, and high schools in Milwaukee, Wisconsin and finds that a school facility's infrastructure conditions has a relationship with student achievements for fourth, eighth, and tenth graders on standardized test scores.

Furthermore, there is evidence suggesting that newer school facilities are positively associated with student performance. When Plumley (1978) investigates the relationship of school facility age on student achievement for Georgia fourth graders, he finds a negative relationship for older facilities by comparison. Chan (1979) finds similar results in his more robust follow-up study. Chan surveys principals in Georgia schools containing eighth graders to assess each school's "modernized" condition. Comparatively, he finds that the more "modernized" schools have greater eighth grade achievements on standardized test scores. School facility age is found to explain a three percent difference in student achievements in Georgia schools (McGuffey & Brown 1978). Studies in Tennessee and Virginia produce similar findings as well, finding school facility age to inversely correlate with student achievement (Bowers & Burkett, 1987; Ikpa, 1992). What these studies do not address however, is the relationship between the school facility age and the classroom technology available in that school; which is at the foundation of the "newer equals better" perception (Baum, 2004; Briggs, 2005; Gibson, 2009; Gurwitt, 2004).

This phenomenon is perhaps best described by Mac McLelland, of the Michigan Land Use Institute, when discussing new suburban school facilities and growth. He explains that once a new school is built, families begin to say "Hey! They've got a nice new school, let's move there" (Gurwitt 2004, pp. 24). The idea here is that these families perceive "newer" as "better," and will locate residentially to capitalize on the better, newer facility. Briggs ties this sentiment, in part, to the unequal [technological] resources assumed to be in the new suburban school facilities, versus the deteriorating older inner city facilities (Briggs). Baum (2004) goes one step further and focuses on the inverse of this notion, turning to school facilities as a tool to manage suburban expansion. He advocates that if our nation's inner city schools are renovated when expanded facilities are needed, instead of building our new schools in peripheral suburban areas, this will both help curb "sprawl" and address de facto socio-economic segregation in the public school system. This notion rests on the premise that families who would otherwise move to the newly built schools in the suburbs, will instead stay in town to attend the improved, newly renovated inner city schools, with the "better" [technological] resources (Baum, 2004).

Another important factor to consider in regard to school facilities and classroom technology is the role of stakeholder participation in the strategic planning process. Since the (1966) Coleman Study, local populations are thought to have great influence on their schools. In order to engage local populations in their communities, since Arnstein (1969), the proper involvement of stakeholder participation has been at the forefront of community planning discourse. When implemented properly, stakeholder participation in the strategic planning process is able to produce robust ideas and plans for their respective audiences (Arnstein, 1966; Briggs, 2003; Bryson, 1995). It is partly due to this notion that the last several decades have seen much increase in stakeholder engagement in policy planning, moving from traditional "top-down" practices (Briggs, 2003).

Stakeholder participation and strategic planning promotes tactical thought for purposes of forward-thinking growth and addressing barriers of institutional challenges, with this hopes of being tailored to and benefiting all involved. This process is fostered by bringing in outside input and expertise, keeping organizations and communities current and relevant (Bryson, 1995). It is expected that this benefit will not be lost on educational facility planning.

Methodology

This study addresses the assumption that the newest facilities will possess the most current, and thereby "best," technological resources; controlling for stakeholder participation and other external factors. This study asks: *do newer school facilities comparatively have greater student access to modern classroom technological resources?*

Analysis Plan

To test the function of school facility age on classroom technology, controlling for other potential influencing factors, a cross-sectional multivariate ordinary least squares (OLS) regression is employed. Regression analysis is appropriate for this analysis due to the ability of statistically measuring specific relationships amongst individual variables, while controlling for external factors (Hoffman, 2004). In this case, the association of school facility age on classroom technology is being measured, controlling for student population demographics, stakeholder participation, school funding sources, available technological guidance and training for teachers, and tech support personnel. The regression model (hereby known as the "model") is as follows:

$$\textit{classroom technology} = B_0 + B_1(\textit{school facility age}) + B_2(\textit{student minority rate}) + B_3(\textit{Title I status}) + B_4(\textit{stakeholder participation}) + B_5(\textit{funding}) + B_6(\textit{guidance and training}) + B_7(\textit{personnel}) + e$$

To support the hypothesis that newer school facilities will comparatively have greater student access to modern classroom technological resources, the coefficient for "school facility age" should be positive and significantly different than 0 at alpha level .05 in the model (Hoffman, 2003).

Sample

The unit of analysis is the individual school, by school type (elementary, middle, high). Elementary pertains to grades "K" (kindergarten) though five, middle pertains to grades six through eight, and high pertains to grades nine through twelve. The study population contains all kindergarten through twelfth grade elementary and secondary public schools in the core Orlando, Florida area (Orange and Seminole Counties) during school year 2004/05. The Florida Department of Education and local public school district data records are used for study. There are 204 total schools in the study population, consisting of 144 elementary schools, 38 middle schools, and 22 high schools. Of these schools, 59 elementary, 24 middle, and 17 high schools have complete data for analysis; and thereby constitute the study sample.

Variables

The System for Technology Accountability and Rigor (STAR), under the operation of the Florida Department of Education (FL-DOE), administrates a statewide school technology survey in October/November of each year. For analysis, *classroom technology* is the dependent variable is the model. Classroom technology is the ratio of modern computers (less than five years old at time of survey that were internet and multimedia capable) in the school's classrooms for student use, divided by the student enrollment at the time of the survey. Students spend the majority of their time in "regular" educational classrooms as opposed to other locations, such as computer labs or media centers, and therefore Florida Innovates, the direct administrators of the STAR survey, advocate that this figure is the best survey indicator of student technology access, as a snapshot of how technology is integrated into daily curriculum by way of indicating of how much technology students have access to during the bulk of the school day.[1]

The average classroom technology ratio for elementary schools in the study population is .13 modern computers per student, with a standard deviation of .10 modern computers per student [N=144]. The lowest classroom technology ratio is zero modern computers per student, the highest .53 modern computers per student. The average classroom technology ratio for middle schools in the population is .11 modern computers per student, with a standard deviation of .10 modern computers per student [N=38]. The lowest classroom technology calculated index figure is zero modern computers per student, the highest .39 modern computers per student. The average classroom technology ratio for high schools in the population is .09 modern computers per student, with a standard deviation of .08 modern computers per student [N=22]. The lowest classroom technology ratio is zero modern computers per student, the highest .36 modern computers per student. In other words, on average there are roughly ten students per modern

[1] This is based on telephone and email correspondence with a Florida Innovates Program Specialist.

computer in the overall population's school classrooms; but there is a wide range of deviation between individual schools within all three school types, from no modern computers at all, to two or three students per computer. In all three cases there is a positive skew, but due to the central limit theorem this is not a problematic analytic concern (Agresti and Finlay, 1997).

The primary independent variable of interest is *school facility age*. This variable is calculated in two ways. First, the year the school building originally was built or fully re-built is determined. Respectively, this is referred to as the "built" age. Second, the averaged overall age of the facility is determined. This is referred to as the "effective" age. The 2008 FL-DOE, Florida Inventory of School Houses (FISH) Facility Inventory Report is reviewed to calculate facility ages. The built age is simply the year the school facility opened or re-opened (if re-built). The effective age is an addition and division of facility square feet by years (plural) built. For example, if a 20,000 square feet facility was originally built in 1950 and then a 20,000 square feet addition was added in the year 2000, if no other improvements were made to the building during this time, the effective age is 1975 ([(20,000 * 1950) + (20,000 * 20000) / 40,000] = 1975). The built age in this example is 1950.

At the time of the study, the average area elementary school in the study population was built in 1975, with a standard deviation of 19.25 years [N=144]. The oldest elementary school was built in 1924, and the newest was built in 2005. The average middle school was built in 1982, with a standard deviation of 20.59 years [N=38]. The oldest middle school was built in 1926, and the newest was built in 2005. The average high school was built in 1979, with a standard deviation of 16.18 years [N=22]. The oldest high school was built in 1951, and the newest was built in 2003.

The average elementary school effective year is 1982, with a standard deviation of 14.23 years [N=144]. The oldest effective year is 1943, the newest 2005. The average middle school effective year is 1988, with a standard deviation of 12.15 years [N=38]. The oldest effective year is 1968, the newest 2005. The average high school effective year is 1988, with a standard deviation of 8.69 years [N=22]. The oldest effective year is 1971, the newest 2003.

Diagnostics demonstrate that overall the effective school facility age has a more direct linear relationship with classroom technology when compared to the built school facility age for all three school types, due to less clustering. This relationship is mild at best; yet variable transformations result in no substantial improvements. As a result, only effective school facility age is included for analysis.

Besides effective school facility age, conceptualized control variables are included to account for other possible influences on school classroom technology provision. Chiefly, these variables are intended to address possible issues of demographic and administrative discrepancies between schools.

First, school *student minority rate* and *Title I status* are included to control for student/neighborhood characteristics. Race has long been a part of the discourse on public school equality (Briggs, 2005; Coleman, 1966). The school's student minority rate measures the school's race composition by reflecting the percentage of students who are not listed as "White, non-Hispanic." This information is published annually in the FL-DOE School Accountably Reports. The average area student minority rate for elementary schools in the study population is 61.98 percent, with a standard deviation of 23.42 percent [N=144]. The lowest student minority rate is 12.5 percent, the highest 100 percent. The average student minority rate for middle schools is 59.49 percent, with a standard deviation of 21.67 percent [N=38]. The lowest student minority rate is 25.4 percent, the highest 98.1 percent. The average student minority rate for high schools is 55.78 percent, with a standard deviation of 21.51 percent [N=22]. The lowest student minority rate is 24.4 percent, the highest 95.5 percent.

Alongside race, socio-economic status has also been a major part of the public school equality discourse (Briggs, 2005; Coleman, 1966). By definition, Title I schools are those that have been identified under Title I of the federal Elementary and Secondary Education Act of 1965 as "disadvantaged" and "in need of improvement" (US-DOE, 2008). By default, the Title I label of a school serves as a proxy for low student income composition. In the study population, 36 percent of the elementary schools are Title I [N=144], 29 percent of the middle schools are Title I [N=38], and four percent of the high schools are Title I [N=22].

Who the stakeholders in a process are (*stakeholder participation*), will likely have great influence on the outcome. Thus stakeholder participation is accounted for in the model. For analysis, the stakeholders in schools' technology planning processes are measured as a percentage of participation by stakeholder type. The FL-DOE: Florida Innovates STAR survey asks each school to indicate which stakeholders were involved in their school's technology planning process. The options to select from are 1) administrators, 2) business leaders, 3) community members, 4) consortia, 5) district technology leaders, 6) parents, 7) students, 8) teachers, 9) technology specialists, or none. For the purposes of the model, these variable categories are first tested as dummy variables to see if the presence of any particular party has a significant association, and then the number of "checked" categories are added to form a participation score (0-9). This value is entered into the model to assess if there is positive or negative association of having more or less participants. Data are not available for all schools in the study population for this variable.

The average stakeholder participation calculated index figure for elementary schools in the study sample is 3.74, with a standard deviation of 1.32 [N=91]. The lowest stakeholder calculated index figure is one, the highest nine. The average stakeholders calculated index figure for middle schools is 4.03, with a standard deviation of 1.35 [N=30]. The lowest stakeholders calculated index figure is one, the highest nine. The average stakeholder calculated index figure for high schools is 4.22, with a standard deviation of 1.52 [N=18]. The lowest stakeholders calculated index figure is two, the highest eight.

Another possible influence to technology is a school's monetary *funding*. The STAR survey asks each school to identify any additional technology funding sources (other than funds generally provided from the school district, including sales tax proceeds), again selecting from a provided list. This list includes 1) business partnerships, 2) district grants, 3) donations, 4) federal or state grants, 5) foundations, 6) fund-raisers, 7) private grants, 8) Parent-Teacher Organizations (PTOs) or other school-related "booster" organizations, 9) A+ / school recognition funds, 10) profits from school ventures such as cell towers, after-care, vending machines, yearbook sales, etc., 11) Title I money, 12) additional district sanctioned school improvement funds, 13) other. Again, for the purposes of the model, these variable categories are first tested as a dummy variables to see if the presence of any particular party has a significant association, and then the number of "checked" categories are added to form a participation score (0-13). This value is then entered into the model to assess if there is a positive or negative association of having more or less funding sources.

The average funding calculated index figure for elementary schools in the population is 2.81, with a standard deviation of 2 [N=144]. The lowest funding calculated index figure is zero, the highest eight. The average funding calculated index figure for middle schools is three, with a standard deviation of 1.66 [N=38]. The lowest funding calculated index figure is zero, the highest six. The average funding calculated index figure for high schools is 3.31, with a standard deviation of 2.46 [N=22]. The lowest funding calculated index figure is zero, the highest nine.

User (teacher) instruction is controlled for with the addition of a technology *guidance and training* measure. The STAR survey asks each school to select which guidance and training options the school's instructional technology specialists (whoever they may be) provides. The options to select from are 1) guidance for teachers in directing student use of technology in class, 2) guidance for teachers in using technology to prepare and deliver lessons, 3) modeling technology integration, 4) technology skill training for teachers, 5) technology support to administrators, or none. These variable categories are first tested as dummy variables to assess if the presence of any particular party has a significant association, and then the number of selected categories is added to form a guidance and training score (0-5). This value is then entered into the model to assess if there are positive or negative associations of having more or less guidance and training options.

The average guidance and training calculated index figure for elementary schools in the study population is 1.34, with a standard deviation of 1.34 [N=97]. The lowest guidance and training calculated index figure is zero, the highest five. The average guidance and training calculated index figure for middle schools is 4.11, with a standard deviation of 1.23 [N=28]. The lowest guidance and training calculated index figure is zero, the highest five. The average guidance and training calculated index figure for high schools is 4.33, with a standard deviation of 1.11 [N=21]. The lowest guidance and training calculated index figure is two, the highest five.

Finally, whether or not a school has dedicated technical support (*personnel*), as opposed to a faculty member with other responsibilities may also reasonably influence classroom technology use in daily activities, and thereby the technology capacity as measured by the classroom technology variable, again do to user (teacher) resources. The tech personnel variable is a choice of 1) faculty member with other responsibilities, 2) part-time dedicated, but not an additional staff/faculty member, 3) full-time dedicated, but not an additional staff/faculty member and 4) full-time dedicated, additional staff/faculty member, or none. Because this is not an accumulative variable as with the previous technology measures, for the purposes of the model, these variable categories are only tested as dummy variables to assess if any particular personnel type has a significant association to the classroom technology measure. Having no personnel "none" is the reference category in the model.

For comparative purposes, the average personnel calculated index figure for elementary schools in the study population is 2.74, with a standard deviation of .82 [N=144]. The lowest personnel calculated index figure is zero, the highest four. The average personnel calculated index figure for middle schools is 2.86, with a standard deviation of .88 [N=38]. The lowest personnel calculated index figure is zero, the highest four. The average personnel calculated index figure for high schools is 3.45, with a standard deviation of .51 [N=22]. The lowest personnel calculated index figure is three, the highest four.

Diagnostics and Adjustments

Ordinary Least Squares (OLS) assumptions are checked prior to analysis. Besides dropping built school age from the analysis in favor of effective school facility age, no further issues with the model are identified. In addition, the robust standard errors are used to down-weigh any possible unknown influential observations in the regression, allowing cautious and conservative inferences to be concluded from the findings (Chatterjee, 2006; Hoffman, 2004). Finally, as noted in the sample description, only complete cases are included for analysis.

Findings

Regression outputs are examined for all model variables, on classroom technology, for all three separate school types (elementary, middle, and high); displayed in Table 1 and explained in the following text. The overall model has the most collective explanatory power at the middle school level, explaining approximately 64% of variation in classroom technology (R-squared .6363). The model's explanatory value at the high school level is approximately 46% (R-squared .4609), and 13% (R-squared .1316) at the elementary school level. However, within the model, only one variable, stakeholder participation, emerges as being a significant individual predictor for classroom technology.

The quantity of stakeholders in the technology planning process is statistically significant ($p < .05$) at the elementary and middle school levels. This predictor has a positive directional relationship to the classroom technology measure for all school types (elementary .018172, middle .048035, and high .006564). Notably, at the high school level, while the stakeholder participation coefficient displays a positive direction in regard to classroom technology, it is not statistically significant in the model. This could, in part, be due to the smaller sample size for high schools.

Interestingly, no one particular category of stakeholder emerges as being more important than another. Thus while it may not be concluded which specific stakeholders are the most influential from these results, it may be inferred that an increase in stakeholder participation is related with an increase in classroom technology at the associated school facility.

Specifically, this indicates that with each added stakeholder participant in the school technology planning process, there is a slight increase in the ratio of modern computers per student in that respective school. For this sample, this ratio statistically equates to .02 modern computers per student per added stakeholder participant at the elementary school level, and .05 modern computers per student per added stakeholder participant at the middle school level. Thus, while this association is effectively small in size, it is of larger significance, empirically indicating that simply getting multiple/more parties involved in a planning process will influence its outcome towards a stated goal (in this case, technology in school facilities).

Contrarily, the effective school facility age is not statistically significant in the model for any school type. Based on this finding for effective school facility age, along with the lack of virtually any linear relationship between built school facility age and classroom technology in the study sample, it is reasonable to conclude that a school's facility age has little, if any relation to classroom technology available in the 2005 Orlando, Florida area studied.

Also of importance, neither school student minority rate nor Title I status show to be positively associated with classroom technology for any school type. Perhaps the presence of available grants and funds specifically targeted for minority and lower socio-economic neighborhoods to enact improvement programs are accountable for this finding. The number of funding sources is also not statistically significant for any school type. It is expected that this result may be interpreted to mean that the "quality" of the actual funding source is more important than the sheer number of sources. Although, no one particular source type emerges as being of consistent statistical significance either. Thus, likely, this is a case by case issue. As well, the amount of guidance and training provided does not show statically significance; with no one particular type of guidance and training practice emerging as being of consistently statistically significant. Finally, the type of technology personnel available also produces no signs of statistical significance, with no type, not even a dedicated full time staff member, being statistically more important than the other in regard to classroom technology level at a given school. However, notably, not all types of technology personnel are present at each of the three school levels in the model.

In summation, the best explanatory variable in the model for determining the level of classroom technological resources in a given school facility available for student access is the amount of overall stakeholder participation in the school's technology planning process. However, the lack of statistical significance for school facility age, student race and socio-economic characteristics, funding sources, the amount of guidance and training offered to teachers for the use of technology, and the level of technology assistance available to teachers is just as fundamental of a finding to educational facility discourse on technology.

Conclusion

Finding classroom technology to have no relationship with school facility age is contrary to the expectations of "newer equals better" (Baum, 2004; Briggs, 2005; Gibson, 2009; Gurwitt, 2004). A logical explanation for this is that individual school policies will influence school technology levels more so than does facility age. For example, a principal of a school will receive a budget, then it is decided whether to spend that money on new computers or new playground equipment. Therefore it is the principal and other decision-makers, not the age of the facility, which will have the most influence over the school's classroom technological resources.[2] This is likely why it is found that schools with more stakeholder participants in the school

[2] This is based on post analytic conversations with Florida public elementary school administrators, faculty, and staff who are involved in the technology planning process at their respective schools.

technology planning process have greater classroom technology resources in this study, regardless of the age of the school facility, or other controlled factors.

Discussion

There possibly may be several explanations of why more modernized computers per student are found in schools with greater stakeholder participation in this study. Perhaps most significantly is a self-selection bias and the strength of numbers. These are voluntary stakeholders in a school's technology planning process. Thus, it is highly likely that the involved stakeholders are advocates for technology, which is perhaps why they chose to become involved in the first place. Their reason to advocate such belief, likely based on the understanding that technology is an influential tool for student achievement (Betts, 1995).

None-the-less, the found relationship between the quantity of stakeholders in the school technology planning process and the amount of classroom technological resources available at that school is of the utmost importance. This empirically indicates that the act of getting multiple parties involved in a planning process, or not, is influential to its outcome. The implications of this can be quite widespread. Ideally, the inclusion of various stakeholders in a decision-making process will result in outcomes that best represent the desires of the collective community. This is not a new concept, as citizen participation in the community planning process has been advocated for quite some time, and has become a fairly mainstream notion in the community planning field (Arnstein, 1969; Briggs, 2003). This is likely due to the appreciation of the stakeholder regarding their involvement, causing greater "buy in;" being seen as more "democratic" in nature than top-down planning; and the simple fact that the inclusion of external forces will bring new ideas to the table (Briggs, 2003). However, the empirical evidence of this notion is not as abundant.

In the end though, intended for the discourse on public K-12 educational facilities, it is seen that ‘newer does not necessarily always equal better,’ at least not in terms of classroom technological resources; busting the myth of “newer equals better” assumptions.

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Table 1

Regression Outputs of School Facility Variables on Classroom Technology by School Type

Variable	**Coefficients**		
	Elementary	Middle	High
School facility [effective] age	.000643	.000623	.003374
Student minority rate	.000747	.001798	.002251
Title I status *schools versus non-Title I status schools*	.012253	.084990	-.048672
Stakeholder participation	.018172*	.048035*	.006564
Funding	-.004604	.008850	.008057
Guidance & training	.004579	.005766	.016098
[Personnel Category 1] Faculty member with other responsibilities *versus dedicated full-time staff member*	.007141	--	--
[Personnel Category 2] Part-time dedicated, non-staff/faculty member *versus dedicated full-time staff member*	-.026022	-.002438	--
[Personnel Category 3] Full-time dedicated, non-staff/faculty member *versus dedicated full-time staff member*	-.048431	-.033886	.024705

Notes: N for Elementary = 59; Middle = 24; High = 17
"--" = no observations
R-squared for Elementary = .1316; Middle = .6363; High = .4609
*Significance at the .05 level