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Student Engagement and Classroom Variables in Improving Mathematics Achievement

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The study explored how much student engagement and classroom variables predicted student achievement in mathematics. Since students were nested within a classroom, hierarchical linear modeling (HLM) was employed for the analysis. The results indicated that student engagement had positive effects on student academic growth per month in math after taking into account student variables such as gender, SES, race, and interaction effects. The effects of student engagement are consistent regardless of minority and gender. Among classroom level variables such as teachers' degree, experience, certification, authentic instruction, content coverage, and class size, there is no significant predictor of student math achievement growth. The findings suggest that student engagement should be emphasized in a school and educational policy for students' success in a school.

Key Words: Student engagement, Student achievement, Hierarchical linear modeling

Since Coleman et al. (1966) began to explore school effects on student achievement in the United States, research on a relationship between education resources (e.g. money, curricula, and facilities) and education outcomes (e.g. student achievement, cognitive development) has taken large part of educational research in the twentieth century ((Burstein, 1980; Bryk & Raudenbush, 1992; Sammons, 1999; Shavelson & Towne, 2002; Teddlie & Reynolds, 2000). However, the early research design was too simple and did not consider process. Overcoming the critical notes, researchers began to establish links between resources, transformational educational processes, and student outcomes over time (Shavelson & Towne, 2002). This study is also one of the efforts to overcome the limitations of the early research by taking student engagement as one of educational processes and exploring the linkage between educational processes and student outcomes.

Student engagement is the most immediate and persisting issue for improving student learning. Research indicates that the most obviously disengaged students disrupt classes, skip them, or fail to complete assignments. In contrast, engaged students make a psychological investment in learning and try hard to learn what a school offers. They take pride not simply in earning the formal indicators of success (grades), but in understanding the material and incorporating or internalizing it in their lives (Newmann, 1992).

In spite of the significant impact of engagement, research on teacher variables affecting engagement, is sparse. The lack of research is surprising when it is considered that teachers are the most significant people in schools for boosting student engagement and achievement (Brandt, 1998; Hill & Crevola, 1999; Newmann, 1992; Strong et al., 1995; Wasley, 1999; Wolfe, 1998). To help address these shortcomings, this study includes classroom variables as well as student variables. Verifying teacher variables in a classroom helps policy makers and administrators to make a research-based decision for better teacher recruitment.

The main research question addressed is this: How much math achievement can be predicted by student engagement and classroom variables? According to previous research (Finn, 1993; Marks, 2000), student engagement and academic achievement have a positive relationship. This research will

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add to this line of literature by examining the link between student engagement and fall-to-spring achievement gains in math.

Student Engagement Theory

Engagement represented active involvement, commitment, and concentrated attention, in contrast to superficial participation, apathy, or lack of interest (Newmann et al., 1992: 11). Newmann et al. (1992) defined student engagement in academic work as the student's psychological investment in and effort directed toward learning, understanding, or mastering the knowledge, skills, or crafts that academic work is intended to promote. Marks (2000) synthesized the definitions of several researchers and defined engagement as a psychological process, specifically, the attention, interest, investment, and effort students expended in the work of learning. This definition included affective aspects of engagement as well as academic ones. Finn (1993) explained engagement with four levels and those levels of engagement changed with an individual's age.

Explaining engagement with a participation-identification model, Finn (1993) found that there was a strong linear association of participation with academic achievement. In other words, the higher the participation level, the higher the achievement scores in reading, mathematics, science, and social studies. Newmann et al. (1992) found that engagement encouraged them to work hard. In most studies, the strong association of participation with achievement was supported for male and females, and for Asian, Hispanic, African American, and non-Hispanic White students alike (Greenwood, 1991). Hines et al. (1986) showed that task engagement mediated teacher behavior and student achievement, and Silverman (1985) showed student characteristics mediated engagement and outcomes in physical education.

Teacher Quality Effects on Student Achievement

Classroom variables are composed of teacher quality, teaching quality[1], and class size variables. Teachers' years of experience, type of certification, and highest degree earned are used as the measures of teacher quality for this study. According to the 50-state survey, such teacher qualities as years of teaching experience, professional learning and education, and licensure were selected as factors that would improve student achievement (Kaplan & Owings, 2001). Teacher experience and teacher education were the most important input variables to enhance students' academic achievement (Greenwald et al., 1996; Hedges et al., 1994). Researchers generally looked at master's degrees as another way to measure the effects of formal teacher preparation (The Abell foundation, 2001). Darling-Hammond (2000) found that full certification was more influential on student achievement than students' demographic information such as poverty, minority status, and language background. She contended that the proportion of fully certified teachers in a state was the most consistently significant predictor of student achievement in math (Darling-Hammond, 1997; 2000).

Teaching Quality Effects on Student Achievement

When teaching quality is defined as what teachers do to improve student learning in a classroom, authentic instruction and content coverage are the indicators of teaching quality. Authentic instruction is a criterion to measure teaching quality for this study. As a source of enhanced student engagement, authentic instructional work measures how much the work that the students are asked to do in academic subjects is cognitively challenging and connected to the world beyond the classroom. According to Marks's research (2000), authentic instructional work is a powerful contributor to the engagement of elementary, middle, and high school students because authentic academic work involves students in solving meaningful problems with relevance in the world beyond the classroom and of interest to students personally. Wehlage et al. (1996) also found that authentic pedagogy had positive effects on student performance, both in math and social studies.

Another indicator of teaching quality that has received growing attention was curricular content covered in classrooms (Rowan et al., 2002). Definitions and measures of curricular content vary from study to study. While some studies measured only the content that was covered in a classroom, other studies measured both the content covered and the "cognitive demand" of such content (Rowan et al., 2002). The previous research on content coverage in a classroom consistently showed a positive relationship with student achievement (Cooley & Leinhardt, 1980; Stedman, 1997). In other words, the degree of overlap between the content covered in a classroom and the content tested was a good predictor of student achievement (Rowan et al., 2002). Porter et al. (1993) found that the addition of a cognitive demand dimension to the topic coverage dimension increased

1 Kaplan & Owings distinguish between teacher and teaching quality. Teacher quality indicates teachers' individual characteristics such as demographics, aptitude, professional preparation, and college majors, while teaching quality refers to what teachers actually do in the classroom to improve student learning.

the power of content measures to predict gains in student achievement.

Class Size Effect on Student Achievement

In recent years, class size reduction has gained increasing attention nationwide (Nye et al., 2001a; 2001b). One tradition of small class effect research is the econometric work on education production functions (Nye et al., 2001a; 2001b). Hanushek (1986, 1989) argued that small class sizes had non-significant effect on student academic achievement, once student characteristics such as social class or prior achievement were controlled. On the other hand, Hedges et al. (1994) concluded that the effect of class size reduction had a positive effect on academic achievement after reviewing the same studies as Hanushek (1989). Greenwald et al.'s subsequent study (1996) reported a similar result that small class size had a positive effect on academic achievement after reviewing a larger and more contemporary collection of econometric studies. Although debates on effects of small class are still going on, the positive effects of class-size reduction on academic achievement are generally supported (Finn et al., 2001; Nye et al., 2001b).

As another tradition of the small class effect, contrary to the previous research of small scale or non-experimental one, the *Project STAR* (Student-Teacher Achievement Ratio) focuses on small class effect on a large scale in Tennessee. The researchers on the *Project STAR* concluded that students in small classes had superior levels of academic achievement, less disruptive behavior, and fewer in-grade retentions in every school subject in every grade (K-3) (Achilles et al., 1997). Small classes provided additional benefits for minority and low-income students (Achilles et al., 1997; 2002; Finn & Achilles, 1990; Krueger & Whitmore, 2001; Robinson, 1990; Wenglinsky, 1997) and had cumulative effects after the first year (Nye et al.,2001b).

Methods

Sample and Variable Description

This study is based on the nationally surveyed *Prospects* data, which are composed of three grade cohorts: first, third, and seventh. They were collected from the spring of 1991 to the spring of 1994. Using proportionate allocation, a probability sample of students would have included only about 15 to 20 percent of population (Jones et al., 1991: 6-7).

The focus of this paper is on the sample of about 6,000 first grade students and about 460 math teachers from the fall to spring of the 1991-1992 school year. Data were adjusted by applying weighting strategy to the ethnicity variable because the ethnicity distribution did not reflect the true proportion of minority and non-minority population.[2] Student and classroom variables are summarized at Table 1. Student's gender, race, SES, and interaction effects are controlled because they are significant student background variables in most studies. Since each school has different test date, academic gains per month should be used for accurate measurement of student achievement.

Items related to student engagement are selected based on the theory of engagement (Finn, 1989; 1993), and recoded for statistical analysis. Based on Finn's studies with four levels of participation (1989, 1993), first level participation is expressed by paying attention in class, coming to school prepared, and responding to directions or questions initiated by the teacher. The students at the second level initiate questions, dialogue with the teacher, spend more time than required on learning activities both in and out of the classroom, and participate in academically related clubs and activities. The third level of engagement is represented by involvement in social, extracurricular, and athletic clubs and events. At the fourth level, students participate in school government, academic goal setting, and involvement in disciplinary decisions (Finn, 1989, 1993). Indicators of student engagement for this study follow his classification and focus on the first two levels because the sampled students are the first grade of primary school (Table 2).

Analytical Approach

Regarding student engagement and classroom effects on student achievement, multi-level or hierarchical data analysis is implemented. The "nested" structure of multi-level data has dependency among individuals within units in an upper level (Kreft & Leeuw, 1998; Snijdedrs & Bosker, 1999). Ignoring dependency that belongs to an upper-level unit means ignoring the hierarchy of data structure, which causes "aggregation bias". This leads to a faulty conclusion about the effects of variables (Van der Leeden, 1998: 271-273). Multilevel data analysis overcomes the weaknesses of traditional regression models in that it has an ability of modeling individual changes rather than a group-mean profile (Guo & Hussey, 1999; Kreft & Leeuw, 1998).

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2 The true proportion of minority is based on 'Digest of Education Statistics (1992)' published by NCES.

Table 1. *Variable and Sample Description*

Classroom Variables	Coding	Frequency	Percent
Certification	A categorical variable answering for types of certification		
No certification	0	5	1.1
Probationary/temporary	1	31	7.0
Permanent	2	410	91.9
Total		446	100
Teacher's degree	A dichotomous variable indicating whether or not a teacher had the master's degree		
Master's degree and above	1	156	35.0
Below master's degree	0	290	65.0
Total		446	100
Class size	A dichotomous variable indicating whether or not the number of students enrolled was below 15.		
Small class	1	20	4.5
Large class	0	426	95.5
Total		446	100
Student Variables	**Coding**	**Frequency**	**Percent**
Gender			
Male	1	3,141	50.6
Female	0	3,067	49.4
Total		6,208	100
Ethnicity			
Non-minority	1	3,259	52.5(80.0)*
Minority	0	2,949	47.5(20.0)*
Total		6,208	100

Classroom Variables	Number of Cases	Mean	Standard Deviation	Description
Years of Experiences	446	13.52	9.03	A continuous variable based on teachers' answers for the question, “how many years in total have you taught at either elementary or secondary level?”
Degree of Authentic Instruction	446	0	1	A standardized composite measure of the degree of student-centered instruction, interactive teaching, and instructional discourse (α =.65).
Content Coverage	446	0	1	A standardized composite measure of the degree of higher-order thinking skills (α =.71)
Student variables				
Student Engagement	6,208	0	1.00	A standardized composite measure of student's attendance patterns, doing classwork, attentive in class, and discipline (α=.80)
SES	6,208	0	1.00	A standardized composite measure of parents' educational level, occupational prestige, and total family income.
Monthly Growth of Achievement	6,208	12.16	9.10	Differences of math scores between fall, 1991 and spring, 1992 that are divided by months between the two test dates.

* represents adjusted percentage after applying weighting process.

Table 2. *Items for Measuring Student Engagement*

Source	Items
Student Profile recorded by teachers	How many days of school did this student miss this school year?
	How many times was the student late for school this school year?
	Indicate the number of times this student has ever been suspended from school this year (Suspension means the student is asked to leave for a period of time, but is permitted to come back to the school this year).
	This student pays attention in class.
	This student disrupts the class.
	This student is willing to follow rules.
	This student can understand and follow directions.
	This student completes homework assignments.
	This student completes seatwork (classroom) assignment.
	This student asks questions in class.
	This student volunteers answers/take part in class discussions and conversations.
	This student works hard at school.
	This student cares about doing well in school.
	This student gets along with teachers.
Parents questionnaire	I think my child believes he or she cares about doing well in school.
	I think my child believes he or she gets along with teachers.
	I think my child believes he or she enjoys school.

The data that are used here have a hierarchical relationship. Students are regarded as the first level, and classroom variables that students belong to are located in the upper level (level-2). Multilevel modeling is the most appropriate method to be implemented because student engagement and classroom characteristics affect student achievement with two different levels.

The main research question is to see if student engagement has the effects on student academic achievement after controlling student background variables such as gender, SES, race, and interaction effects. Student variables are situated within classroom variables when student engagement is influenced by teacher qualities, teaching qualities, and class size. These relationships are expressed with the following equations. The random effects of the β's depend on the results of the level-1 analysis.

$$Achievement\ gains = \beta_{0j} + \beta_{1j}(Student\ engagement)_{ij} + \beta_{2j}(Gender)_{ij} + \beta_{3j}(Minority)_{ij} + \beta_{4j}(SES)_{ij} + \beta_{5j}(Student\ engagement*Minority)_{ij} + \beta_{6j}(Student\ engagement*Gender)_{ij} + \beta_{7j}(SES*Minority)_{ij} + \beta_{8j}(SES*Gender)_{ij} + e_{ij}$$

$$\beta_{ij} = \gamma_{i0} + \gamma_{i1}(yrs.\ of\ experience)_j + \gamma_{i2}(highest\ degree\ earned)_j + \gamma_{i3}(certification)_j + \gamma_{i4}(authentic\ instruction)_j + \gamma_{i5}(content\ coverage)_j + \gamma_{i6}(small\ class)_j\ (+ u_{ij})$$

β_{0j} represents intercept, β_{1j} is a coefficient of student engagement, and e_{ij} is an error term. β_{0j} is the average achievement gains for students in a teacher j, and β_{1j} represents the relationship between student engagement and monthly achievement gains for students under a teacher j. The γ_{*1}, γ_{*2}, γ_{*3}, γ_{*4}, γ_{*5}, and γ_{*6} reflect the classroom-level prediction coefficients, and u_{*j} represents level-2 residuals.

Results

Empty Model

The analysis begins with empty model without student- or classroom- level predictors. This empty model estimates overall average academic achievement gains per month, and the level-one and level-two variances in the outcomes simultaneously. The empty model helps to measure the intra-class correlation of the response variable 'growth of academic achievement', which is calculated by dividing the school variance into the total variance.

The results of the empty model are displayed on Table 3. The average growth rate a month is 2.7839 SD, which is large. The student-level variance for students' academic achievement rate is 80.3560, and the student-level variance of academic gains a month (80.3560) is larger than the classroom-level variance (18.1729). It indicates that the effect

Table 3. *Empty Model for Academic Gains in Mathematics*

Fixed effect	***Coefficient***	***se***	***Effect size****	***T ratio***
Mean academic gains in Math, γ_{00}	11.8678***	0.2415	2.7839	49.133
Random effect	***Standard Deviation***	***Variance Component***	***df***	X^2
Mean academic gains in Math, u_{0j}	4.2630	18.1729***	434	1745.86
Level-1 effect, γ_{ij}	8.9642	80.3560		

- The effect size in this table is computed by dividing the HLM gamma coefficient by the classroom-level SD computed by HLM and is presented in a standardized metric.
- $^{*}p \le .05$, $^{**}p \le .01$, $^{***}p \le .001$

Table 4. *Student Model for Academic Gains in Mathematics*

Fixed effect	***Coefficient***	***se***	***Effect size****	***T ratio***
Classroom mean academic gains a month, γ_{00}	12.0668***	0.1985	3.7617	60.795
Student engagement differentiation, γ_{10}	1.4638**	0.4803	0.2732	5.950
Gender differentiation, γ_{20}	0.4422	0.2267	0.1379	1.951
Minority differentiation, γ_{30}	-7.8960***	0.2576	-2.4615	-30.647
SES differentiation, γ_{40}	0.2532	0.2611	0.0789	0.970
Student engagement*minority differentiation, γ_{50}	0.0453	0.5882	0.0141	0.077
Student engagement*gender differentiation, γ_{60}	0.3487	0.6023	0.1087	0.579
SES*minority differentiation, γ_{70}	-0.2909	0.1712	-0.0907	-1.699
SES*gender differentiation, γ_{80}	0.1692	0.3369	0.0527	0.502
Random effect	***Standard Deviation***	***Variance Component***	***df***	X^2
Classroom mean achievement gains, u_{0j}	3.2078	10.2897***	426	1136.13
Student engagement slope, u_{4j}	2.8640	8.2027***	426	505.53
Level-1 effect, γ_{ij}	8.3820			

- The effect size in this table is computed by dividing the HLM gamma coefficient by the classroom-level SD computed by HLM and is presented in a standardized metric.
- $^{*}p \le .05$, $^{**}p \le .01$, $^{***}p \le .001$

Table 5. *Student-Classroom Model for Academic Gains in Mathematics*

Fixed effect	***Coefficient***	***se***	***Effect size****	***T ratio***
Classroom mean achievement gains				
Intercept, γ_{00}	12.0601***	0.1975	3.7573	61.053
Years of experience, γ_{01}	-0.0049	0.0223	-0.0015	-0.218
Certification type, γ_{02}	-0.2598	0.5930	-0.0809	-0.438
Highest degree earned, γ_{03}	0.3965	0.4039	0.1235	0.982
Class size, γ_{04}	0.0087	0.0439	0.0028	0.202
Authentic Instruction, γ_{05}	-0.4738	0.3825	-0.1476	-1.239
Content coverage, γ_{06}	-0.3132	0.2825	-0.0976	-1.109
Student engagement differentiation				
Intercept, γ_{10}	1.5224***	0.4857	0.4743	3.135
Years of experience, γ_{11}	0.0080	0.0347	0.0025	0.229
Certification type, γ_{12}	-0.8673	1.0038	-0.2702	-0.864
Highest degree earned, γ_{13}	0.2408	0.6202	0.0750	0.388
Class size, γ_{14}	-0.0506	0.0657	-0.0158	-0.769
Authentic Instruction, γ_{15}	0.2199	0.5419	0.0685	0.406
Content coverage, γ_{16}	-0.0144	0.4164	-0.0045	-0.035
Gender differentiation				
Intercept, γ_{20}	0.4433	0.2272	0.1381	1.951
Minority differentiation				
Intercept, γ_{30}	-7.8744***	0.2621	-2.4532	-30.046
SES differentiation				
Intercept, γ_{40}	0.2506	0.2615	0.0781	0.958
Student engagement*minority differentiation				
Intercept, γ_{50}	0.0518	0.5937	0.0161	0.087
Student engagement*gender differentiation				
Intercept, γ_{60}	0.3364	0.6018	-0.0947	0.559
SES*minority differentiation				
Intercept, γ_{70}	-0.3040	0.1722	-0.0947	-1.766
SES*gender differentiation				
Intercept, γ_{80}	0.1766	0.3378	0.0550	0.523
Random effect	***Standard Deviation***	***Variance Component***	***df***	X^2
Classroom mean achievement gains, u_{0j}	3.20982	10.3030***	420	1113.15
Student engagement differentiation, u_{1j}	2.9145	8.4943***	420	502.37
Level-1 effect, γ_{ij}	8.3840	70.2814		

- The effect size in this table is computed by dividing the HLM gamma coefficient by the classroom-level SD computed by HLM and is presented in a standardized metric.
- * p ≤ .05, ** p ≤ .01, *** p ≤ .001

student intra-class correlation estimate that represents the proportion of variability among classrooms is 0.1845 [18.1829/ (80.3560 +18.1829)]. Since the random effect for mean academic gains, u_{0j}, is significant, the multilevel analysis seems to be appropriate.

Student Model Student-Classroom Model

The student level regression resulted in random coefficients that were regressed on the classroom level predictors at student-classroom model. The significant classroom level coefficients weaken or strengthen the student level association (Chang, 2003; 541). However, no classroom variable had significant effects on student engagement slope and average academic gains at this study (Table 5). This means that that the hypothesized classroom variables do not explain the classroom differences of the students' academic gains and those of the student engagement effects on student math achievement. The residual variance is not reduced, which represent that classroom variables of this study do not explain the classroom differences.

Based on this hypothesis, student engagement is a predictor of academic gains in mathematics. At level-one, academic gains for student *i* under classroom *j* is regressed on student engagement after controlling student' gender, minority, SES, and interaction effects. These variables are centered around the grand mean for the sample. As the slopes of student engagement on achievement gains are investigated as random variables in the student-classroom model, student engagement is group mean centered within each classroom.

The results show that student engagement has a significantly positive relationship with academic gains in mathematics. Student engagement has no interaction effect with SES or with minorities, which means that student engagement does have positive effects on academic gains in mathematics regardless of gender and race. Minority status has a negative impact on outcome variable, which represents that non-minority students are 2.4615 more gained in math than minority students during the first year of elementary school. This result needs to be cautiously interpreted. It does not mean that minority students have better scores in math in the end but indicates that the minority students learn more in math during the first year schooling.

In terms of random effects, the effect of student engagement on academic achievement is significantly different depending on a mathematics classroom (Table 4), which needs class-level predictors to explain the classroom differences. When γ_{ij} indicates the explained residual variance after considering student engagement, gender, SES, minority, and other interaction variables, differences between γ_{ij} of student model and γ_{ij} of the empty model are the explained variances by level-one variables. The reduction of 10.0847 indicates that 12.55% [(80.3560-70.2713)/80.3560=0.1255] of student-level variances are explained by level-one variables.

Summary Interpretation of the Findings

The primary interest of this research is to see the effects of student engagement and classroom variables on math achievement growth. Even after taking into account student variables such as gender, minority status, SES, and interaction effects, student engagement does have positive effects on student academic growth per month in mathematics class during the first year of primary school. This result is consistent with the previous research results that show the positive relationship between engagement and student academic achievement (Finn, 1993; Greenwood, 1991; Newman et al.,1992). The positive effects of student engagement are consistent regardless of SES and minority. This finding is also consistent with the Greenwood's study (1991) that shows the strong association of participation with achievement across race and gender. Based on both previous and these present research results, it is proven that student engagement is a significant predictor of students' success in a school. Therefore, student engagement should be emphasized in a school and in educational policy.

It is interesting to see the first year schooling effects of primary school on minority students. The previous studies had a greater focus on achievement score than students' growth in achievement regardless of the beginning status of the students, and have shown that the non-minority students are better in math achievement. However, a student model shows that the minority students have significantly larger gains than non-minority students (Table 4). This does not mean that the minority students have better scores than non-minority students. It shows that minority students learn more than non-minority students for the first year of elementary school. It is more meaningful to see the students' change or growth because the degree of change is regarded as the education effect controlling the previous level of knowledge. Students' growth rather than final score or achievement needs to be more focused in education research to enhance the learning process and prepare the appropriate learning environment.

As the research results of a student-classroom model indicates, classroom variables neither explain the achievement differences across classrooms nor significantly affect student engagement slope at all. One possible explanation is because student level variance far larger than classroom level variance (Table 3). However, this explanation is insufficient because the average math achievement gains and the student engagement slope on math gains are significantly different (Table 4). The results are interpreted to indicate that the classroom variables affect neither the student achievement gains nor the student engagement slope. In other words, classroom variables such as teacher quality, teaching quality, and class size have no effect on students at least in terms of math achievement and student engagement acceleration on student achievement. However, more caution needs to be exercised in generalizing research results because these results are not completely consistent with the previous studies. Even the research with the same dataset, even though it is about reading, explores the significant effects of classroom level variables on student achievement (Park, 2004). Further studies on classroom variables need to be developed for more robust conclusions to be drawn.

This research is meaningful in that it explores classroom level variables that make differences in student engagement. Still, there are several limitations in this study. First, this study does not apply full definitions of student engagement based on Finn's (1989) four levels because the students analyzed are at the first grade. To see if student engagement is a critical factor in students' success in a school, full definition and the four levels should be applied to middle school and high school students in further studies.

The second and third limitations are related to the colleted data. The second limitation is that this study makes use of secondary data source. The nationally surveyed data, the *Prospec*t, have good points in generalizing the findings thanks to the extensive sampling process. However, the main concepts of the study are constructed based on the limited survey items, which restricts data analyses. Thirdly, weighting should be applied to the race variable to reflect the true distribution of minorities and non-minorities. Although the Prospects used a stratified sampling method, the data have still no responses that may lead to faulty conclusions. This is why weighting is applied to the minority variable. However, there are still inconclusive debates on the effects and methods of weighting. Since weighting makes differences in the results, much caution is needed to use weighting adjustments and explaining the results. A systematic data sampling plan and increased response rate are essential for a more robust study.

The fourth limitation is related to generalization of the findings. The data for this study are limited to the U.S. environment, but further studies need to be explored in other countries for better generalization. The study should be extended to the middle school and high school students with full definition of student engagement as mentioned earlier. In addition, further research on other subjects is expected to see if these results are consistent in other subjects.

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