Working Paper:

Student Engagement in America's Urban High School Mathematics and Science Classrooms: Construction of a Comprehensive Model and Findings on Race[1]

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Abstract
The purpose of this paper is to construct and evaluate a model of student engagement in classrooms. By following 8 sets of students for one week with Experience Sampling Method (ESM), we collected data from four urban school districts' mathematics and science classrooms. We measured students' engagement levels, using Rasch Model Analysis, and examined the relationship between student engagement level and an array of predictors, both time-varying and time-fixed, using 3-level hierarchical linear models (HLM). Based on this model, as well as class observation and focus group interviews, we explored two research questions. The first examines the extent to which classroom activities, such as lecturing, group work and seatwork, influence opportunities to learn in classrooms, as well as student engagement levels. The second is to understand differences of engagement that may vary by race and ethnicity of students, using insights from sociolinguistic research on classroom language. We found that student engagement level varied partly by classroom activities, as well as other factors, as they influence the phenomenological processes favorable for students' engagement in classrooms. Furthermore, we found that Hispanic students had a lower level of engagement, yet their engagement levels varied by the types of classroom activities. We propose that cultural, pedagogical preferences be taken into consideration for reforming classrooms into more productive, egalitarian sites for student learning.

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Introduction

Researchers have long pointed out that American high school students are not fully engaged in classrooms. Heavy reliance on traditional instructional methods, such as lecturing, has been criticized for the increased boredom and subsequent poor academic achievement students may experience in the classroom (Newmann 1992; Shernoff, Knauth et al. 2000; Yair 2000). For its consequences to cognitive development, as well as life chances of students, the subject of classroom engagement has increasingly been treated seriously by researchers. Engagement in classrooms is a crucial ingredient for students' academic growth (Finn and Cox 1992). The ability level achieved by students in turn will have significant consequences to students' course taking patterns with consequences to their occupational opportunities in the future (Schneider, Swanson et al. 1998). Another productive realm of research is researchers' interest in differences in the academic productivity of various social groups. The gap between blacks and whites in achievement levels has attracted considerable scholarly attention, (Hedges and Nowell 1999)and thus some, particularly those using qualitative approaches , have explored whether classroom experiences for these social groups differ so immensely as to create problems of educational inequality (Page 1991).

Engagement is a phenomenon that exists in time and space. On-going learning processes in classroom contexts did receive the attention of ethnographers in the past, yet in the context of the quantitative research paradigm, understanding teachers and students in classrooms has lagged behind. For example, the measurement of engagement was typically derived from a one-time survey and thus the temporal changes of engagement in classrooms could not be captured in analysis. Only a limited number of researchers have analyzed data that allow the analysis of temporal changes of engagement level in accordance with changes in classroom activities, as well as analysis of social, psychological contexts that a record of teachers' activities provides. Without understanding students in time and context, it would be difficult to know what pedagogy really works to promote students' interests, engagement, and achievement. Also it is not possible to know how and why social group differences matter in the learning processes in classrooms.

Our goal in this paper is to explain changes in students' engagement levels during classes, as well as variation by social groups. We derive our hypotheses based on the research literature of both educational psychology and sociology of education. Using the Experience Sampling Method (Larson and Csikszentmihalyi 1983), we surveyed students during on-gong classroom instruction in high school mathematics and science classrooms, recording on-going classroom processes. In this way, we were able to obtain time-related data from students directly and, using running records in the form of field note data, on classroom processes, allowing us subsequently to analyze both types of data together. What we propose is a model of student engagement and analysis of racial differences in engagement level.

Student Engagement

Many researchers use the definition of engagement that is rather categorical, such as either students being engaged or not engaged. Imai and his associates (Imai, Anderson et al. 1992) quoted William James who said that attention is "taking possession by the mind in most clear and vivid form, of one out of what seems several simultaneously possible objects or trains of thought. Nystrand and Gamoran's study of the English classrooms

(Nystrand and Gamoran 1991) and their recent report with other colleagues (Nystrand, Wu et al. 2001) enriched the notion of students' engagement by separating it into the one that is about procedures, such as memorizing routine knowledge and the one that accompanies higher order thinking. And such educationally important moments, in their model, was prompted by the discourse of teachers. In the definition of engagement employed by Nysstand et al and Imai et al, duration of attention or the occurrence of educationally critical moment becomes the dependent variables, leading them to choose event history analysis as a modeling strategy.

Yair's research, for example, (2000) referred to Goffman's notion of alienation in motivating his interest in students' psychological state of engagement and disengagement. Goffman illustrated the social situation where individuals are present physically, yet may be inattentive and thus mentally not involved in the activities. Yair's definition is one step more nuanced than Imai and his associates in a sense that Yair contends that students may look engaged by appearance, but may be disengaged mentally. Using student reports on whether they were thinking about class or non-class issues, Yair modeled the instance of engagement using a logistic regression framework.

Many other researchers, such as Turner and her associates (Turner, Meyer et al. 1998), have referred to Csikszentmihalyi's treatment of the issue as "flow" or optimal experiences. Flow is a psychological state of mind where a person is so engaged in the activity that time and events seem suspended and creativity and problem solving seem effortlesss This state of mind is hypothesized to arises when the challenge level of a task and a person's skill match up, freeing one's fullest capacity to be efficiently used for working on a task. Arisen in this line of definition was the development of the Experience Sampling Method, which attempts to capture flow moment by moment.

While different research groups use slightly different definitions of engagement, their conceptualizations tend to be categorical, such as being attentative/inattenative, being alienated/engaged, or being in the flow or not. In providing a definition of students' engagement in psychological phenomenona experienced in everyday classrooms in high school , we reference Dewey and his metaphors of spectator and agent in comparing engaged and disengaged subjects (Dewey 1975). Dewey compared "spectator" students to prisoners watching the rain falling outside their cells. Dewey felt that what is happening before a student's eyes does not matter much if he or she does not have a way to affect the situation. The student as an agent in the classroom on the other hand, has a stake in the situation and has a way to affect the situation. Engagement in the Deweyan metaphor suggests that a student will be interested in curricular materials when the student has a stake in the outcome and control over that outcome. We also postulate that engagement can be seen as a continuum ranging between being least engaged as a complete spectator to most engaged, being a fully empowered agent in a classroom situations.

Predictors of Engagement in Classrooms

Educational psychologists have been interested in how students' engagement can be improved or motivated through students' various psychological conditions. When students experience a strong sense of autonomy n classrooms, it was assumed that students would in turn experience higher levels of engagement. Choices that students are given is an important factor in determining engagement (Assor, Kaplan et al. 2002); as is a sense of perceived control, the feeling that students themselves are in charge of their learning

environments (Skinner, Wellborn et al. 1990) and also interested in the subject matter and the outcomes of the learning process (Ainley, Hidi et al. 2002). The views that students hold about the nature and purposes of learning havealso been the subject of study since they influence students' motivation (Ames 1992).

Educational psychologists do related these psychological states of mind with social contexts. For Turner and her associates (1998), social contexts were conditioned by the discourse of teachers. They identified pro-engagement factors in the teachers' discourse, including teachers' press for understanding, student autonomy, and problem solving. Herrenkohl and Guerra studied the role structure of students by testing whether playing roles of audience in the process of learning may increase the level of engagement (Herrenkohl and Guerra 1998) with a finding that social roles that students play have an impact on their level of engagement.

Although teachers' ability to increase students' interests and motivation, as well as their ability to provide appropriate encouragement are important, research related to this issue lacks the perspective on how such sources of inspiration is communicated byteachers to students and how idiscourse is affected by the social organization of classrooms. In criticizing the findings around 1980 that schools made no difference to students' achievement level, Bidwell and Kasarda (Bidwell and Kasarda 1980) proposed a social organizational approach to understand schooling processes. Bidwell abd Kasarda proposed to look at the social organizational properties of school in or near locations where learning takes place, so as to recognize that educational resources do not reach every individual student in a uniform way. Different activities in classroom, such as lecturing and group work, can mediate the way in which teachers' classroom affects students. For example, visibility of students' performance among peers (a sense of who is doing better than others) may increase if teachers use lecture and recitation, and such school process may have impact on the way students learn such that high performing students may perform even better, while low-performing students may be discouraged from active engagement.

Two important implications were, first, for us to get as close as possible to the production site of students' learning and, second, for us to pay close attention to organizational processes that mediate the relationship between educational resources and student outcome. In this way, Barr and Dreeben (1983) found that in elementary school instruction of reading differentiation of ability level growth occurs partly in between ability groups of students that teachers use as a social organizational strategy to facilitate a reading instruction. Bossert's participant observation of high school classrooms(1979), the work that Bidwell and Kasarda cited in strengthening their argument, found that the role that classroom activity that teachers choose, such as group work and lecturing, in influencing the schooling processes, such as peer pressures and visibility of achievement levels. Recently, Macfarland (McFarland 2001) examined the way in which peer social networks may allow the social support with which to resist the teacher's instructional authority; thus, allowing us to see how pedagogical activities also influence the power relation between a teacher and students, which affect the level of friction that a teacher may experience when instructing a classroom-full of students.

Following the line of research extending from Bidwell and Kasarda's work (1980), we also propose to integrate social organizational perspective in building our model of student engagement. Our units of analysis are time-varying state of mind of students; thus,

our focus is as closest as possible to the phenomenological process of our subjects. Furthermore, we integrate in our model four basic teacher activities, including lecturing, group work, seat work, and testing, as well as the act of doing "nothing" when no instructional activity is occurring. These are social organizational features because the choice of instruction changes the way teacher instruction reaches students. We shall pay close attention to psychological processes that students experience while applying themselves to these different activities.

Social Group Differentiation of Student Engagement

Sociologists of education have dealt with similar problems, yet their attention tends to extend to issues outside the classroom, including the issues of race, ethnicity, and social class. Perhaps the most relevant literature to the issues of student engagement and social group differences may be sociolinguistic studies of classroom life. . As Mehan (1984) summarizes it, while juxtaposing it with related quantitative sociology of education research, there are a series of research studies that take the cultural backgrounds of students seriously. Culture can refer to race groups or social class. A study of Indian children, families, and classrooms showed that the way of learning that Indian children are familiar with at home may not be compatible in classrooms where white teachers conducted their classrooms, using pedagogy familiar to white middle class children (Philips 1972). The similar gap between cultural orientation of home and of classroom was pointed out about Mexican Americans (Evans and Anderson 1973). Bernstein's theory of social class and language code suggests that while school utilizes the language of middle class, children of lower social class may not find it unfriendly; hence, leading to lower academic performances of children of certain social groups (Bernstein 1977).

The strength of this sociolinguistic school is the conceptual rigor in going beyond the immediate context of classroom, and instead connecting classroom interaction with larger issues of social hierarchy, as well as their ability to document processes occurring during the classroom interactions. Some quantitative researchers, however, have begun to combine concerns for social differentiation of student engagement, while focusing on on-going classroom processes. Some important studies, such as Shernoff (2001) and Yair (1999)[1],are coming out of research groups that use Experience Sampling Method. Students are surveyed multiple times when signaled at randomly occurring intervals. In addition to structural factors including subject matter and track assignment, Shernoff et. al. found that individual work is strongly associated with the experience of flow, i.e., a state of high levels of engagement. Yair approached the problem of student engagement by taking into account a variety of factors including students' background characteristics, classroom instruction as well as a host of what he refers to as "external contexts." These include work obligations, family life, leisure and personal pursuits. Yair concludes that student engagement is more pronounced when the teacher employs hands-on problem solving strategies as opposed to a lecture format in presenting material.

What is appealing in Yair's analyses is not just that student engagement level is affected by ace and ethnicity in addition to external factors, such as how students spend time at home (Table 3, p.258), but that the effect of race and ethnicity on engagement depends on instructional contexts. Although this is done in a simple, descriptive analysis (Table 4), Hispanics students' engagement level varied according to the quality of instruction. While Hispanic students had generally lower levels of engagement, engagement fell to even lower levels when the quality of instruction was perceived by

students to be poor. Contrariwise, their engagement levels increased when instruction is challenging, relevant, and academically demanding and also uses their skills. Similar trends were found with Blacks, as well as students at risk. Yair concluded, "Boring classes can only reproduce externally effected social inequalities."

Research Questions

Based on our review of past literature related to our questions of interest, we construct a comprehensive model of student engagement. Following Bidwell and Kasarda's insights, our units of analyses are the time-varying moments that subjects experience during the on-going classrooms. Furthermore, by integrating teacher activities as key social organizational variables into our model, we assess the degree to which they, such as lecturing and group work, promote processes that have consequences to the changes of student engagement. Such processes are perhaps phenomenological such that some classroom activities change the perception of students either in educationally favorable or unfavorable ways towards the experience of learning in classroom. In addition, we shall explore the implication of race and culture. Following the finding of Yair that Hispanic students' engagement heavily depended on instructional contexts, we evaluate the degree to which racial gap in engagement level can be explained away by the pedagogical activities employed in the classroom.

Data

Our study of student engagement is embedded in a large-scale evaluation of the impact of the National Science Foundation's Urban Systemic Initiative $(USI)^2$ in four cities—Chicago, El Paso, Memphis and Miami. During the course of our three-year project we undertook a series of studies aimed at providing an understanding of student achievement and engagement beyond their performance on standardized tests or high stakes state tests. Instead, we wished to augment such student outcome information with data using other measures such as the ESM, student focus group data, and observational data to allow us both to understand students' responses to their classroom experiences and to determine more generally which experiences constituted favorable conditions for learning in the classroom setting. Results from our analyses inform our understanding of which pedagogical strategies are particularly effective in promoting classroom learning.

Schools, Teachers and Students

Participants in the study of student engagement were drawn from two senior high schools in each USI site. These schools in turn had been selected as focal schools included in a pool of 10-14 participating schools in each USI site. In each case, we selected schools that at the baseline year exhibited comparable demographic characteristics. We further refined our school sample by matching pairs of elementary, middle and high schools -- one viewed as "high reform" and the other as "low reform." In each school, we selected five teachers who had appropriate certification, had been teaching at the school for more than three years, and who were willing to participate in the study throughout its three-year duration. From the pool of teachers studied throughout the tenure of the project, we requested one mathematics and one science teacher from each high school willing to have us observe their students each day for one week during two of their mathematics or science classes.

<Exhibit 1 Participant Selection Strategy>

Methods

We employed the Experience Sampling Method (Larson and Csikszentmihalyi 1983) that documents the feelings and activities of subjects in time and place. From each participating mathematics and science classroom, ten students were selected as subjects for the study. These students were then asked to complete a short questionnaire [because it involved open-ended written response items] when given a signal during class. With 10-minute intervals, we sent signals four times during a given classroom hour, typically 45 minutes in length. The first and third signals went to one-half of the participating students and the second and fourth signals to the other half. Thus, each subject received two signals during each class and was observed everyday for one entire week; therefore, each subject contributed 10 observation points to the sample.

Survey questions were concerned with (a) what students are doing and thinking and (b) how they are feeling. The types of classroom activities occurring at the time of the signal are also recorded by the researcher (e.g., group work, discussion, lecture); therefore, we can examine how types of classroom activities are related to what students are doing and feeling and how well they are concentrating on these class activities.

Focus group interviews with ESM participant students are also conducted once at the final day of our school visits. We had used the protocol that deals with questions about their mathematics and science classrooms.

Quantitative Models

The data structure is hierarchical such that signal-level repeated measures are nested within participants, who are in turn nested within classrooms. The repeated measures and participants can be also considered being nested within courses. In order to take into account this hierarchical nature of data and the resulting correlated errors, we used SAS Institute's PROC MIXED (Littel, Milliken et al. 1996) and replicated what is often referred to as hierarchical linear model (Bryk and Raudenbush 1992). In this model, errors are decomposed at repeated measure-level, individual level, and class level.

Outcome measure_ijk= f (COV_ijk, COV_jk, COV_k) + error_ijk + error_jk + error_k.

COV stand for covariates. Postscripts i is a repeated measure, j is a person, and k is either courses or days. We hypothesize that covariates have linear effect on the engagement measures. Error components were derived not only for signal levels but also for both individual and course levels.

Variables

Dependent Variable: the Level of Student Engagement

We used Rasch modeling techniques to create a scale measuring the level of engagement (Wright and Stone 1979; Wright and Masters 1982). A pilot study consisted of testing 30 engagement items with a classroom of students and selecting best eight items that have desirable statistical properties in order to make a sensible composite score. Such statistical properties include low misfit statistics, high reliability, and a wide and balanced range of item difficulty[3]. We used John Lanacre's Winsteps to derive measures, as well as diagnostic statistics. According to the results derived by Winsteps, person measure

reliability and item reliability were respectively 86% and 99%, high enough to believe that the construct measures what it was designed to measure.[4] For multivariate analysis, observations with too large a misfit statistics, constituting 10% of the whole sample, were eliminated from the sample.[5]

<Exhibit 2 Survey Items for Student Engagement>

Independent Variable
Basic Characteristics of Site, Class, Students, and Time
The most basic properties of students were characterized by the following variables. Cities are Chicago, El Paso, Miami, and Memphis. Individuals are characterized by their gender, race (Black, Hispanic, Asian, and White), and Grade (GRADE 9 to 12).

Table 1 is a summary of these demographic characteristics by cities. In Chicago and El Paso, there are more girls than boys. Our field observations suggest that on the first day of our research, especially in morning classes, there were more boys arriving late to classes. This may pose a bias such that male participants who got into our participant pools were more diligent than the ones that did not show up at the start of the class. The table also shows that participants' schools have a dominant race group that is not white. As much as 64% of our Chicago subjects and all Memphis subjects were black. Hispanics were dominant in El Paso and Miami. As El Paso is situated by the border; thus, the Hispanics were primarily Mexican. El Paso also had a large military base; thus, providing a mix of other racial groups. Miami's Hispanics were primarily from Cuban or Central American and many of the black students were from Haiti.

<Table 1 Demographic Characteristics of Participant Students>

Signal ID shows the timing when students are signaled. In Chicago and Memphis where class hour is 50 minutes, signal ID ranges from 1st to 4th. In El Paso and Miami, where class hour is 90-minutes, signal ID ranges from 1st to 8th. These are treated as categorical variables, rather than one continuous scale. Days of the week ranging from Monday to Friday are also coded as categorical variables.

Teacher and Classroom
To characterize fixed properties of classrooms, we recorded the number of students in classroom. In addition to mathematics/science distinction, we have sub categories for algebra, geometry, precalculus, and calculus, as well as biology, chemistry, and physics. Honors' classes, as well as higher level subjects, such as calculus and physics, are distinguished as higher-level courses, as opposed to the rest of classes. Seating arrangement of a classroom was either individual-seating, roundtable seating, or laboratory seating. Laboratory seating was seen in science classes where students were seated at lab tables. It is close to individual seating because students are facing teachers rather than other students, but like a roundtable type seating where students shared a common desk space. Whether the seating position was decided by teacher or students themselves was coded categorically.

For charactering classrooms that are changing moment to moment, we classified

what was occurring in class between a signal and the previous signal or the start of the class into dummy variables, based on the observation notes of researchers. Whole class instruction indicates the time when the teacher lectures in front of class. Individual work is when students are told to work on problem sets on their own at their seat. Students may be doing problem sets from textbook or handouts, as well as homework assignments at the end of the class. Group work is when students are asked to do problems together with classmates. They may be doing experiments in science classes, or may be doing problem solving together in mathematics classes. Sometimes, the state of nothingness, when teachers were not doing anything with class, was observed often at the beginning and the end of classes.

Relevance of Content Perceived by Students

When signaled, students reported their perceptions of what was being taught. Relevance of class to students' everyday life, going to college, future jobs, and future tests, were reported with dichotomous categories of yes and no. When they found the class relevant to test taking, students were further asked whether what was being taught was important for their future performance on class quizzes, term tests, SAT or ACT, or state assessment tests. Replies were yes or no.

Five Student Conversation Types

Students reported whether they were talking at the time of signal. Students were asked whether they were talking with anyone, either teacher or classmate and then if they were, they were asked whether the talk was about class. This created five categories of moments, a) not talking, b) talking with teacher about class, c) talking with teacher about things unrelated to class, d) talking with peers about class, and e) talking with peers about things unrelated to class. Unfortunately, we don't know how this networking phenomenon is related to friendship network that existed outside the classrooms.

Technology

When teachers used blackboard or overhead projectors as the demonstration tools, we have coded blackboard or overhead as 1, as opposed to 0. The use of computers did not occur during our research visits. The calculator use was observed, yet its occurrence was too small to evaluate. In some rare occasions in mathematics classrooms, students were given graphing calculators to solve problems.

Results

Descriptive Statistics

We explored how classroom activities may be related to students' perception and behaviors. Such variables are related students' feelings, perception about contents, and their talking/chatting behaviors. In our view, these constitute the schooling processes, as Bidwell and Kasarda (1980) defined as the appropriate object of analysis for productivity study of schooling.

The first panel of Table 2 reports the distribution of classroom activities, while the rest of the panels report the percentages of yes-response as opposed to no-response to the selected survey items. The first column uses a whole sample, while other four correspond to, respectively, lecture, group work, seat work, and testing. In deriving these percentage values, we used 3-level hierarchical linear model to derive these

statistics and take into consideration the fact that the data is hierarchically structured.[6]

<Table 2 Descriptive Statistics (Percentage) of Student Variables from 3-level Logistic HLM>

To begin from the distribution of classroom activities among collected experience moments, the dominant activity students experienced was lecturing (41.19%), while seatwork also dominated as much as 34% of the sample. Group work occupied only 13 percent, while test was only seen among 3% of the sample. This is consistent with the national-level finding that American classrooms have lots of lecturing and seatwork [TIMSS].

Next panel reports on students' feeling during classes. Roughly one fourth of the time, students are having fun (21%), feeling cooperative (22%), but also feeling sleepy (20%) and also confused (17%). Competitiveness was a minor descriptor of students' feeling (5%) during class. It is hard to have a perspective to know if these numbers are particularly large or small. Yet, when students' feeling is compared across the moments of varying classroom activities, we begin to see how social organization of instruction impacts these sentiments. Group work stands out, providing educationally favorable psychological experiences. Students are having more fun (35% as opposed to lecturing's 19%) and are feeling a lot less sleepy (Only 13% as opposed to lecturing's 25% or testing's 29%). Students are also feeling competitive (11% as opposed to lecturing's 5%) or cooperative (34% as opposed to lecturing's 26%). Such feelings are perhaps aroused because during group work students have other classmates to feel competitive or collaborative with. The level of confusion, however, was not very different by activities, except during the testing. This shows that, while bringing fun into the classroom, group work is as challenging as lecturing and seatwork in terms of content difficulty.

As for students' perception, it is surprising that overall only 37% of the class moments students are being exposed to contents that are new to students. Yet, again, class activities seem related to the perception. When doing group work, students are exposed more to new sources of knowledge, as 54% of the collected moments students found the contents new, almost 10% more than lecturing. As for seatwork, an activity very common in American classrooms, as well as in our sample, students already knew the content half of the times. Seatwork, in our observation, is a time students do homework on the content already covered at the early part of the class; thus, it is natural that students knew the content. Still, this common activity seems to add more redundancy to a classroom to a classroom that is already old 40% of the time when a teacher is lecturing.

As for the level of difficulty that students report, 30% of the whole sample were "about right" and roughly 30% were either "very easy" or "easy." Difficult or very difficult contents were covered only 10% of the time. Again it is not easy to interpret this, yet when teachers are not right on the target of students' ability level, the trend is that teachers tend to be covering rather easy contents for students rather than difficult ones. To allow a cross-activity comparison, we prepared a summary measure of difficulty index by assuming that the categories form a linear measure ranging form 1 (very easy) to 5 (very difficulty). The result shows that class activities do not change the perceived difficulty level. This again confirms that group work, while bringing fun

to the classroom, does not reduce the level of content difficulty.

Next panel reports on the relevance of class contents. Content is almost always felt to be relevant to testing, as only 8% of the time students are unaware of its relevance. College is another important relevance that students felt (67%). It can be said that during the class students are constantly reminded of their test, as well as going to college. Students found the instruction also relevant to everyday life at a relatively high 35%, but future job was perceived relevant only 23% of the signaled moments. Going across the values by activity types, only one noticeable difference was that during group work students felt that the content was relevant to their everyday life and they did so 52% of the moments as opposed to about 35% during lecturing or seatwork. Through group work, students may be sensing the utility of knowledge in everyday life or appreciating knowledge based on what they know from everyday life.

Finally, talking behaviors are examined. The aggregate statistics suggest that students were silent about half of the time, yet they were talking about class with teacher 6% of the time and with peers 20% of the time. Chatting with peers occurred 14% of the time and with teachers negligeable 1% of the time. It is rather surprising and encouraging that a quarter of the time students are engaging in class-related issues, while our imagery of classroom tends to be negative such that students are either silent or chat with peers.

As for differentiation by classroom activities, again group work was substantially different than other activities. Group work promoted greatly the exchanges among peers about class-related issues (54%), while it surprisingly discouraged chatting among peers (9%). In fact chatting was most prominent during lecturing (14%) and seatwork (14%), the two most frequently observed activities in classrooms in this sample.

Section Summary

To summarize, we found that students' perception and talking behaviors, two important processes with possible consequences to student engagement level, were associated with classroom activities, the social organizational variables. Particularly, group work brought educationally favorable sentiments, perception to contents, and talking behaviors. Our sampled confirmed some of the negative imageries of American classroom documented by past researchers: what was being taught tends to be old and redundant. Our sample also added positive description of students. They were found talking about class matters a quarter of the sampled moments. Furthermore, if given opportunities to interact with peers through group work, we found them engaging in class-related talks rather than chatting.

Results of Student Engagement Model

Table 3 show the results of 2-level Random Intercept Models with the outcome variable being the level of student engagement. Percentages shown in the table right next to the variable names refer to the descriptive statistics of the predictors. All predictors were categorical, so the percentages show the proportion of the given category of all moments that we sampled through Experience Sampling Method.

Model 1 or Analysis-of-variance model is an intercept-only model with variance decomposed at three levels, repeated measures, individuals, and courses. Model 2 or Basic model, incorporates basic statistical controls, including individual, classroom, and

time-related information. Model 3, Ecological model, adds characteristics of classrooms, such as class size and seating arrangement. Model 4, Teacher Model adds what was occurring in classes in a time-varying fashion, the variables related to class configuration types, such as lecturing and group work, as well as the use of classroom technology, such as writing on the board. Model 5 or Student Model adds the perception of students about the class contents, as well as their talking behavior variables.

Recall that all predictors are categorical variables and the outcome measure is standardized with a mean of 0 and SD of 1. The coefficient, therefore, can be interpreted as a SD difference of that category and the baseline category.

<Table 3 Random Intercept Model of Student Engagement Level>

Model 1, Analysis of Variance Model

Using this intercept-only model, we estimated error variances at multiple levels. As represented in Figure 2, the results indicate that engagement level, as we measured it, is a phenomenon of mostly within-individual (39%) or between-individual phenomena (51%), which justifies our interests particularly for the time-varying factors of on-going classroom contingencies, such as pedagogy and the changing contexts of classrooms. The scarcity of variance between classes (10%) is interesting while, according to our impressions as observations, we felt our teachers substantively varied in terms of quality of teaching and the excitement that they can arouse in classrooms. It may be that individuals perceive the same teachers differently, which may deflate the size the classroom level variances.

<Figure 2 Decomposition of Variance for Student Engagement Level>

Model 2, Basic Model

We evaluate the role of basic predictors. Between class-variance became zero; thus, these predictors explained the between-class differences. The city difference is in between Chicago (-.24) and El Paso (.26). Grade effects are non-linear, incomprehensible, and trivial in size. There is no gender difference at least in this sample, yet as we described earlier, our boys may be self-selected to be more diligent than girls for they were the ones who showed up on time on Monday morning.

As for the differences by race, Hispanic effect was -.50, meaning that they were as large as half a SD less engaged in class than black students, a group constituting an omitted category in the model. While whites and Asians were lower than blacks, the differences were trivial.

Subject difference, advanced courses, and dates made only trivial differences to the outcome. Advanced courses did not show a substantial difference (.15SD), implying that any students, regardless of their course level, may experience the state of engagement level at their own levels. Monday and Friday, the days of transition into or out of the school week, had slightly lower engagement level than the days in the middle of the week.

The difference by time blocks during the class was large and significant. The engagement level starts at .31SD at the first 10 minutes and stays more or less at the same level up to the fifth beep, which is about the time an ordinary 45 or 50 minute class

would end, and then dips, with some fluctuation, to 0 at the 8th beep. Our observation tells us that it is not so much that students cannot hold their attention longer than 50 minutes. Rather many teachers that we observed stopped teaching towards the end of the long class period, letting students do assignment at their seats and then socialize as they finished the tasks.

Model 3, Ecological Model

We added classroom size, seat type, and seat choice in to the model. No substantial changes beyond margins of errors are noticed among the coefficients of the variables already in the models.

Contrary to the conventional idea that small classes must be more engaging, the largest size class had slightly higher in engagement level than other two size categories, yet it was not statistically significant. Our classroom observation tells us that this lack of variance may come from the lack of variance in size measures. Most of the classes we saw tend to be the moderately small size of 20 students. [Quote]

In terms of seat type, individual seating, the most typical seating comprising 73% of observations, had .33SD higher in engagement level when compared to roundtable seating. Individual seating may buffer students from distraction from other peers, while roundtable seating may increase the chance of being distracted from other students. In fact, many students expressed their concerns that peers in classroom can be distracting for doing their work, especially, the tasks assigned by teachers for seatwork.

Finally, seating choice made a suggestive difference. When seats were chosen by students rather than by teachers, their engagement level was as large as .34SD lower. In our observation, students choosing their own seats tended to sit with their peers and thus there seemed more opportunities for them to socialize with each other.

Model 4, Teacher Model

Next we evaluate the extent to which what teachers consciously do, including class configuration (lecture, group work,. etc.) and the use of technology (overhead and blackboard), affect students' engagement level. Some moderate reduction in coefficient sizes occurred to beep-time variables for perhaps the use of certain pedagogical activities are correlated to them.

Group work, though a minor activity in terms of frequency of occurrence (13%), had a higher level of engagement level by .22SD compared to lecturing and by about the same magnitude compared to seatwork and testing. For an obvious reason, nothing, the state in which teachers are not leading any activities in class, showed the lowest engagement level, -.18 when compared to lecturing. The effect of overhead in classroom also was associated with engagement level by .15SD, which is not so large yet statistically significant. These effects are important because they inform us of the size of impact that what teachers' activities can do to engagement level.

Model 5, Student Model

We consider students' perception about the class, as well as students' talking behavior in this final model. The effect of being not confused in class had a large effect of .25 SD. This shows the extent to which engagement is partly about the level of understanding to which teachers achieve in students' mind.

With reference to the pre-knowledge of the content covered, there was no substantial difference between the times when the contents were already known or unknown to students. Yet, the large difference was in between these two categories and the "cannot tell" category. Students' engagement was substantially lower when they could not even tell if they knew the content or not. Perhaps the most interesting finding here is not about the effects of pre-knowledge on engagement, but almost half of the times students were signaled they already knew the contents, implying that the classrooms that we observed were highly redundant in coverage. For the relevance of class content perceived by students, engagement level was higher when students found the content related to their everyday life (.17SD) and to test (.16SD), but not greatly to their going to college and future jobs. This may suggest that the susceptibility of students to things that have immediate concerns for them.

When students are talking with teachers about class, their engagement level was as large as .30SD higher than the moments when students were silent. If the talk was occurring with classmates, the engagement level was also higher, but compared to silent moments, it was only higher by .10 SD. To state this relationship more clearly, teachers gain only .10SD of student engagement by encouraging them to talk about class rather than to sit quietly, but teachers lose as much as .28SD if the talk turns into chatting. Thus, this may explain some teachers' reluctance to encourage verbal communication among students. If students are oriented towards distraction, there is more to lose rather than gain by encouraging talks among students.

The slight reduction of variance among coefficients for time blocks may suggest that talking is correlated with socialization time that tended to occur at the end of the class in many of our observations. The reduction in the group work coefficient, going from .22 to .17, 22% reduction, is suggestive in that group work encourages talking about class content, which may promote engagement. Some results became heightened in this model. Moments collected on Monday now is .23 SD less engaged than those collected on Wednesday, supporting the trend that mid-week is more engaging than transitional days.

Section Summary

The variables that were mostly negligible in our analyses were cities, grades, gender, and subject matter (mathematics versus science). This is an important finding in and of itself since it suggests that engagement is a feature that cuts across location. Time, however, is a different matter. Controlling for various factors, Monday, a day of transition from weekends to the school week, was clearly lower in engagement than Wednesday, a mid-week day. The flow of time in class was also important such that students' engagement level lowers beyond a traditional 50 minute class, but this may be correlated also with the tendency that teachers stop teaching beyond that point in many of our 90 minute classrooms.

Hispanics students had the lowest engagement score over all, having almost .37 SD difference from black students, the problem of which we shall come back to in the next section. In addition, group work, among various class configurations, promoted engagement level. Other factors that were found important were relevance of everyday life and test in the content, talking behaviors, the confusion level. Some of these are obvious, yet using an outcome composite derived by rigorous statistical procedure; we

learned the extent to which these variables matter. Somewhat surprising in terms of the effect size was the ecological factors of classrooms. The use of roundtable in the classroom, though only rarely used in our sample (13%), had an engagement level .40SD lower than the conventional individualed seating. In addition, when seats are chosen by teachers and thus not by students themselves, engagement level was almost .30SD higher.

Further Analyses of Racial/ Ethnic Differentiation

We have found, at least in our sample, that Hispanic students were the least engaged in the classes that we studied. This tendency of Hispanics' alienation from classroom experiences, in fact, is consistent with Yair's report (Yair 2000, Table 2, p. 257). We suspect that in our sample this phenomenon arose from the fact that in our sample their first language was not English, but the Hispanic alienation remained strong even after controlling for the level of confusion that students are feeling during the instruction.

Now in our attempts for further analyses, we let several hypotheses guide our analytical procedures. The first is the cultural hypothesis as our guiding perspective. As some literature suggest, Hispanics students have different approaches to the learning such that they prefer the educational environment characterized by group work and collaboration rather than competitive and individualistic mode of learning.

To probe this possibility, the samples are now grouped into the sampled based on class configuration (whole class instruction, seatwork, and group work), and seating arrangements (individual seating, lab seating, roundtables, seating determined by a teacher or no seat assignment). Also, based on students' report on whether they were feeling competitive or cooperative, we ranked courses and selected only the courses with a top 33% on these measures. Also, we separated samples into observations when students said they were talking with someone or they were not talking with anyone. Again, the hypothesis to test using these analytic samples is to see whether race differential in engagement level depends on the collaborative nature of the classroom.

Also tested are the match of race between students and teachers. Samples are separated into the ones where students and teachers are or are not of the same race. As a more explicit test, the samples were selected based on the race of teachers, so we know if racial differential of engagement behaves differently.

Table 3 starts from city differences of Hispanics effect. We know that Hispanics in Chicago are a mix of various Hispanics groups, El Paso Hispanics were mostly Mexican, and Miami Hispanics were Cuban and Central American. The results suggest that both Chicago and Miami's Hispanics had about the same level of alienation compared to other racial groups. El Paso Hispanics were also lower than whites and Asians, though in this casethey were slightly higher than blacks. Unlike other cities, El Paso's Whites were not European immigrants, which may explain why it surged as a top group in terms of engagement level. In all cities, except for 100% African American Memphis sample, Hispanics' lower engagement level was more or less a fact regardless of original nationality of the Hispanic students.

<Table 3 Racial Differentiation of Student Engagement Level>

Class configuration differences tell a story consistent with a cultural hypothesis. Hispanics' alienation is of the same magnitude as the whole sample model was found

with the whole class instruction sample, but it is greatly weakened in the samples based on seatwork and group work. Interestingly, racial differentials weakened when students were engaged in group work. Hispanics were the top-engagement group and Asian students, though a small minority in this sample, became alienated from engagement when doing group work.

Next is seating arrangement differences and we found the same patterns. Hispanics alienation was salient with individual seats and even more salient with lab seating. With roundtable seating, however, Hispanics students became top-engagement group. Just like earlier findings about Hispanics in group works, this supports a cultural hypothesis that group work driven classrooms are more favorable for alleviating Hispanics alienation from instructions.

More explicit testing of this hypothesis comes from the next sets of models. The same models were run with the sample from highly competitive and highly collaborative courses, as defined earlier. Also the samples were separated by whether students were talking with someone or not talking at all at the time of signals. Resonating well with earlier findings, Hispanics alienation was present only when the courses were competitive, but with collaborative climates of the classrooms, Hispanics became second from the top group in terms of engagement. When placed under collaborative climates, the gain in engagement was particularly strong for Asian students. Furthermore, Hispanics alienation was somewhat weakened when Hispanics students were talking with someone. Hispanics alienation was -.40SD compared to blacks while not talking, while once they start talking the disadvantage shrank to -.24SD.

Finally, we wanted to see if there are any changes of racial differentials, depending on the race of teacher and the race of students. For this purpose, the same models were run on the samples whose teachers were whites, Hispanics, and blacks. The result particularly for Hispanics students was interesting. Hispanics students are highly engaged only when their teachers were Hispanics. When their teachers were white, their engagement level drops very drastically.

Section Summary

Our cultural hypotheses were all supported by the direction and the size of race coefficients. Also interesting was the degree to which Hispanics students' engagement is associated their having Hispanics teachers. We thus seemed have found, at least in our sample, the interaction between the culture of Hispanics that holds together those who speak Spanish and share similar cultural and social circumstances and micro-level production of engagement level.

Discussion and Conclusion

We added some description to the body of literature about America's mathematics and science classrooms. Findings from our convenient sample supported TIMSS researchers' concern that America's curriculum is predominantly lecture-oriented and very much redundant because of large mount of reviews teachers conduct (Stigler and Hierbert 1999). Our subjects were being lectured 40% of the time and were exposed to new knowledge only 37% of the sampled moments. The level of challenge defined by the perceived difficulty of instruction was more towards easy rather than difficult. Yet our sample also added positive description of classrooms. Past research, such as Yair

(2000) or McFarland (2001), both based on convenient samples like our sample, tended to portray students wanting to get away from serious participation as much as possible. Yet our students were found talking about class-related matters either with teacher or students for a quarter of the sampled moments. Although teachers' lecturing dominated the classrooms, but students were also the carriers of informal classroom conversation among themselves. We saw in classrooms and heard in focus group interviews that students liked helping each other with problems they had as long as it does not become a source of distraction. Furthermore, given opportunities to interact with peers through group work, we found our subjects talking more about class-related matters rather than chatting on things unrelated to class. Perhaps we should recognize the potential that peers' networks in classroom can be well utilized to promote learning, providing the classroom with social capital conducive to collaborative learning.

Among the predictors of engagement that we tested, we confirmed the past research findings that group work promotes engagement and also found evidence supporting educational psychologists' insight that a sense of goals is important ingredient of engaging classrooms. Perhaps the relevance of everyday life and testing provoked by teachers in classroom provide students with goals that motivate them. Among the various factors found substantial, what was surprising was the effect of ecological factors, such as seating arrangements and the choice of where to sit. With individual seating, as well as teachers deciding where to sit for students, we saw substantially large effects. In fact, the effects of these ecological concerns were larger than any of the pedagogical variables. Students choosing their own seats may increase the level of distraction as it increases the probability that friends sit together, yet it may also reflect the philosophy of teachers (e.g., "libertarian" versus "disciplinarian"). Some teachers may strategically position distractive students in the front rows to suppress their chatting as the visibility increases the surveillance and social control ability of teachers. Future research must conduct a more rigorous classification of seating factors, as well as increasing the number of classrooms under comparison.

To answer our first research question, we have shown that basic social organizational features of instruction, namely, class activities, did impact various processes related to the enhancement of opportunity to learn. For example, our descriptive analyses (table 2) showed that when teachers used group work, students were more likely to be exposed to new source of knowledge, felt that what was being taught had relevance to their everyday life, and engaged more in talking about class-related issues. Our multivariate modeled showed that engagement level was higher roughly by .20 SD when group work was employed and its effect was slightly decreased by the addition of student perception variables, as well as talking/chatting variables. This intervening effect was a weak finding, yet taken together with descriptive analyses, we conclude that classroom activities do affect the psychological processes, as well as talking and chatting, in such a way to influence students in classrooms.

Without taking into account this realm of educational institutions, which is the immediate, time-dependent contexts of schooling, we would be grossly miss-specifying the model of educational productivity. For example, studies utilizing large national data set tend to ignore the factors that we were able to explore in our model because their data collection occurs only at a limited number of time points. Our study suggests that as much as 40% of the variance of engagement measure, a known correlate of academic

achievement, is located within the same individuals. Time-varying contexts is too important a location of variance to ignore.

To answer the second research question, the implication of Hispanics effect and its variance by other factors informs the study of social stratification. We found that Hispanics students had lower level of engagement level, but the degree of Hispanics alienation varied under various classroom conditions. Hispanics disadvantage disappeared and Hispanics engagement even became a top engagement group when Hispanics students were placed under the group work and collaboration-driven environments. As sociolinguistic research on classroom language suggest, the cause of Hispanic alienation in classrooms could arise from the gap between the pedagogical culture of home and of classrooms. Yet to really prove this mechanism, more careful analysis of home cultures is called for.

At least, our evidence suggests that this racial differential occurred partly because of the dynamic, on-going processes occurring during the classrooms, rather than just fixed properties of certain teachers, classrooms, or schools. In other words, classroom switch on and off as social stratifier of students' learning processes. Thus, for us to intervene the process of educational stratification and aim to see the opportunity to learn more equalized, we should not only look at the implication of larger institutional arrangements, such as tracking and standardization of curriculum, but also examine micro conditions of organization of pedagogy.

This study suggests that some answers to problems of urban education, such as high Hispanic dropout rate, could be obtained by promoting the pedagogy that is more sensitive to instructional preferences specific to race and ethnicity groups. To the extent that the problems lie within the immediate social organizational features of the classrooms, as this study suggested, solutions maybe also found in the same location of educational production within the reach of individual educators.

APPENDIX

Exihibit 1
Participant Selection Strategy

5 boys and 5 girls=10 students
From a math teacher's two classes
From a science teacher's two classes=4 classes
of two high schools=2 schools
From Chicago, El Paso, Memphis, and Miami
=4 cities
10*4*2*4=320 students

Exhibit 2
Engagement Items

Strongly Disagree = SD, Disagree = D, Agree=A, Strongly Agree=SA
When you were signaled the first time today,

	SD	D	SA	A
I was paying attention……..				
I did not feel like listening……				
My motivation level was high……..				
I was bored……..				
I was enjoying class……				
I was focused more on class than anything else				
I wished the class would end soon…… .				
I was completely into class ……				

TABLE 1
Demographic Characteristics of Students

	N		N			N			N	
CHICAGO	95	Boy	41	(43%)	asian	18	(19%)	10th grade	37	(39%)
		Girl	54	(57%)	**black**	61	(64%)	11th grade	26	(27%)
					hispanic	12	(13%)	12th grade	32	(34%)
					white	4	(04%)			
EL PASO	85	Boy	44	(52%)	asian	1	(01%)	10th grade	47	(55%)
		Girl	41	(48%)	black	11	(13%)	11th grade	28	(33%)
					hispanic	57	(69%)	12th grade	10	(12%)
					white	14	(17%)			
MEMPHIS	99	Boy	34	(34%)	black	99	(100%)	10th grade	26	(26%)
		Girl	65	(66%)				11th grade	50	(51%)
								12th grade	23	(23%)
MIAMI	66	Boy	35	(53%)	asian	2	(03%)	9th grade	10	(16%)
		Girl	31	(47%)	**black**	29	(44%)	10th grade	35	(55%)
					hispanic	30	(45%)	12th grade	19	(30%)
					white	5	(08%)			
Total	345	Boy	154	(45%)	asian	21	(06%)	9th grade	10	(03%)
		Girl	191	(55%)	**black**	200	(58%)	10th grade	110	(32%)
					hispanic	99	(29%)	11th grade	104	(30%)
					white	23	(07%)	12th grade	84	(24%)

Note: Racial groups in Bold when concentrated with a large proportion

TABLE 2
Descriptive Statistics (Percentage) of Student Variables from 3-level logistic HLM

		Classroom Activity Types			
	Whole sample	Lecture	Groupwork	Seatwork	Test
Number of Observations	2360	972	304	813	81
Percentage*		41.19%	12.88%	34.45%	3.43%
Feeling					
Confused	16.5	16.2	15.9	16.7	25.9
Fun	21.0	19.2	35.3	21.9	11.2
Competitive	4.5	4.6	11.3	4.2	3.7
Cooperative	22.1	26.1	33.8	21.9	20.3
Sleepy	20.8	24.7	12.7	21.8	28.8
Subject Contents					
I knew	44.4	41.4	37.8	49.7	53.4
I did not know	37.2	43.6	54.7	32.7	22.5
Cannot tell	11.9	11.4	4.9	14.4	23.3
Very Easy	10.5	12.3	16.1	11.3	9.4
Easy	21.8	23.3	23.9	23.5	6.6
About Right	28.8	31.9	32.7	27.9	34.9
Difficult	9.1	9.1	6.6	9.8	22.3
Very Difficult	1.2	1.5	1.2	1.3	4.9
Cannot Tell	28.7	21.7	19.5	26.3	22.0
Summary Measure**	1.8	2.0	1.9	1.9	2.4
Perceived Relevence					
Everyday life	35.3	34.7	52.2	35.4	33.3
College	67.3	67.2	62.8	68.1	56.1
Future Job	23.0	27.0	29.0	29.7	26.0
Unrelated to Test	8.4	9.0	13.0	10.6	6.7
Talking					
No talk	51.48	59.20	25.07	49.47	84.19
With teacher re: Class	6.25	7.96	8.22	4.68	2.72
With classmates re: Class	19.54	15.23	54.65	21.84	4.94
Chat with Classmates	14.63	13.88	9.42	14.24	7.41
Chat with teachers	1.05	0.78	0.00	1.60	0.00

Notes. All values are percentages.
We used SAS GLMMIX macro to simulate 3-level HLM where repeated measures is level1, student is level-2, and class is level 3.
*Percentage for class activity type does not add up to 100% because each activicy could cooccur.
**Categories are assumed to have a linear property (e.g., 1=very easy) and a mean was derived

TABLE 3
Random Coefficient Model of Student Engagement Level

		Model 1 Anova Model		Model 2 Basic Model		Model 3 Ecological Model		Model 4 Student Model		Model 5 Teacher Model	
N. of Cases		1945		1945		1945		1945		1945	
Intercept		0.01	(0.08)	-0.09	(0.27)	-0.33	(0.44)	-0.29	(0.45)	-1.36	(0.42)
Level 1 Variance		0.43	(0.01) ***	0.42	(0.01) ***	0.42	(0.01) ***	0.41	(0.01) ***	0.38	(0.01) ***
Level 2 Variance		0.54	(0.05) ***	0.53	(0.05) ***	0.52	(0.05) ***	0.52	(0.05) ***	0.42	(0.04) ***
Level 3 Variance		0.11	(0.05) **	0.00		0.00		0.00		0.00	
City											
Chicago	25%			-0.24	(0.16)	-0.22	(0.22)	-0.22	(0.23)	-0.13	(0.21)
ElPaso	30%			0.26	(0.16)	0.20	(0.25)	0.24	(0.25)	0.31	(0.23)
Memphis	28%			-0.07	(0.19)	0.05	(0.24)	0.03	(0.24)	0.10	(0.22)
Miami (ommited)	16%			0.00		0.00		0.00		0.00	
Grade											
9	23%			-0.02	(0.31)	-0.28	(0.32)	-0.25	(0.32)	-0.28	(0.29)
10	3%			-0.15	(0.14)	-0.27	(0.15) +	-0.29	(0.15) +	-0.28	(0.14) *
11	42%			0.12	(0.14)	-0.05	(0.17)	-0.07	(0.17)	-0.13	(0.16)
12 (ommited)	32%			0.00		0.00		0.00		0.00	
Gender											
Male	44%			-0.05	(0.09)	-0.05	(0.09)	-0.04	(0.09)	-0.02	(0.08)
Female (ommited)	56%			0.00		0.00		0.00		0.00	
Race											
White	8%			-0.26	(0.20)	-0.19	(0.21)	-0.22	(0.21)	-0.17	(0.19)
Hispanic	30%			-0.50	(0.15) ***	-0.43	(0.16) **	-0.45	(0.16) **	-0.37	(0.15) *
Asian	6%			-0.32	(0.22)	-0.24	(0.25)	-0.25	(0.25)	-0.13	(0.22)
Black (ommited)	55%			0.00		0.00		0.00		0.00	
subject											
math	51%			0.13	(0.10)	0.13	(0.15)	0.18	(0.15)	0.18	(0.14)
science (ommited)	49%			0.00		0.00		0.00		0.00	
Low level course	72%			-0.15	(0.11)	0.05	(0.13)	0.05	(0.13)	0.06	(0.12)
Date											
Monday	18%			-0.10	(0.05) +	-0.10	(0.05) +	-0.09	(0.05) +	-0.12	(0.05) *
Tuesday	22%			0.04	(0.05)	0.04	(0.05)	0.04	(0.05)	0.05	(0.05)
Wednesday	22%			0.08	(0.05) +	0.08	(0.05) +	0.05	(0.05)	0.10	(0.05) *
Thursday	17%			0.10	(0.05) +	0.10	(0.05) +	0.07	(0.05)	0.04	(0.05)
Friday (ommited)	21%			0.00		0.00		0.00		0.00	
IDbeep											
1	21%			0.31	(0.09) ***	0.31	(0.09) ***	0.26	(0.09) **	0.18	(0.09) *
2	18%			0.36	(0.09) ***	0.37	(0.09) ***	0.28	(0.09) **	0.22	(0.09) *
3	20%			0.37	(0.09) ***	0.37	(0.09) ***	0.27	(0.09) **	0.19	(0.09) *
4	16%			0.30	(0.09) ***	0.31	(0.09) ***	0.20	(0.09) *	0.12	(0.09)
5	8%			0.36	(0.10) ***	0.36	(0.10) ***	0.29	(0.10) **	0.22	(0.10) *
6	5%			0.12	(0.10)	0.12	(0.10)	0.06	(0.10)	0.01	(0.10)
7	7%			0.23	(0.10) *	0.23	(0.10) *	0.18	(0.10) +	0.13	(0.10)
8 (ommited)	4%			0.00		0.00		0.00		0.00	
An Outlier teacher	6%			0.66	(0.21) **	0.86	(0.24) ***	0.73	(0.24) **	0.60	(0.22) **

TABLE 3 (CONTINUED)

		Model 1	Model 2	Model 3		Model 4		Model 6	
classSize									
Large	27%			0.25	(0.18)	0.22	(0.18)	0.21	(0.16)
Midium	36%			-0.02	(0.14)	-0.03	(0.14)	-0.03	(0.13)
Small (ommited)	37%			0.00		0.00		0.00	
seattype									
Individual	74%			0.33	(0.20)	0.36	(0.20) +	0.42	(0.19) *
Lab	13%			0.15	(0.29)	0.21	(0.29)	0.35	(0.26)
Roundtable (ommited)	13%			0.00		0.00		0.00	
Seat Chosen by									
Student	51%			-0.34	(0.16) *	-0.33	(0.16) *	-0.29	(0.14) *
Teacher (ommited)	49%			0.00		0.00		0.00	
Class Config.									
Nothing	8%					-0.18	(0.07) **	-0.08	(0.07)
Groupwork	13%					0.22	(0.06) ***	0.17	(0.06) **
Seatwork	35%					-0.02	(0.04)	-0.03	(0.04)
Lecturing (ommited)	58%					0.00		0.00	
Testing	3%					0.04	(0.09)	0.06	(0.09)
Technology									
overhead	10%					0.15	(0.06) *	0.11	(0.06) +
blackboard	21%					-0.02	(0.05)	-0.05	(0.05)
Confused or not									
Not Confused	81%							0.25	(0.04) ***
What was being taught was something:									
I already knew	46%							0.33	(0.05) ***
I did not know	40%							0.22	(0.06) ***
Cannot tell (ommited)	14%							0.00	
What was being taught had relevence to:									
every23	38%							0.17	(0.05) ***
college23	63%							0.05	(0.05)
job23	31%							0.06	(0.06)
Related to Test	87%							0.16	(0.06) **
Conversation during class									
Not talking	53%							0.28	(0.05) ***
Talk w/ Teacher	6%							0.58	(0.08) ***
Chat w/ Teacher	1%							0.05	(0.15)
Talk w/ Peers	23%							0.38	(0.05) ***
Chat w/ Peers (ommited)	17%							0.00	

Note: The outcome measure is standardized with a mean of 0 and stadard deviation of 1.
Since all covariates are categorical, the coefficients correspond to the deviation from a baseline category.
Inside parentheses are standard errors. + if p < .10; * if p <.05; ** if p < .01; *** if p < .001.

TABLE 4
Racial Differential of Student Engagement Level

By City

	Whole sample		Chicago		Memphis	El Paso		Miami	
White	-0.06	(.19)	-0.21	(.42)		0.17	(.21)	-0.06	(.40)
Hispanic	-0.21	(.15)	-0.55	(.30)		-0.08	(.22)	-0.55	(.26)
Asian	-0.03	(.23)	-0.04	(.29)		0.28	(.70)	-0.81	(.54)
Black	0.15		-0.09		0.36	-0.26		-0.09	
N. of Cases	1879		444		535	604		296	

	Lecture		Seatwork		Groupwork	
White	-0.05	(0.22)	-0.06	(0.23)	0.36	(0.46)
Hispanic	-0.25	(0.17)	0.00	(0.20)	0.60	(0.32)
Asian	-0.05	(0.25)	0.14	(0.32)	-0.55	(0.57)
Black	0.11		0.23		0.39	
N. of Cases	834		668		252	

	Individual Seat		Roundtable		Lab seating	
White	0.23	(.29)	-0.35	(.19)	-0.45	(.55)
Hispanic	-0.17	(.21)	-0.31	(.21)	-0.54	(.44)
Asian	-0.65	(.53)	-0.35	(.35)	0.15	(.43)
Black	0.22		-0.47		0.22	
N. of Cases	1401		243		235	

By Classroom Climate

	Competitive		Cooperative	
White	0.33	(.41)	0.40	(.21)
Hispanic	-0.32	(.27)	0.47	(.23)
Asian	0.25	(.39)	0.89	(.39)
Black	0.12		0.11	
N. of Cases	601		642	

By Conversation

	Not talking		Talking	
White	-0.06	(.23)	0.04	(.21)
Hispanic	-0.25	(.17)	-0.12	(.16)
Asian	0.01	(.26)	-0.02	(.26)
Black	0.15		0.12	
N. of Cases	994		885	

By Teacher's Race

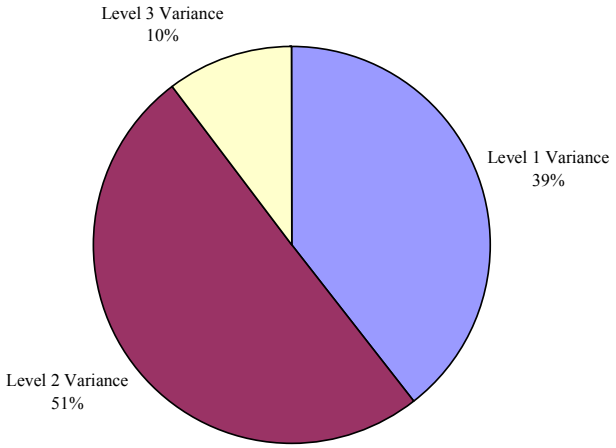
	Black		Hispanic		White	
White	0.13	(.40)	0.18	(.24)	-0.31	(.27)
Hispanic	-0.39	(.30)	0.03	(.29)	-0.66	(.18)
Asian	-0.73	(.55)	0.44	(.70)	0.00	(.30)
Black	0.29		-0.50		-0.09	
N. of Cases	854		416		608	

By Importance of High-Stake State Exam

	Low		High	
White	-0.10	(.32)	0.13	(.18)
Hispanic	-0.41	(.24)	0.11	(.18)
Asian	0.06	(.32)	0.21	(.37)
Black	0.17		0.00	
N. of Cases	955		924	

Notes: Inside Parents are standard errors.
Blacks were ommited categories and receievd a value of an intercept of models where predictors were all centered around grand-mean. Thus, the intercept value is that of a hypothetical, average person..

Figure 1 Decomposition of Variance of Student Engagement Level



Bibliography

Ainley, M., S. Hidi, et al. (2002). "Interest, Learning, and the Psychological Processes That Mediate Their Relationship." Journal of Educational Psychology **2002**(94): 3.

Ames, C. (1992). "Classrooms: Goals, Structures, and Student Motivation." Journal of Educational Psychology **84**(3): 261-271.

Assor, A., H. Kaplan, et al. (2002). "Choice is good, but Relevence is Excellent: Autonomy-Enhancing and Suppressing Teacher Behaviors Predicting Students' Engagement in School Work." British Journal of Educational Pshychology **72**: 261-278.

Barr, R. and R. Dreeben (1983). How Schools Work. Chicago, University of Chicago Press.

Bernstein, B. (1977). Social Class, Language, and Socialization. Power and Ideology in Education. J. K. a. A. H. Halsey. New York, Oxford.

Bidwell, C. E. and J. D. Kasarda (1980). "Conceptualizing and Measuring the Effects of School and Schooling." American Journal of Education **88**(4): 401-430.

Bossert, S. T. (1979). Tasks and Social Relationships in Classrooms. Cambridge, Cambridge University Press.

Bryk, A. S. and S. Raudenbush (1992). Hierarchical Linear Models: Applications and Data Analysis Methods. Newbury Park, Sage Publications.

Dewey, J. (1975). Interest and Effort in Education. Carbondale, Southern Illinois University Press.

Evans, F. B. and J. G. Anderson (1973). "The Psychocultural Origins of Achievement and Achievement Motivation: The Mexican American Family." Sociology of Education **46**(4): 396-416.

Finn, J. D. and D. Cox (1992). "Participation and Withdrawal Among Fourth-Grade Pupils." American Educational Research Journal(29): 141-162.

Hedges, L. V. and A. Nowell (1999). "Changes in the Black-White Gap in Achievement Test Scores." Sociology of Education **72**(2): 111-135.

Herrenkohl, L. R. and M. R. Guerra (1998). "Participant Structures, Scientific Discourse, and Student Engagement in Fourth Grade." Cognition and Instruction **16**(4): 431-473.

Imai, M., R. C. Anderson, et al. (1992). "Properties of Attention During Reading Lessons." Journal of Educational Psychology **84**(2): 160-173.

Larson, R. and M. Csikszentmihalyi (1983). The Experience Sampling Method.

Naturalistic Approaches to Studying Social Instruction. H. G. Reis. San Francisco, Jossey-Bass. **15:** 42-56.

Littel, R. C., G. A. Milliken, et al. (1996). SAS System for Mixed Models. Cary, NC, SAS Institute Inc.

McFarland, D. A. (2001). "Student Resistance: How the Formal and Informal Organization of Classrooms Facilitate Everyday Forms of Student Defiance." American Journal of Sociology **107**: 612-278.

Mehan, H. (1984). "Language and Schooling." Sociology of Education **57**(3): 174-183.

Newmann, F. M., Ed. (1992). Student Engagement and Achievement in American Secondary Schools. New York, Teachers College Press.

Nystrand, M. and A. Gamoran (1991). "Instructional Discourse, Student Engagement, and Literature Achievement." Research in the Teaching of English **25**: 261-290.

Nystrand, M., L. L. Wu, et al. (2001). Questions in Time: Investigating the Structure and Dynamics of Unfolding Classroom Discourse. Albany, National Research Center on English Learning & Achievement.

Page, R. N. (1991). Lower Track Classrooms: A Curricular and Cultura Perspective. New York, Teachers College Press.

Philips, S. (1972). The Invisible Culture: Communication in Classroom and Community on the Warm Springs Indian Reservation. New York, Longman.

Schneider, B., C. Swanson, et al. (1998). "Opportunities for Learning: Course Sequences and Positional Advantages." Social Pshychology of Education **2**: 25-53.

Shernoff, D. (2001). The Experience of Student Engagement in High School Classrooms: A Phenomenological Perspective. Department of Education. Chicago, The University of Chicago.

Shernoff, D., S. Knauth, et al. (2000). The Quality of Classroom Experiences. Becoming Adult. M. Csikszentmihalyi and B. Schneider. New York, Basic Books**:** 141-164.

Skinner, E. A., J. G. Wellborn, et al. (1990). "What It Takes to Do Well in School and Whether I've Got it: A Process Model of Perceived Control and Children's Engagement and Achievement in School." Journal of Educational Psychology **82**(1): 22-32.

Stigler, J. W. and J. Hierbert (1999). The Teaching Gap: Best Ideas from the World's Teachers for Improving Educaiton in the Classroom. New York, The Free Press.

Turner, J. C., D. K. Meyer, et al. (1998). "Creating Contexts for Involvement in

Mathematics." Journal of Educational Psychology **90**(4): 730-745.

Wright, B. D. and G. Masters (1982). Rating Scale Analysis. Chicago, MESA Press.

Wright, B. D. and M. Stone (1979). Best Test Design. Chicago, MESA Press.

Yair, G. (1999). "Social Stratification of Minding in Classrooms: Explaining Gaps between Opportunities to Learn and Student Outcomes."

Yair, G. (2000). "Educational Battlefields in America: The Tug of War Over Students' Engagement with Instruction." Sociology of Education **73**: 247-269.

[1] Sloan project's ESM data collection (located at NORC at the University of Chicago), from which Yair or Shernoff's data came from, targeted individuals' time-varying experiences. Their ESM survey instruments and research design, however, were designed for taking into account youths' life experiences in general and not specifically for studying classroom experiences. In a way, this research design has the strength of comparing classroom experiences and outside the classroom experiences, such as extracurricular activities, jobs, and home life. Yet, their data collection design lacks crucial information necessary for the in-depth study of classroom contexts.

[2] The USI program, funded by the National Science Foundation in 1993 supported math and science teaching and learning reforms in 21 cities over a 5 year period, providing 15 million dollars to each USI/city site over the duration of funding.

[3] We acknowledge that the role that Dr. Benjamin Wright played in helping us select best survey items for our purposes.

[4] We checked the problem of differential item functioning by gender by running the same models with boys' and girls' data separately. We compared the item's difficulty measures to see if they vary by gender. No substantial difference was found and we concluded that boys and girls responded to our survey items in the same way.

[5] For the multivariate regression models, we decided to use observations only when their engagement measures' misfit statistics was less than 2, the threshold of which is considered reasonable among Rasch model practitioners. As a result, 10% of observations were eliminated for the final analysis. We thoroughly examined that the sample with misfit and the sample without were not different in any major ways. Furthermore, the final results reported did not change substantially either with or without misfitting items.

[6] The model to derive probability, or percentage was: log(P/1-P)=b0 + error 1+error 2+error 3. Error 1 is a repeated-measure level residual, Error 2 is a individual-level error, and error 3 is class-level error. SAS's GLMMIX macro was used to run PROC MIXED. The results looked very close to percentages obtained from a simple, ordinary procedure, using SAS PROC FREQ, though standard errors obtained by HLM are more realistic.

FIRST SIGNAL

What is your beeper ID? ( )
When you were signaled the first time today,
what was the main thing that you were doing?

what else were you doing?

what was on your mind?

Please fill in the bubbles (example O)
Strongly Disagree = SD, Disagree = D, Agree=A, Strongly Agree=SA

When you were signaled the first time today,

	SD	D	A	SA
I was paying attention to class……..	O	O	O	O
I did not feel like listening……	O	O	O	O
My motivation level was high……..	O	O	O	O
I was bored……..	O	O	O	O
I was enjoying class……	O	O	O	O
I was focused more on class than anything else	O	O	O	O
I wished the class would end soon…… .	O	O	O	O
I was completely into class…….	O	O	O	O

Please fill in the bubbles.

When you were signaled the first time today,
was the main thing you were doing more like
Work O Play O Both O Neither O

What was being taught was
Very easy O Easy O About right O Difficult O
Very difficult O Can't tell O

What was being taught was
something that I already knew Yes O No O Can't tell O

Please fill in the bubbles that apply.

When you were signaled the first time today,
what was being taught was important for
my everyday life YesO No O
going to college YesO No O
my future job YesO No O
future tests YesO No O

If you felt that class <u>at the time of signal</u> was important for tests,
please tell us for which tests it was important. Fill in <u>all that apply</u>.
Class quiz O Midterm/Final O SAT or ACT O
State Assessment Tests (e.g., TAAS, End of Course Exam) O

Class was unrelated to test O

Please fill in the bubbles that apply.

When you were signaled the first time today,
you were feeling: (Fill in <u>all that apply</u>)

HappyO	ConfusedO	ActiveO	Having funO
NervousO	IntimidatedO	SadO	CooperativeO
RelaxedO	WorriedO	AngryO	ConfidentO
CompetitiveO	FrustratedO	BusyO	SleepyO

Were you talking with anyone?
No oneO ClassmateO Teacher O
Was it about the class? YesO No O

Comments – if any: