

PROJECT DESCRIPTION

PROJECT TITLE: Positive Learning Environments Aiming for Success In Science Education
PROJECT ACRONYM: PLEASSE

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SUBMITTING INSTITUTION: Morgan State University, Baltimore, MD

PROJECT CLASSIFICATION: EXPLORATORY RESEARCH PROJECT.
Component A: (Applied Research). Category 3: Studies of Teachers and Teaching.

STEM Disciplines: Physical Science (Microgravity, Space Travel, Astronomy, Aviation). **Life Science:** (Effect of space travel on human body, Estuary Ecology in Maryland).

1. Introduction: The test score gap between white and black students has been a national concern for more than a half-century. Despite the sustained attention of researchers and policymakers, little progress been made to date in eliminating or even substantially reducing this gap. According to Jencks and Phillips (1998), nothing will advance equality and positive race relations in the US as much as a substantial reduction or elimination of this gap. Over the last two decades the scholarship and research on the test score gap has yielded theoretical constructs and psychological insights that have solid empirical anchors (see below) and are therefore sufficiently robust to support strong scientific claims that can form the basis for exploring interventions aimed at substantially reducing the test score gap. These constructs and insights will form the basis of this Exploratory Research Project proposed under **Component A: (Applied Research) in Category 3: Studies of Teachers and Teaching**. The proposed research project is aimed at exploring the components and impact of a teacher professional development model (PDM) on teacher performance and student achievement in STEM disciplines at schools serving large numbers of minority students.

2. Addressing the National Science Board merit review criteria:

2.1 Broader Impact: The project addresses the National Science Board merit review criterion of **broader impact** by seeking a solution to the black-white test score gap which has been identified as one of the most pressing national problems in education. The research will help to develop and validate a teacher professional development model that

can be used to produce teachers who will positively impact the learning and academic engagement of minority students. In anticipating a broad impact, the proposed project will build on and extend the impact already generated by the previous NSF funded project of the PI (REC 202132). A publication from that related project (Norman et al., 2001) is included in a readings list on urban education recommended by the Rutgers University Library¹ for reading by education students. This publication is one of about 20 pieces recommended alongside the work of luminaries such as Stanford's Claude Steele and the Harvard Civil Rights Project. There is additional evidence that the related previous work is having a broad transformative impact on teacher education² at leading campuses.

2.2 Intellectual Merit: The criterion of intellectual merit is satisfied by the potential of this project to develop and provide a solid empirical basis for strategies aimed at reducing or even eliminating the 'achievement gap' in school contexts. It is also a measure of the intellectual merit of the proposed project that is based on over two decades of widely recognized and groundbreaking empirical work. The work by Steele and his coworkers on stereotype threat has afforded Steele with membership in both the National Academies of Science and Education. As early as 1997, Steele called for an extensive research program to provide a “definitive test of wise schooling” to “stop or reverse a tenacious negative trajectory in the school performance of stereotype-threatened students” (p. 625). The proposed project is a research program in that mold. Additionally, the theoretical constructs underlying the project have informed the scholarship on minority education for the last two decades and are based on work which earned Ogbu induction into the National Academy of Education. As a scale-up research project is ultimately anticipated, the project maintains intellectual merit and integrity in its design by identifying and controlling for key contextual variables in order to justify a claim for generalizability of positive student outcomes to similar school contexts serving large minority student numbers (see McDonald, 2006).

¹ The link on the Rutgers University library website is <http://newark.rutgers.edu/~natalieb/teach.htm>. The 'Teaching for Success' button links to the page referencing the article.

² The website of a student in the University of Pennsylvania Graduate School of Education contain the following text at (<http://courseweb.gse.upenn.edu/~ianstith/main%20pages/changes.htm>):
'Obed Norman, Charles R. Ault Jr., Bonnie Bentz, Lloyd Meskimen "Journal of research in Science Teaching" VOI. 38, NO 10, PP. 1101- 1114 2001. We must look at the science classroom as a cultural interface zone in order to understand the situation. The situation being that urban schools in general and science classes in particular are failing. This article takes a socioeconomic view of the situation and draws conclusions about what needs to be changed in order for students to learn. Based on this research, teachers need to change their classroom from a place of conflicting ideas to a place of inquiry and growth. Teachers need to take energy and direct it towards learning. This is not just white teachers teaching black students it is all teachers. The culture of the school may be in direct conflict with the culture of the student outside the school, so the teacher needs to help the student live in both worlds effectively. This article forced me to reassess my own practices as a white science teacher in an urban school. After reading this article it became more obvious that I cannot ignore the fact that my classroom itself may be seen as conflicting with the norms of my students. I have and will make every effort to relate to my students, not simply in talking with them but changing my strategies around them'.

3. Goals and Projected Research Outcomes

3.1 Research Problem Statement: The literature on minority education points to a need to identify the qualifications required by teachers who will be successful with minority students (see for example Ladson-Billings, 1994). It is also clear from the literature that both content competency and the ability to motivate students are required for effective teaching of these students. The work of Social Psychologists such as Steele (1999), Dweck (1998), Oyserman (1993) and others demonstrates that enhancing teacher content knowledge is a crucial but not the sole area of concern when it comes to addressing the needs of minority students. An equally important area of concern is to equip teachers with insights and pedagogies aimed at ensuring that schools become welcoming, nurturing, and equitable learning environments that will engender in all students the high levels of 'effort optimism' (Ogbu, 1986) that will enhance their educational aspirations and achievement.

There is also a growing conviction among many scholars that teacher expectations and perceptions may be among the most potent mediating mechanisms implicated in both the genesis and maintenance of the black-white test score gap. An example is Ferguson (1998) who concluded on the basis of an extensive review of the literature: 'My bottom line conclusion is that teachers' perceptions, expectations, and behaviors probably help to sustain, and perhaps even to expand, the black-white test score gap' (p. 313). Ferguson (1998) also warns that if teachers 'expect black children to have less potential, teachers are likely to search with less conviction than they should for ways to help these children to improve, and hence miss opportunities to reduce the black- white test score gap' (p. 312). There is also a growing body of empirical evidence that suggests a considerable role for teacher expectations and perceptions in student outcomes, especially for minority students. On the basis of our own 5 -year research on the test score gap we have reached the same conclusion regarding the link between teacher perceptions and minority student performance (Norman et al. 2001, Norman & Crunk, 2004).

Social psychologists regard the cultivation of 'possible selves'(images of the self one would like to attain), as critical for motivating action (Strauman and Higgins, 1987; Higgins, Oyserman and Markus, 1990). Studies have found that adolescents with school-focused possible selves are at reduced risk of involvement in delinquent activities, do better at school, and feel more connected to school (Oyserman, 1993; Oyserman and Harrison, 1998). There is also some empirical support for the assumption that academic possible selves are rooted in part in racial identity. Oyserman, Terry, and Bybee (2002) have identified a type of racial self-concept that is compatible with high levels of academic engagement and performance for African American students. This racial self-concept is characterized by a positive orientation towards one's own ethnic group as well as an optimistic engagement with respect to the dominant culture.

The scholarship on the affective and identity issues impacting minority education cites negative school experiences as an important source of the 'disidentification' with school which leads many minority youth to under-perform on academic tasks. (Steele 1998, Norman 2001). Steele and Aronson (1998) advanced the idea that competitive learning environments may engender 'stereotype threats' which may compromise the test performance of African American and other minority college students who suspect that they are perceived as intellectually inferior. Stereotype threat is the apprehension felt by members of stigmatized groups that they are at risk of confirming a negative stereotype

of their group. The significance and uniqueness of Steele and Aronson's work is that it sheds light on a putative mechanism for the test score gap. Our interpretation of this proposed mechanism is that it is essentially an action/reaction duality involving teacher and student perceptions. (see Norman et al. 2001 p. 1103 for a fuller discussion of this duality). Teachers' negative perceptions about the ability of black students in turn elicit negative student perceptions that manifest themselves as 'oppositonality' and/or stereotype threat. Both manifestations seriously undermine students' motivation and ability to perform optimally on academic tasks. Our proposal addresses this crucial aspect of minority education.

It would appear that addressing teacher perceptions and student motivation is a fruitful area for research aimed at understanding and addressing the ethnic test score gap. Our project is also aimed at researching and evaluating the impact of teachers who are equipped through our intervention to provide their students with school experiences that are more geared toward fostering the development of exactly the types of racial self-concepts that Oyserman and others have identified as associated with high academic performance and engagement. On the basis of these insights we propose to explore the research questions that follow.

3.2 Research Questions: 1. Can a structured intervention aimed at fostering positive student academic attitudes be integrated with a quality inquiry science program to increase both student academic outcomes and positive achievement-oriented attitudes.
2. What is the impact of teachers with positive perceptions and expectations on the academic performance and perceptions of all students but particularly minority students?

3.3 Hypotheses to be tested: a. A structured intervention aimed at fostering positive academic attitudes can be integrated with a quality inquiry science program to increase both student academic achievement and positive achievement-oriented attitudes.
b. Teachers with positive perceptions and expectations can enhance the academic performance and perceptions of all students but particularly minority students.

3.4 Projected Outcomes: To contribute to an understanding of the essential features and components of a professional development model that can be disseminated nationwide to school districts and colleges to be used in preparing teachers equipped to adequately address the problem of the 'achievement gap'.

4. Research Sites: The research will be a 3-year controlled study where the impact of the Professional Development Model (PDM) on teacher performance will be evaluated using measures of student achievement and attitudes. The schools in the study are from the Baltimore City Public School System (BCPSS). The BCPPS is particularly well placed as a project site as it is a system in dire need of improvement of student learning in order to bring their largely minority students at least up to par with state and national achievement levels.

Some of the project school partners are elementary and middle schools that have been implementing cutting edge instructional strategies as participants in the Science, Engineering, Mathematics and Aerospace Academy (SEMAA) curriculum sponsored by NASA. Co-PI Wilson has been working with the teachers for the past year. The SEMAA

curriculum exposes students to cutting edge science content and is aimed at increasing participation of underrepresented groups in STEM learning and careers.

By including schools in our research where we are already involved in efforts to implement cutting edge science content, our project addresses **Grand Challenge 3: Cutting-Edge STEM Content in K-12 Classrooms**. Our research seeks to understand the teacher competencies and strategies that contribute to the academic success of students from underrepresented groups. The Physical Science emphasis of the SEMAA curriculum will be complemented with the Life Science learning opportunities provided by the Morgan State University Estuarine Research Center (MERC). MERC also sponsors and participates in educational programs designed to enable K-12 students to learn more about the ecology of the estuary and coastal ocean. Thus our project has strong collaborations with established centers in science, engineering, and STEM education as recommended in the announcement.

5. The Variables: The research questions: 1. Can a structured intervention aimed at fostering positive student academic attitudes be integrated with a quality inquiry science program to increase both student academic outcomes and positive achievement-oriented attitudes. 2. What is the impact of teachers with positive perceptions and expectations on the academic performance and perceptions of all students but particularly minority students?

The basic research task is to explore the impact of two independent variables on two dependent variables.

The Independent variables: 1. A structured intervention aimed at fostering positive student academic attitudes and integrated with a quality inquiry science component. 2. Teachers with positive perceptions and expectations on the academic performance and perceptions.

The Dependent variables: 1. Student academic outcomes. 2. Achievement-oriented student attitudes.

5.1. Independent Variable 1: A Professional Development Model

The research project will study the impact of a Professional Development Model (PDM). The PDM will have two major components that will be implemented concurrently and in an integrated fashion.

5.1.1 Content Component of Independent Variable 1 (PDM)

The content component of the PDM will be based on the NRC's 'How People Learn' Framework and will be aimed at the development of teacher expertise in delivering inquiry-based science teaching that will achieve higher order student learning as well as improved achievement on standardized tests. Hammerman's (2006) Traditional Versus Inquiry-based Classroom Behaviors instrument will be used to model inquiry-based teaching to participants and also to measure fidelity of implementation during classroom observations. Generating inquiry teaching scores for classes and teachers will enable us to determine correlations between inquiries based teaching and student achievement and other relevant outcomes. The actual science content is described elsewhere.

The content component is also rooted in the consensus that teaching STEM as inquiry involves introducing the discipline as authentically practiced by professionals and this has the potential not only to foster robust student understanding but also to enhance the possibility that students might consider STEM careers. There is also increasing recognition that inquiry teaching has to be adapted to retain its essential features and at the same time be adequate to the demands of high stakes testing in an age of accountability measured largely as standardized test outcomes.

By developing and evaluating this aspect of inquiry teaching the proposed project will address a crucial aspect of STEM teaching and learning particularly as it pertains to groups underrepresented in STEM careers. Additionally there is a strong suggestion in the literature that when teachers use hands on and inquiry based approaches advocated in the standards-based reform movement, all students benefit but minority students benefit the most (see for example Schoenfeld, 2002; also Boaler (2002, 2006). The irony is that the inquiry-based approaches are less likely to be used in schools with large minority populations (Achinstein, Ogawa, & Speigman, 2004). Our perspective is that minority students are the most likely not to have had the out of school exposure to enriching learning experiences to compensate for the lack of appropriate materials and instructional strategies in school. This may explain why minority students benefit more from inquiry teaching approaches and may perhaps be more adversely affected by the absence of these teaching approaches.

5.1.2 The Pedagogy Component of Independent Variable 1 (PDM)

The research focus of the pedagogy component is to identify and validate characteristics of highly qualified teachers. The research design is for the PDM intervention to equip teachers with the insights from social psychology that will enable the teachers to deal effectively with the affective and identity issues that two decades of research have shown to have an impact on the academic performance of minority students. The design of the research project is such that student outcomes for a randomized sample of teachers who have experienced and implemented both intervention components (content and pedagogy) will be compared to student outcomes in classes where teachers have experienced only one or none of the intervention components. This will help identify the content and pedagogical skills teachers should have to help all students but particularly minority students achieve at higher levels.

The pedagogy component has an intervention aimed at students and one aimed at teachers. According to Loucks-Horsley, Love, Stiles, Mundry, Hewson, (2003) it is advisable to incorporate student interventions in Professional Development Models (PDM) aimed at schools with student populations underrepresented in STEM fields. According to these authors the PDM should also include activities that address equity, make teachers aware of existing problems, and help them learn new teaching strategies to reach and better motivate all students.

5.1.2.1 Student-Focused Intervention: Enhancing Student Motivation

We have already made reference to the insight from social psychology that the cultivation of 'possible selves' (images of the self one would like to attain) is critical for motivating action (Strauman and Higgins, 1987). Studies have also found that adolescents with school-focused possible selves are at reduced risk of involvement in

delinquent activities, do better at school, and feel more connected to school (Oyserman, 1993; Oyserman and Harrison, 1998). Our intervention is aimed at developing school experiences and perceptions of African American students that are geared toward fostering the development of exactly the types of racial self-concepts or 'possible selves' that Oyserman *et al* have identified as associated with high academic performance and engagement.

Oyserman et al (2002) also explored ways of translating the correlation between racial self-concept and academic engagement into an intervention program to help African American middle school students cultivate for themselves possible selves that are compatible with attitudes of academic engagement and persistence. An essential part of this cultivation is for these students to start seeing school success and their identity as congruent (Ford, 1992). Cognitive science, basic social psychological theory, and research on the nature of information processing and motivation all contribute to a model of how adolescents can be helped to develop positive possible selves (Bandura, 1986; Dweck and Leggett, 1988; Baumeister et al., 1994; Heatherton and Nichols, 1994; Mischel, 1996). The model suggested rests on the assumption that structured activities set in everyday contexts can exercise a big influence on what people regard as possible for themselves.

The intervention by Oyserman et al (2002) therefore consisted of a sequence of structured after school activities and tasks that were intended to help these youth 'articulate achievement-oriented possible selves in a positive peer-based social context that implicitly framed academic achievement as part of African American racial identity' (p. 314). This intervention was called the School to Jobs program and it had great success in enhancing student motivation and achievement. Middle school youth who participated in the intervention reported significantly higher academic performance, more bonding to school, concern about doing well in school, better school attendance, and for boys, less trouble at school. By all measures the intervention was very successful in the pilot phase and holds the kind of promise which merit further exploration as envisaged in this proposal. The instruments developed by Oyserman et al (2002) to measure attitude outcomes will be adapted for use in the proposed project.

In the proposed project we depart from the Oyserman model in that our project teacher partners will integrate the intervention activities into their daily teaching routine. In talking to our teacher partners there was consensus among them that incorporating the activities into their classroom time would not impose a time burden as the cultivation of classroom culture and motivating students is already a part of the classroom routine with teachers who are serious about helping their students succeed. This consensus is consistent with the findings of Ladson-Billings (1994) who found that successful teachers of African American students made time to address issues of motivation and identity with students. Our professional development activities are aimed at developing teacher skills in integrating the teaching of inquiry based science with the creation of a classroom culture that incorporates the elements of the intervention. The impact of these interventions on teacher practice and student outcomes will be our research focus.

The original intervention by Oyserman et al (2002) consisted of daily 30-minute after-school sessions spread over a 9-week period. Our adaptation is to incorporate the intervention activities into the classroom activities over the academic year. Our modified strategy adds a substantial element of originality and extension to existing work in two

ways: 1. It provides an opportunity to explore the feasibility of institutionalizing an intervention that has proven effective in after school settings. 2. It provides an opportunity to explore the integration of this intervention with inquiry based science teaching. Additionally, our intervention model is cost-effective as the original after school program would require ongoing external funding in order to continue.

The following are the components of the student-focused intervention aimed at enhancing student motivation:

- (1) Creating a positive sense of membership in the classroom learning community
Teachers and students develop classroom rules that build on the idea that students have positive attributes related to school achievement.
- (2) Creating concrete experience of imagining positive adulthood. Portraying of positive images of racial-ethnic minority adults of various ages.
- (3) Making real the connection between present and future and fostering recognition of failures and setbacks as part of progress to the future.
- (4) Working together to reinforce and cultivate the important component of racial identity that all should care about succeeding in school and can be resources for each other.
- (5) Solving everyday problems.
- (6) Reinforcing students' ability to make school-related plans for the future and the need to reach out to adults to accomplish this.
- (7) Focus on parents or other important adults and how they can help youth on their pathways to adulthood. Building student-parent alliances by developing intergenerational communication skills.
- (8) Identifying gaps in knowledge about how schooling links to STEM careers and providing youth with skills to obtain this information. (Adapted from the Oyserman (2006) Manual: Pathways for Youth: School to Jobs, An After-School Program).

5.1.2.2 Teacher-Focused Intervention: Addressing Teacher Expectations

The research project includes the development and testing of a focused professional development program for K-12 teachers aimed at assisting teachers to develop perceptions and expectations that are both realistic and positive *vis a vis* minority students. Changing teacher perceptions may be a one way of making student achievement less dependent on family income and levels of education. Once teachers acquire the insights, perceptions, and pedagogical content knowledge from the Professional Development Summer Institutes and academic year activities, project staff will investigate the impact of the teachers on the academic performance and participation patterns of especially minority students.

5.1.2.2.1 Rationale for Addressing Teacher Expectations

Rationale 1: Teacher perceptions may exacerbate the negative perceptions that certain minority students harbor regarding schools and formal learning environments.

Our analysis of student responses to the National Longitudinal Study of Youth (NLSY : 79,97) and our own web-based survey instrument (PEASS Survey 2002) shows that black and white students differ significantly in their perceptions of how teachers relate to them. By way of example, the statement 'My science teacher encourages me to do well in science' had a black-white difference with an effect size of

.85 ($p < .05$). White students agree significantly more with this statement than do black students. (Norman and Crunk, 2004).

Rationale 2: Analyses of the achievement gap trends suggest a role for teacher and student perceptions in the way the gap has changed over time.

Hedges and Nowell (1989 p. 167) explored the reasons for the narrowing of the achievement gap in the period 1965 to 1988. Their extensive review and analysis of every major national survey of high school students, attribute the largest decrease in the gap which occurred in 1965 to 1972 to an increase in the perception among blacks that education was indeed the pathway to a successful life. Grissmer, Flanagan, and Williamson (1989) speculate that an inflow of teachers with a generally 'more positive attitude toward minorities' (p. 218) coupled with the hopeful optimism among blacks (p.222) may have been the main factors accounting for the narrowing of the gap in the 70s and 80s. A review of the literature suggests that the recent troubling increase in the gap in the 90s was also accompanied by a significant decline in black optimism regarding expectations for fairness (Mickelson, 1990; Fordham and Ogbu, 1986). Studies on teacher perceptions in this period also point to problems with teacher perceptions and expectations (Norman et al. 2001; Casteel, 1997)

Rationale 3: The literature suggests that expectations and perceptions may be amenable to modification through professional development.

In an extensive review of the literature on teacher expectation and perception Ferguson (1998) advises: 'Simply cajoling teachers to raise their expectations for black children -using phrases such as' All children can learn ' -is probably a waste of time. However, good professional development programs can make a difference'. (p. 312).

Aronson and Fried (1998) and Aronson (1998) have shown through a series of elegant experimental studies that student susceptibility to 'stereotype threat' (see above) can be significantly reduced by training. The training involved teaching students to view intelligence and ability not as fixed or static but rather as malleable and dynamic. Students who underwent the training not only out-performed their peers but also developed a more positive attitude toward their learning environment. The training drew on the work of Dweck (2000) who states that people implicitly conceive of intelligence and ability as either static (entity theorists) or as malleable (incremental theorists). Dweck and her colleagues (Levy, 1998; Levy & Dweck, 1998; Levy et al., 1998; Levy, Freitas, & Dweck, 1998) performed many studies with diverse groups of college age and K-12 students. These studies all demonstrated that persons who hold entity theories also exhibit greater propensity to stereotype others. In the proposed project we will develop a part of our professional development program in consultation with Dr. Dweck and extend her work to teachers. Teachers will be shown the benefits of an incremental approach to intelligence and ability. Teachers will also shown how to help their students adopt an incremental approach to their own abilities and intelligence. David Perkins' 1995 book '*Outsmarting IQ: The Emerging Science of Learnable Intelligence*' also addresses the issue of incremental and malleable intelligence and will be part of the summer institute materials..

6. The Theoretical Framework

This project is based on Wenger's notion of learning as social participation. (Wenger 1998). 'We are social beings. Far from being trivially true, this fact is a central aspect of learning'. (p. 4). According to this social theory of learning, learning is not only engaging in practice and negotiating meaning but also involves membership in a community of practice and identity forming. Social interactions in learning contexts are therefore crucial in determining learning outcomes. Wenger's theory of learning as social participation informs both our approach to the kind of learning envisaged for teachers in the professional development intervention as well as the changes in the learning outcomes we anticipate for the target students.

The project professional development activities are aimed at assisting teachers to examine critically how they form perceptions about students and to reflect on the impact of those perceptions on students. In so doing teachers -and ultimately also their students - will be engaging in the following aspects of meaning negotiation as defined by Wenger (p.59):

- a. Producing meaning that is both dynamic and historical.
- b. Exploring both their resistance and malleability
- c. Exploring both their power to affect and their potential to be affected.
- d. Engaging multiple factors and perspectives.

The resilience of communities of practice includes their ability to resist change by rendering change ineffective through a process of cooptation and dilution. While this tendency to inertia cannot be underestimated, we should not abandon our quest for ways to bring meaningful changes to improve teaching and learning in our classrooms. Effective initiatives for change must however target teaching as a cultural system. Based on their extensive analysis of the TIMSS study, Stigler and Hiebert (1999) point out the difficulty of changing cultural systems as well as the futility of reform initiatives that fail to recognize teaching as a cultural system: 'The fact that teaching is cultural further complicates and impedes effort to change it. The widely shared cultural beliefs and expectations that underlie teaching are so fully integrated into teachers' worldviews that they fail to see them as mutable. The more widely shared a belief, the less likely it is to be questioned -or even noticed' . ' (p. 100). These authors further state: ' If we take seriously the notion that teaching is a cultural activity, we would begin the improvement process by becoming more aware of the cultural scripts teachers are using' (p.100)

The research project proposed in these pages is consonant with the reform approach advocated by Stigler and Hiebert (1999). Teacher participants will in effect be invited to participate in a collaborative project to scrutinize and ultimately transform the 'cultural script' that informs their practice which in turn significantly impact the participation (and performance) of all students. The notion that teachers' expectations and perceptions can improve student performance and motivation has deep theoretical and empirical anchors in a variety of disciplines (see for example Berger, Fisek, Ridgeway, and Norman (98); West (2002); Cohen and Lotan, 1995).

7. Work Plan and Data Collection: Elementary and Middle school teachers from the Baltimore Public School System (BCPSS) will participate in this study (Letters of support from school personnel are included in the appendix). The 30 teacher participants will be selected in the first year from the schools that have indicated support as well as others. Among the volunteers, a stratified random sample will be taken to identify a

group of teachers who will actually participate in the professional development summer institute. Our use of stratified random sampling is to ensure that we are not limited to a self selected group of teachers.

The stratification will occur over individual schools in order to ensure a representative population of teachers and students are included in all facets of the study. This will ensure that we get a variety of schools accounting for different demographic profiles. We will obtain demographic profiles of each school participating so that we may take into consideration differences when evaluating the changes under study. The actual number of teachers from each school will be proportional to the size of the student body in the individual school. The 30 teachers selected will be placed into 3 groups of 10. Group 1 will participate in both the content and pedagogic components of the PDM. Group 2 will participate in only the content component of the PDM. Group 3 will participate in only the pedagogic component of the PDM.

The schedule for the Summer institute for the Year 1 will be as follow:

Week 1: Group 1 and 2 participate in content component institute.

Week 2: Group 1 and 3 participate in pedagogic component institute.

This schedule ensures that the various groups receive the same relevant intervention treatments. It is important to note that for Year 2 and 3 the time for the summer institute will be reduced by 50% for all three Groups. All three groups will still participate in the one day refresher meeting during the academic year for each of the three project Years.

Teachers who volunteer and are not chosen to participate in the training, as well as non-volunteer teachers, will serve as unique control groups and baselines for the study. All three groups will have their students surveyed as to classroom attitudes as well as tested for science learning in the classroom. These later two groups will provide us with a comparison group of similar teachers (teachers who were willing and interested in participating) in order to verify the effect of the intervention on the outcome, as well as an additional comparison group of those who did not volunteer to participate. In this way we will investigate how initial differences in teachers affect the relevant outcomes.

After classroom teachers are identified and selected, and before any interventions occur, all involved classrooms (teachers and students) will be surveyed with our instruments currently under development and validation. This will establish a baseline for all groups involved in the study. Baseline data will, among other measures, also determine initial determination of whether participants have entity or incremental approaches to intelligence or ability. During the first summer of the study, the selected teachers will undergo their initial summer institute. Twice every year, the students and teachers will be surveyed as to their attitudes and expectations in the science classroom, once during the first week of school at the beginning of the academic year (or at the beginning of the summer institute, for those teachers who are attending), as well as at the conclusion of the school year. Over the three years of the project data will be collected from the classrooms of the 30 participating teachers as well as from at least 10 non-participating teachers who will act as an overall control group. Participating teachers will undergo training during a summer institute as well as a one-day refresher institute during the school year. These refresher institutes will allow the teachers to renew knowledge and share their experiences with regard to students' classroom membership. These

refresher meetings will be conducted on Saturdays or on school professional development days in order to avoid the cost of substitute teachers.

8. Data Analysis Plan: The analysis will include three-factor ANOVA, testing the change in attitudes among students whose teachers have undergone the training as compared to students whose teachers volunteered to undergo training but were not selected as well as teachers who did not volunteer for training. The ANOVA will have teacher effects nested within training effects, where teachers are random effects as they are selected from the district-wide population of teachers. The third factor, after teacher and training regime, is the ethnic identity of the student. Given the nested nature of the data, hierarchical linear models (HLM) will be used throughout in the analysis of the data. Such analysis will be expanded upon with HLM ANCOVA and regression models using changes in attitude (as measured by the difference between end of year attitude survey results and beginning of year attitude survey results) as the dependent variable and a variety of other factors including student attitudes, teacher attitudes, ethnic identity of students and teachers, gender and other ethnographic and socioeconomic data as independent variables, in order to determine the amount of improvement that can be attributed to teachers participating in the intervention.

To the extent possible, attention will also be given to the difference in attitudes between minority students and non-minority students, and how the treatment, or the willingness to have participated in the treatment, affects the gap between minority and non-minority students. This analysis will occur at the end of each academic year. The survey instruments will also be analyzed for validity and reliability as to measured attitudes, and improvements in the instruments will be made as necessary throughout the term of the project.

Students will also be tested for science learning in order to determine if improved attitudes are reflected in improved learning in the classroom. This will first be analyzed by an ANOVA similar to that described above, except upon science learning rather than attitudes, to detect differences in science learning between students whose teachers were included in each of the three treatment groups. Such analysis will be expanded upon with HLM ANCOVA and regression models using changes in science ability (as measured by the difference between end of year science ability scores and beginning of year science ability scores) as the dependent variable and a variety of other factors including student attitudes, teacher attitudes, ethnic identity of students and teachers, gender and other ethnographic and socioeconomic data as independent variables.

In addition to the analysis described above, observational studies will also be conducted by trained individuals who will observe the classrooms of participating teachers in order to monitor interactions between students as well as between the teacher and students. A randomly chosen sub-sample of teachers from each of the three groups (institute participants, those willing to be institute participants but not selected, as well as those who were unwilling to participate in the summer institutes) will be selected for observation so that comparisons may be completed. Furthermore, student focus groups will be held near the end of each year as an additional means of determining intervention impact.

Baseline data will be collected on the students at the beginning of the project.

To test the hypothesized impact of the intervention on student positive academic self-identity development and important school outcomes, we will compare youth who are in intervention classrooms with those who are not. This comparison will be on post-test measures administered in the final weeks of the school year. Gender, cohort and pre-test scores on the Fall administered measures will be used as covariates in posttest ANCOVA in order to enhance the power and increase the precision of the comparisons. The covariate-adjusted means will be subjected to one-tailed contrasts examination in order to determine the directional intervention effects attributable to the intervention.

In addition to academic performance, student motivation and development of positive academic identities will be measured by indicators to be determined by observations, school records, interviews and responses to short surveys. Some, but not all, of these indicators are: a. A reported sense of a more balanced possible self. b. Adoption of more plausible strategies to attain these possible selves. c. Decreased frequency of getting into trouble at school. d. Sense of bonding to school. e. More concern about doing well in school.

9. Evaluation and Dissemination Plan:

9.1 Evaluation will cover soundness of research design and validity of results as well as the efficacy of the professional development program to bring about the desired changes in teachers and students. All the data that will be collected for the research will also be used for project evaluation. Additionally data will be collected on Participant reactions, learning, as well as their use of the knowledge and insights acquired. Survey instruments, learning logs, case study analysis, interviews, rigorous self-analysis, and focus groups will be used for this purpose. Although it is a secondary focus, evaluation data will also be collected on organization change and support for the implementation. Interviews with administrators and school records will be used for this purpose. Student learning and change in attitude will be regarded as the ultimate goal of the project, especially with regards to minority students and their academic performance relative to other students. Indicators such as drop out rates and homework completion rates, among others, will be constantly monitored. All evaluation data will be carefully analyzed in an ongoing fashion in order to detect trends and take corrective action as needed to ensure project success.

Project evaluator Dr. Stephen Plank is a faculty member at Johns Hopkins University and Research Associate at the Center for Social Organization of Schools. Plank will draw upon his prior experience evaluating various aspects of curriculum, instruction, and professional development in conjunction with the Talent Development Middle School model, and related studies (Plank 2007; Plank & Young forthcoming; MacIver et al. 2000; MacIver, Balfanz, & Plank 1998). Additionally, in his capacity as Co-Director of the newly formed Baltimore Education Research Consortium (a collaboration of several local universities, the Baltimore City Public School System (BCPSS), and several non-profit agencies), Plank is actively engaged in analyses of BCPSS student data. The PLEASSE evaluation team will draw upon their understanding of the organizational and demographic contexts of Baltimore public schools, which will allow us to maximize the representativeness of the sampled schools and teachers, and to interpret the statistical results appropriately.

For statistical analysis and evaluation the PLEASSE team has access to the robust combined cyber infrastructure resources at Johns Hopkins and Morgan State Universities.

Available statistical packages include but are not limited to SPSS, SAS, and Stata. Furthermore Dr. Planck has the newest versions of HLM and LISREL software and regularly uses these in his work. The anticipated development of secure, password-protected accounts for data sharing between Morgan State University and Johns Hopkins University can only benefit both institutions beyond the life and scope of the proposed project. .

9.2 Dissemination of project results will be done through conference presentations at scholarly conventions as well as teacher conventions. AERA, NARST, NSTA, are only some of the research and practitioner conference outlets that will be used. The Project will also develop a website housed on the Morgan State University server. Project results will also be disseminate through the various Digital Libraries outlets. This will bring the project to the attention of a national teacher and researcher audience. National organizations of school administrators, school boards, elementary or secondary principals, the NSCD, and others will also be provided with project results from time to time. The ultimate aim will be to get emerging insights on this problem into the hands of practitioners as soon as possible.

10. Prior NSF Support: The project PI Obed Norman served as PI on NSF Research Grant REC 0222310. Award Amount \$500,000 over 5 years. This award resulted in a publication in the Journal of Research in Science Teaching (JRST), 6 Presentations at AERA, 6 presentations at NARST, 1 presentation at NSTA, and one invited public presentation before Oregon State legislators, academics, teachers, and the general public. The JRST publication is listed on a reading list on the web page of the Rutgers University and is used in teacher education courses (see footnote on page 1 and 2 of this proposal). The grant was concluded on August 30,2006. The goal of REC 0222310 was to investigate the underlying reasons for the 'achievement gap' and propose possible solutions to the problem. The project proposed in this application aims to conduct an empirical investigation of the effectiveness of the proposed solutions indicated in the prior research. PI Norman was also the co-PI on project PESE, the Local Systematic Initiative which provided Teacher Professional Development for over 300 teachers in South Western Washington State. As co-PI on PESE Norman conducted many professional development institutes for teachers. Project PESE was concluded in August 2005.

11. ACTIVITIES TIMELINES AND INTERVENTION CONTENT

Year	Period of Year	Personnel	Activity
Year 1	End of previous school year	Senior Personnel (Refers throughout to Norman, Prime, and Wilson)	Survey teachers for willingness to participate. Create stratified Random sample of approximately 30 teachers to participate. Preparation and validation of Instruments. Baseline student data: motivation and test scores.
	Summer (before school year)	Senior Personnel (SP)	Two-week summer institute for 3 Groups of teachers as described in text. Training of Observers to observe teaching and learning in classrooms.
	Beginning of	SP, Observers,	Classroom observations; Data

	school year	and Evaluator	collection. Start of Data Analysis
	Middle of school year	SP, Observers, and Evaluator	Mid year 1 day refresher institute. Observations
	Middle of school year	SP, Observers, Evaluator	Classroom observations; Data collection. Data Analysis
	End of school year	SP, Observers, Evaluator	Classroom observations; Data collection. Data Analysis
	End of school year	SP, Observers, Evaluator	Focus groups on classroom membership comprised of random student sample. . Full analysis of all collected data. Adaptations dictated by 1 st year discussed and incorporated. NSF Report. Scholarly report on Year I results.

Year 2 and 3 will be very similar except that that the institutes will be one for each group of 10 teachers will be 50% of the time taken in Year 1. Note that analysis and evaluation of data continues throughout the course of the study. Teachers implementing the in-class student motivation intervention will be guided to implement the intervention in a uniform and structured manner.

Brief Overview of Professional Development Intervention: This brief overview supplements the descriptions given in the narrative about the intervention components.

1. Elements of Inquiry Teaching (Text: Hammerman, E. (2006). *Eight essentials of inquiry-based science*. Thousand Oaks, CA: Corwin Press) (CONTENT)
2. SEMAA (Science, Engineering, Mathematics and Aerospace Academy) Curriculum. (CONTENT).
3. Student Motivation in Schools to Job Intervention (PEDAGOGIC)
4. Teacher Perceptions: Stereotype threat; Dynamic and Static Theories regarding Intelligence. (PEDAGOGIC) (Dweck, Perkins and others.)