Creating a supportive environment to enhance computer based learning for underrepresented minorities in college algebra classrooms

Kimberly D. Kendricks[1]

Abstract: Significant research in K-12 education has shown that computer based learning in mathematics positively impacts students' attitudes toward mathematics and greatly increases academic performance. Little research has shown, however, how this success can be replicated in a postsecondary classroom for minority students. This paper is a case study that examines the development and implementation of a complementary learning environment for a computer based College Algebra class. Preliminary results show a 15% increase in student success (earning grade C or higher) compared to national gains of 10% for computer based mathematics classrooms. Furthermore, an evaluation of student performance showed a better understanding of fundamental mathematics concepts and continued success in subsequent mathematics courses, demonstrating the need for further research in the enrichment of computer based learning environments for underrepresented minority students.

Keywords: mathematics software, multicultural education, computer based learning, support services

For many teachers, technology—calculators, computers, software—has continued to serve as a useful tool in mathematics classrooms. In particular, computer based learning has had a significant impact on the academic performance of at-risk and minority students (Schofield, 1994; Nguyen et al. 1995). Consistent with this best practice, in 2007 the Department of Mathematics and Computer Science at Central State University (CSU) adopted a blended instruction (BI) pedagogy via the integration of Educosoft mathematics software into traditional lectures for College Algebra. The BI courses consisted of online lectures and homework, quizzes, exams, and academic support in the form of online tutors or departmental tutors. After two years of implementing the software, CSU's results of a 10-12% increase in student success (earning grade C or higher) were comparable to results in studies conducted at the University of Idaho and Rio Salado College that targeted minority students respectively in Algebra and Pre-Calculus (Twigg, 2004). Seeking even better results, CSU redesigned its BI course further to enhance student learning outcomes and overall student success.

CSU, a Historically Black College and University (HBCU), is an open access institution in Wilberforce, Ohio, that seeks to prepare diverse students for a professional career and/or graduate study in any field. At the time of this study, CSU had a population of approximately 2,500. Over 95% of the student body was African American and more than 59% lived below the poverty level (census.gov, 2008). Of the student population, 20% majored in a STEM (Science, Technology, Engineering, and Mathematics) field where they often struggled in gateway "killer courses" like College Algebra, English, Biology, and Chemistry (Killer courses are defined as

[1] Department of Mathematics and Computer Science, Central State University, 1400 Brush Row Rd., P.O. Box 1004, Wilberforce, Ohio 45384

those courses that have a high failure, withdrawal, and/or incomplete rate.). For remedial courses in mathematics (College Algebra and below), the success rate prior to 2007 was below 50%. In 2007, the department received a Minority Science and Engineering Improvement Program (MSEIP) grant titled BISCA (Blended Instruction to Improve Student Success in College Algebra), to incorporate Educosoft in the classroom. Since 2007, the success rate for College Algebra has risen by 10-12%. This success resulted in the use of computer based learning in other remedial courses, as well as in courses like Trigonometry and Calculus. However, for the past few years, the success rate in College Algebra has remained around 60%, indicating that computer software alone is not sufficient to produce significant success for minority students. Thus, to strengthen the BI approach, CSU introduced new complementary teaching and learning practices into the College Algebra classroom to help students transition from the drill and practice of Educosoft to a better conceptual understanding of mathematical topics, and to an increase in students' overall academic performance.

I. Literature Survey.

The Census predicts that the United States (U.S.) will double its minority population by 2050. For the U.S. to remain a leading competitor in the world, a diversified STEM workforce is imperative. Consequently, the U.S. government placed a strong emphasis on increasing the number of minority STEM graduates and professionals. Through considerable funding and changes to educational policies, the K-16 system strengthened its recruitment, retention, and support of underrepresented minorities, particularly in STEM. In 2006, for example, the National Science Foundation (NSF) reported that 21.5% of undergraduate freshmen majored in a STEM field. Of these, 20.5% were Caucasian and 20.9% were African American. Yet, graduation statistics showed that only 8.3% of African Americans earned a STEM Bachelor's degree compared to 64.7% of Caucasians. So despite tremendous government efforts, there is still much important work to be done to reach national goals. To increase graduation rates of minorities in STEM, educators and scientists have invested time and money to study certain social systems and learning environments that will enhance the educational experience for underrepresented minorities (Allen, 1992; Davis, 1991; Fleming, 1984; Noddings, 1988; Hurtado et al., 1999). Ladson-Billings (1994) provided the clearest direction for educators, calling for the use of culturally relevant practices in the classroom. The purpose of culturally relevant practices is to construct an environment where the minority student can reach his/her highest potential. HBCU's are well known for providing nurturing and supportive campus environments for minority students. These environments increase students' academic confidence and performance, and build social skills (Davis, 1991; Kozma, 1992). Many HBCU's have successfully taken at-risk or underprepared students, and through their unique campus environments, brought students' skill levels to national and above national levels.

What HBCU's are able to create outside of the classroom, like the sense of belonging, is difficult to duplicate in a classroom of a specific discipline, of course, where students' abilities and skills determine whether they belong in the class, or belong to the group of students pursuing that major (Walton et al., 2007). Moreover, in a large social system of colleges, schools, and departments, it remains difficult to maintain a culture of relevant practices that ensures a sense of belonging inside the classroom (Johnson et al., 2007). The most profound techniques of doing so inside the classroom occur in K-12 classrooms. K-12 teachers interact with their students daily to form bonds that transcend on many levels, and despite societal influences or the school's campus

environment, K-12 teachers have continued to develop successful strategies to overcome social and academic challenges for minority students.

A. Components of a Supportive Learning Environment.

The successes in K-12 computer based mathematics classrooms indicate a need to understand the unique components of such a productive and supportive environment (Allison & Rehm, 2009). Howard's (2001) study, conducted at four urban elementary schools, demonstrated that African-American students prefer to learn in classrooms that have a *family environment*. Hill (1995) adds that both *caring and authoritative environments* are preferred by minority students. Results from Grantham and Ford's (2003) high school study showed that *positive feedback, frequent meetings with mentors and/or advisors, cooperative learning, professional development sessions, engaging activities, and high expectations* were the leading strategies for academic achievement among gifted African-American students. These components are discussed in greater detail below:

> a)   *Caring Teachers:* A caring teacher employs a sincere commitment and relatedness to student needs-- physical, mental, and social--displays affection, and exhibits parenting and nurturing (Vogt, 2002; Rogers, 1991; Goldstein, 2000, Collier, 2005). Noddings (1988) found that teachers, mentors, and advisors, particularly those who have an ethic of caring, have the most influence on student success.
>
> In Schofield's (1994) computer based geometry study of student attitudes and perceptions of classroom support, over 70% of high school students preferred the assistance of their teacher to computer based tutors. Despite daily use of the computers, the computer based tutors served only as a secondary resource for students in the classroom. The benefits of the online tutors were undeniably significant: 1) students who were afraid or ashamed to ask for help in front of their classmates sought answers through the online tutors without anyone else's knowledge, 2) given online privacy, students felt more comfortable acknowledging their deficiencies and working independently to become more proficient, and 3) online intervention allowed students to control how much help they received from their teachers. As a result of computer based learning, classroom behaviors toward mathematics were positive and more productive. The most striking finding from the study, however, was that even though students enjoyed learning mathematics online and learned more online than they did through traditional lectures, students still preferred to get help from their teacher rather than from the online tutor because the students preferred person to person contact, daily conversation (that did or did not include math), examples from the teacher relating concepts to their personal lives, and knowing that someone believed in them and was proud of their achievements, all of these making the teacher the primary resource in the classroom.
>
> b)   *Positive Feedback*: Hattie et al. (2007) stated that feedback had the largest impact on learning and attainment. In this study, feedback, whether positive or negative, and the way in which it was conveyed, the timing of delivery, as well as the environment in which it was delivered, affected human behavior differentially. A classroom that was

founded on positive feedback that included praise as well as a reward system enhanced student interest in academic achievement (Pfiffner et al., 1985).

For example, in a middle school study conducted by Nguyen et al. (2006), drill and practice on the computer, coupled with instant feedback and an online tutor, increased student interest in mathematics. In fact, all of the students perceived that they were better problem solvers because of the online system. Minority students felt more confident, perceived they could do more challenging problems, and had less anxiety about exams when taken on the computer. In particular, minority males felt that immediate feedback developed their problem solving skills and encouraged them to evaluate their own progress more frequently.

c) *Peer Mentors/Tutors:* McNamara (1995) found that tutors, student teachers, and mentors improved classroom practices, the curriculum, and the learning environment.

In Schofield's (1994) study, the friendly competition among students resulted in some students serving as "peer experts." Students began to tutor one another with the online system. This role allowed peer experts to demonstrate their knowledge by teaching their peers, multiplying the impact of everyone's learning. Peer experts also served as teaching assistants which allowed the teacher to spend more time creating bonds with other students, serving as a facilitator instead of a lecturer, and less time grading and preparing lessons.

d) *Cooperative Learning/ Interdisciplinary Group Projects:* Johnson, et al. (2000) defined cooperative learning as the process of working together to accomplish a shared goal. Student success, team building skills, and self-esteem increased with the use of cooperative learning in elementary and secondary classrooms (Slavin, 1980). Furthermore, Slavin (1999) found that students developed a respect for different perspectives and ideas that transcended gender, race, and ethnicity.

e) *Professional Development Sessions:* Academic support programs such as career services, tutoring, counseling and advising, as well as student organizations increased student achievement, retention and graduation rates. In particular, professional development sessions where students learned interviewing skills, resume writing, and tips to prepare for undergraduate and/or career placement enhanced student persistence toward professional goals (Dellana et al., 2004; McElroy 2000).

CSU's mathematics department adopted key strategies from the above studies to create an atmosphere in its computer based classroom that was more conducive for student learning. Piloted in one computer based College Algebra classroom in the fall of 2008, this unique environment led to improved student learning and overall success.

II. Methods.

This case study took place in one College Algebra class offered on Tuesdays and Thursdays in the fall semester of 2008. Students in the class were part of a learning community for STEM majors called Just Undergraduate Mentoring Program (JUMP), a retention program for freshmen biology and chemistry majors. In the learning community, students took all of their gateway

classes (Biology, English, Chemistry, and Algebra) together. There were 12 students (2 males and 10 females), all African-American, and all had an ACT score below 21.

A. College Algebra Course Design.

a) *Blended Instruction (BI):* The College Algebra course covered five chapters: functions, logarithms, conic sections, matrices, and sequences, and was taught with traditional and online lectures. Students were graded on weekly online homework assignments, handwritten quizzes and exams, interdisciplinary projects, notebook checks, and attendance. Engaging activities such as group work, math games, and daily challenges, as well as peer teaching and grading, were also included. Extra credit assignments and assessment review packets were hand written and given often.

b) *Mandatory Tutoring:* Mandatory tutoring helped students to appreciate that learning was not optional. A student who earned a "D" on any assessment (quiz or exam), for example, was required to meet with a tutor for two hours until the next assessment (Assessments were biweekly and only covered two or three sections at a time.). A student who earned an "F" on any assessment was required to meet with a tutor for four hours until the next assessment. Classroom tutors who were proficient in the online software were hired by the department to support lower level classes. Students were welcome to use other tutoring services offered on campus if preferred.

c) *Online Homework:* The online homework was the second largest determinant of students' final grades (Exams were the largest determinant). During the semester, there were 7 weekly online assignments, each consisting of 35-50 problems from two to three sections of a chapter. Eighty percent of the problems were free response, and 20% were multiple choice. The problem sets were grouped by concept so students completed 2-7 problems per concept. Each conceptual set of exercises was prefaced with a thorough explanation of the concept as well as how to solve that particular type of problem. Students could refer to this example or the online lectures for further assistance. Immediate feedback ("Correct" or "Incorrect") was given after students entered a solution into the system. Students could enter as many solutions as they liked for a problem until they earned a "correct" response. They could also monitor their progress with the assignment in a vertical table that highlighted how many of the problems the student got right (marked green), wrong (marked red), or were incomplete (marked white). In the first half of the semester, students could only take a homework assignment once, but during the second half of the semester, students could retake any assignment from the first half of the semester as often as they liked. This was done to remediate students on past concepts in preparation for the comprehensive final exam held at the end of the semester.

B. Integration of the Complementary Supportive Environment Components into the Course Design.

The above environmental components—caring teacher, class tutors, cooperative learning, positive feedback, and professional development—were incorporated into the College Algebra

class through a learning community. A Learning Community is a group of individuals who share similar goals and/or beliefs and participate in activities guided by those goals or beliefs. Learning communities have increased student academic performance, student belonging, college satisfaction, and retention and graduation rates for underrepresented minorities, first generation students, and college freshmen (Zhao et al., 2004; Stassen 2003).

a) *Caring Teacher*- The teacher was an assistant professor of mathematics with a Ph.D. in mathematics. The teacher also had a concentration in multicultural education at the undergraduate and graduate levels, particularly pedagogy focusing on the African-American student, and had experiences using the above practices in K-12 classrooms before teaching at the university level.

b) *Class Tutors/ Peer Tutors*- The classroom tutor served as an undergraduate teaching assistant (UTA) who designed classroom games, mini-projects, and exam review packets, and graded students' in-class assignments. The UTA was a biology major who had taken the College Algebra course using the online material and earned a B in the course.

c) *Cooperative Learning/ Interdisciplinary Projects*- Students completed online work individually, in pairs, or in groups. Some homework and project grades were interdependent. That is, these grades were the average score of the pair or group working on the assignment.

Three interdisciplinary group projects demonstrating the use of mathematics in biology were used. The first project focused on graphing and interpreting a graph (i.e., identifying where the graph increases and decreases, finding the maximum and minimum points, as well as x- and y- intercepts). Students could choose a variety of datasets ranging from the harvest and sale of carrots to the number of HIV/ AIDS infections or related deaths. For the second project, students plotted scatter plots of given datasets and found the line best fit using linear regression. Students plotted cricket noise compared to temperature, planetary motion and distances to the earth, and genealogical data collected from the Genetics class. In the last project, students conducted an in-depth study on white blood cells and the effect HIV/ AIDS has on them. The students solved logarithmic and exponential word problems projecting the white blood count and life expectancy of particular human subjects.

d) *Positive Feedback*- Positive feedback was used in every form--through comments written on quizzes and exams, and praises inside and outside of the classroom from the teacher, UTA, fellow students, and the online system.

e) *Professional Development Sessions*- As a requirement of the learning community, all JUMP students were required to attend professional development workshops offered through the natural sciences department or the Center for Student Opportunities, an academic support program. The Center for Student Opportunities provided scholarships, tutoring, mentoring, internship and career placement, and professional development workshops for all students. The professional development workshops focused on communication skills, resume writing/statement of purpose, business demeanor and

dress, dinner etiquette, having a positive attitude, making great first impressions, as well as career options in the STEM fields and research talks by STEM scientists and professionals.

III. Results.

At the end of the semester, 75% of the class passed College Algebra with a grade of "C" or higher. There were two results and one finding of this new environment which led to this difference: high homework completion rates using the online system, average and above average scores on written exams and quizzes, and the discovery of a correlation between the number of completed mandatory tutoring hours and the resulting success on subsequent assessments.

A. Online Homework.

Table 1 shows the number of online assignments and how many students completed each assignment.

Table 1. Online homework completion out of 7 assignments.

Homework Assignment #	1	2	3	4	5	6	7
N = 12 students (% of Completion)	9 (75%)	12 (100%)	6 (50%)	11 92%)	12 (100%)	7 (58%)	6 (50%)

The percentage of students in the class completing the online assignments decreased toward the end of the semester. There were no additional activities assigned to the class toward the end of the semester, so the reason for this decrease needs further investigation.

Table 2 shows the percentage of online problems that were correct for the seven homework assignments. The class scored an 80% or higher on four of the seven assignments. Very few (two to three) students in the class retook an assignment, so the percentage of correct problems on retakes (shown in grey) was not considered in this discussion.

B. Classroom Assessments.

To evaluate conceptual understanding, the class was given four written exams corresponding to homework assignments 2 *(exam 1)*, 4 *(exam 2)*, 5 *(exam 3)*, 6 and 7 *(exam 4)* and two quizzes corresponding to homework assignments 1 and 3. On the first exam, the average score was 80% ($\sigma= 8.04$), and on the fourth exam, the average score was 75% ($\sigma= 26.84$). The class scored below a 60% on the second and third exams which can be explained by the lower homework scores on these sections (see assignments 4 and 5). For the two quizzes, the class averaged a 77.5% ($\sigma=14.21$).

The handwritten homework assignments were not used to evaluate student performance, but were used as a tool to strengthen student understanding prior to each assessment. Two of the handwritten assignments were assigned problems from the textbook. The other handwritten assignments were review packets designed by the UTA and those results were not considered in this paper.

Kendricks, K. D.

Table 2. Average percent of correct responses for online homework assignments by content (values in parentheses denote the percentage of correct responses for retaken assignments).

Homework Assignment #	Content	% of Correct Responses
1	Graphical Representation of a Function, Distance, Slope, and Composite Functions	88% (92%)
2	Inverse Functions, Exponential Functions, and Logarithmic Functions	82% (95%)
3	Properties of Logarithms, exponential and logarithmic equations	63% (76.92%)
4	Variations, Circles, Parabolas, and Ellipses	52% (100%)
5	Systems of linear Equations and Systems of Non-linear Equations	68% (96.77%)
6	Gauss-Jordan Method and Matrix Algebra	89% (98%)
7	Multiplication of Matrices and Inverses of Matrices	93% (98%)

The class averaged a 70% (σ=13.07) on the comprehensive final exam. The final exam consisted of printed online questions that were both free response and multiple choice.

C. Mandatory Tutoring.

Over the course of the semester, 63% of the class completed the mandatory tutoring hours, resulting in a 67% increase in students' grades on subsequent assessments. Mandatory tutoring, then, had a significant effect on student performance.

Table 3. End of the semester comparison of completed mandatory tutoring hours and percent increase for six course assessments.

# of Students	# of Tutoring Assignments	# of Tutoring Hours Assigned	# of Tutoring Hours Completed	% of students who increased their scores on subsequent assessments
12	27	94	59	67%

By analyzing particular student cases, it can be shown that those students who were the most persistent with completing tutoring hours demonstrated continued success throughout the course.

IV. Discussion.

A. Benefits.

a)   *Small class size*: A second factor leading to the class' success was the class size. The small group size allowed for more student-teacher interaction and more peer-to-peer interaction with very few interruptions.

b)   *Learning Community:* The learning community was the key environmental factor contributing to student success, offering a sense of belonging by discipline that was missing from other courses. Studies have shown that students participating in a learning community have a greater chance of succeeding in college than those students who do not participate in a learning community (Mlynarczyk & Babbit, 2002; Reyes et al., 1999; Zhao & Kuh, 2004). Through their unique structure, learning communities increase student engagement and overall satisfaction with the institution. Tinto (2003) argues that there are three reasons resulting in this success: *shared knowledge* (accomplished through a common curricular experience), *shared knowing* (by meeting and working with fellow students within the community), and *shared responsibility* (accomplished through mutual dependence in group/community activities). Each of these was transparent in this case study: Without being asked, the students formed study groups to prepare for upcoming exams as well as to complete homework assignments. In fact, this was a strategy students used in all of their "killer" courses. So, when students were subsequently asked to complete online assignments in pairs or to work as a group on the interdisciplinary projects, the students were comfortable doing so. For class lectures, students asked to work with a classmate or to be placed in groups to do review exercises of the day's lesson or to complete an exam review packet. Furthermore, as noted by Williams et al. (2002), making the grades of some of the homework assignments and the group projects interdependent reinforced the spirit of working together and resulted in the students completing more of the online homework assignments. Even when assigned mandatory tutoring hours, students completed the hours in pairs or in groups, and the UTA even held exam review sessions for the class. This explains why a greater percentage of tutoring hours were completed during the course.

c)   *Professional Development Workshops:* As a requirement for participating in the JUMP program, students attended professional development workshops as well as JUMP advising meetings. The class attended at least 4 professional development workshops through the Center for Student Opportunities or the Department of Natural Sciences. Attending these workshops kept the students' career goals at the forefront of their studies and had a positive impact on student behavior in the classroom.

d)   *Cooperative Learning:* The interdisciplinary projects reinforced career development. Students enjoyed seeing how knowledge learned in class lectures had a useful purpose in everyday life. Students used calculators and Microsoft Excel to graph and interpret functions. Through follow up word problems, students drew conclusions about their graphs and made predictions. In fact, the students liked using the solutions they found to make recommendations about problems experienced by everyday

businesses and workers. For example, through internet research, one group hypothesized that low carrot sales were due to the freezing climate which lasted longer than previous harvest seasons. Another group hypothesized that AIDS infections decreased for young adults in some locals due to abstinence initiatives and the distribution of condoms at workshops, high schools, and colleges. The most interesting response was to the third project which studied white blood cells and the impact HIV/ AIDS had on them. The majority of students were biology majors interested in pursuing a career in nursing or medicine. A majority of students knew of someone who was affected by HIV/AIDS, so students took a particular interest in the project. Students learned about different types of white blood cells, were able to classify a white blood cell count as normal or abnormal, and apply this knowledge to solve exponential and logarithmic equations. These projects, particularly the last project, increased student interest in biology and illustrated a greater appreciation of mathematics and its uses in the real world.

B. Challenges.

a)   *Class Schedule:* On the end-of-semester course evaluations, students indicated that they would have liked to have met for less time three days a week rather than for more time two days a week. They believed they would have been just as successful meeting more frequently for a shorter period of time. In the future, a follow up study can be done to compare two College Algebra classes using the BI model that meet on different days for different periods of time and have roughly the same number of students in each class. A questionnaire can also be developed to evaluate student perceptions about the structure of the course and the use of technology.

b)   *Appropriate Use of Online Lectures/Homework:*   Some sections and chapters were taught more effectively with the online material whereas other sections were better explained using traditional chalkboard methods. The same is true of the online homework some questions were more effective in soliciting conceptual understanding than others. Determining the appropriateness of online assignments over traditional book work was a learning curve during this study, and could be mastered with continued teaching of the course.

c)   *Software Literacy:* The Educosoft software required students to learn a new language. Even when calculations were correct, students were required to enter solutions a certain way into the system. For example, if students were asked to solve the equation $x^2 - 40 = 0$ for x, students would arrive at the solution $x = \pm \sqrt{40}$, but Educosoft would only accept $x = \pm 2\sqrt{10}$ as the correct solution. Reducing the solution in this manner provided continued practice with perfect squares and primes. The students, however, became frustrated when asked to accommodate to the electronic system in this way.

d)   *Implementation of New Environment:* The implementation of the complementary learning environment was challenging. There were several activities happening at once which at times were difficult for the professor to manage. Having a teaching assistant qualified to carry out some of the class' formal responsibilities would have been beneficial. Because the UTA was a student, the assigned responsibilities for the UTA

were limited. Of all the activities, mandatory tutoring was the most difficult to implement. Initially, students resisted this component of the course due to a socially, negative stigma associated with tutoring. After having students who did complete tutoring hours share positive exam results with the rest of the class, other students began to favor the idea. By semester's end, most students supported the tutoring component of the course.

Overall, the implementation of the complementary learning strategies made the College Algebra learning environment dynamic and engaging. Kozma (1992) asserts that it is in these kinds of environments where computers are best used. The BI model allowed for traditional and online lectures to be used more appropriately given the topics being taught. Even though the class called for both the student and teacher to assume new roles in the classroom (O'Callaghan, 1998), the role of the in-class tutors should not be overlooked, the UTA was for some students their first contact and helped to retain them in the course (Tait, 2004). All of these components, taken together, yielded a greater conceptual understanding by students and led to an increase in student success. Over 75% of students in the class were retained in their discipline, and, according to their academic transcripts, over 80% earned a "C" or higher in subsequent mathematics courses. The success of this study has led to continued use of these practices in other mathematics courses in the department and has been disseminated across the campus and nationally at professional conferences.

V. Conclusion.

This study illustrated that for minority students in a computer based mathematics classroom, creating a complementary supportive environment increased student success by 15%, compared to national gains of 10% for computer based classrooms having no formal supportive learning environment. This study reinforces conclusions that using computer based classrooms for traditional drill and practice is not sufficient for continued academic improvement, particularly for underrepresented minorities. Additionally, support created through a dynamic learning environment (such as a learning community, a caring teacher, cooperative learning, tutors, and professional development) in a course designed with activities (computer based learning and mandatory tutoring) that will allow the learning environment to thrive is necessary to increase student understanding and student performance. Through this study, students demonstrated a broader understanding of mathematics concepts and were successful in subsequent mathematics courses. Although the results are promising, continued research is needed to learn more about complementary learning environments in computer based classrooms for minority students. This case study proposes a model for universities and colleges interested in increasing the academic performance of minority students through computer based learning within a carefully constructed supportive learning environment.

Kendricks, K. D.

References

Allen, W. R. (1992). The color of success: African-American college students outcomes at predominantly white and historically black public colleges and universities. *Harvard Educational Review, 62,* 26-44.

Ball, A. F. (2000). Empowering pedagogies that enhance the learning of multicultural students. *Teachers College Record, 102*(6), 1006-1034.

Booker, K. C. (2006). School belonging and the African-American adolescent: What do we know and where should we go? *The High School Journal*, *89*(4), 1-7.

Collier, M.D. (2005). An ethic of caring: The fuel for efficacy. *The Urban Review, 37*(4), 351-359.

Davis, J. (1991). College in black and white: Campus environment and academic achievement of African American males. *The Journal of Negro Education, 63*(4), 620-633.

Dellana, S.A., & Snyder, D. (2004). Student future outlook and counseling quality in a rural minority high school. *The High School Journal, 88*(1), 27-41.

Fleming, J. (1984). *Blacks in college: A comparative study of student success in black and white institutions.* San Francisco: Jossey-Bass.

Goldstein, L.S, & Lake, V.E. (2000). Love, love, and more love for children: Exploring preservice teacher's understandings of caring. *Teaching and Teacher Education, 16*(8), 861-872.

Grantham, T.C., & Ford, D.Y. (2003). Beyond self-concept and self-esteem: Racial identity and gifted African-American students. *The High School Journal, 87*(1), 18-29.

Hanley, M.S. (1999). *A culturally relevant lesson for African-American students.* New Horizons for Learning. www.newhorizons.org.

Hativa, N. (1988). Computer based drill and practice in arithmetic: Widening the gap between high- and low- achieving students. *American Educational Research Journal, 25*(3), 366-397.

Hattie, J. & Timperley, H. (2007). The power of feedback. *Review of Educational Research, 77*(1), 81-112.

Hill, H.E. (1995). The relationship between family environment and parenting style: A preliminary study of African American families. *Journal of Black Psychology, 21*(4), 408-423.

Howard, T.C. (2001). Telling their side of the story: African-American students' perceptions of culturally relevant teaching. *The Urban Review Journal, 33*(2), 131-149.

Hurtado, S., Milem, J., Clayton-Pedersen, A., & Allen, W. (1999) Enacting diverse learning environments: Improving the climate for racial/ethnic diversity in higher education. *ASHE-ERIC Higher Education Report, 26*(8).

Johnson, D. W., Johnson, R. T., & Stanne, M.B. (2000). *Cooperative learning methods: A meta analysis.* University of Minnesota, MN.

Johnson, D. R., Soldner, M. L., Brown, J., Alvarez, P., Inkelas, K. K., Rowan-Kenyon, H. T., & Longerbeam, S. D. (2007). Examining sense of belonging among first-year undergraduates from different racial/ethnic groups. *Journal of College Student Development, 48*(5), 525-542.

Kendricks, K., & Arment, A. (2010). Reconstructing the family model: Improving student success in STEM. *Higher Learning Commission's Annual Conference.*

Kozma, R.B., & Croninger, R.G. (1992). Technology and the fate of at-risk students. *Education and Urban Society, 24*(4), 440-453.

Ladson-Billings, G. (1994). *The dreamkeepers: Successful teachers of African American students*. San Francisco: Jossey-Bass.

McElroy, C. (2000). Middle school programs that work. *Phi Delta Kappan, 82*(4), 277-279.

McNamara, D. (1995). The influence of student teachers' tutors and mentors upon their classroom practice: An exploratory study. *Teacher and Teacher Education, 11*(1), 51-61.

Mlynarczyk, R., & Babbitt, M. (2002). The power of academic learning communities. *Journal of Basic Writing, 21*(1), 71-89.

Nguyen, D. M., & Kulm, G. (2005). Using web-based practice to enhance mathematics learning and achievement. *Journal of Interactive Online Learning, 3(*3).

Nguyen, D. M., Hsieh, Y.C.J., & Allen, G.D. (2006). The impact of web-based assessment and practice on students' mathematics learning attitudes. *Journal of Computers in Mathematics and Science Teaching, 25*(3), 251-279.

Noddings, N. (1992). *The challenge to care in schools.* New York: Teachers College Press

Noddings, N. (1988). An ethic of caring and its implications for instructional arrangements. *American Journal of Education, 96*(2), 215-230.

O'Callaghan, B. R. (1998). Computer-intensive algebra students' conceptual knowledge of functions. *Journal for Research in Mathematics Education, 29*(1), 21-40.

Pfiffner, L. J., Rosen, L.A., & O'Leary, S.G. (1985). The efficacy of an all-positive approach to classroom management. *Journal of Applied Behavioral Analysis, 18*(3), 257-261.

Rehm. M. L., & Allison, B. (2009). Positionality in teaching culturally diverse students: Implications for family and consumer sciences teacher education programs. *Family and Consumer Sciences Research Journal, 34*(2), 260-275.

Reyes, P., Scribner, J., & Scribner, A. (1999). *Lessons from high performing Hispanic schools: Creating learning communities.* New York: Teacher College Press.

Rogers, D., & Webb, J. (1991). The ethic of caring in teacher education. *Journal of Teacher Education, 42*(3), 173-181.

Slavin, R. E. (1980). Cooperative learning. *Review of Educational Research, 50*(2), 315-342.

Slavin, R. E. (1999). Improving intergroup relations: Lessons learned from cooperative learning programs. *Journal of Social Issues, 55*(4), 647-663.

Schofield, J.W., Eurich-Fulcer, R., & Brit., C.L. (1994). Teachers, computer tutors, and teaching: The artificially intelligent tutor as an agent for classroom change. *American Educational Research Journal*, *31*(3), 579-607.

Stassen, M. L. (2003). Student outcomes: The impact of varying living-learning community models. *Research in Higher Education, 44*(5), 581-613.

Tait, J. (2004). The tutor/facilitator role in student retention. *Open Learning*, *19*(1), 97-109.

Tinto, V. (2003). Learning better together: The impact of learning communities on student success. *Higher Education Monograph Series (1),* Higher Education Program, School of Education, Syracuse University.

Twig, C. A. (2004). Using asynchronous learning in redesign: Reaching and retaining the at-risk student. *Journal of Asynchronous Learning Networks, 8*(1).

Vogt, F. (2002). A caring teacher: Explorations into primary school teachers' professional identity and ethic of care. *Gender and Education, 14*(3), 251-264.

Walton, G. H., & Cohen, G.L. (2007). A question of belonging: Race, social fit, and achievement. *Journal of Personality and Social Psychology, 92*(1), 82-96.

Williams, L., Wiebe, E., Yang, K., Ferzli, M., & Miller, C. (2002). In support of pair programming in the introductory computer science course. *Computer Science Education Journal*, *12*(3), 197-212.

www.census.gov

www.educosoft.com

Zhao, C.M., & Kuh, G.D. (2004). Adding value: Learning communities and student engagement. *Research in Higher Education, 45*(2), 115-138.