Simulated Physics Class Management: Does It Predict Student's Academic Achievement?

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Abstract

In this paper, we examined how simulated physics class management predicted the percentage of students who achieved a grade point average of B or better as reported by teachers in secondary school physics classes. We conducted this study with the eighty-two secondary school physics teachers who were members of the American Modeling Teachers Association (AMTA), and used physics educational technology (Ph. T) simulations in their physics classes from 2013 to 2014 in New York schools. We used the linear regression analysis to determine the relationship between simulated secondary school physics class management and student academic achievement of grade point average (GPA) of B or better. Classroom management was significantly related to the percentage of students who achieved a grade point average of B or better, $F(7.166) = 12.50$, $p < .001$, indicating that class management accounts for 12.5 percent of the variance of the percentage of students who achieved a grade point average of B or better. To improve their students' academic achievement, teachers should focus on the use of simulations to manage secondary school physics classes.

Keywords: *Simulations, Physics Class management, Student achievement*

1. Introduction

This study offered a close examination of how simulated physics class management predicted the percentage of students achieving a grade point average of B or better as reported by teachers in secondary school physics classes. Physics learning was a national priority of the USA because its future economic prosperity was concomitant with student success in science, technology, engineering and mathematics (Miller, Michalski, & Stevens (2012). The U.S. Department of Education (1987) stated that the number of students graduating from the United States colleges and universities whose major subjects were the sciences had declined from 1970-71 to 1984-85. This decline indicated a scientific illiterate and a loss of economic competitiveness in the United States. The director of the National Science Foundation, Ernest Bloch, anticipated in his

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speech at Carleton College (July 13, 1988) that the nation depended upon undergraduate education to prepare the small number of students who would become research scientists and engineers and many students who would have to play role effectively in an increasingly technological world. The college age population was shrinking. We must persuade more students to study science and especially physics.

Knapp (1997) urged investigators to examine the practices intervening between reform initiatives and realistic practice in physics classrooms. How could the physics class become a place where students were encouraged to find answers to their questions related to physical phenomena and draw their conclusions. Carpenter (2009) commented that the physics classroom was not a well-used resource in teaching and learning instead of being the engine of conceptual understanding of physics. This trend led to rote learning and a majority of students did not have deep understanding of physics phenomena. Mazur (2014) argued that a classroom was a place where students accomplished their learning within the class time. Class time was a valuable asset for future knowledge and skills, but how often did we stop to think about it and how teachers and students used it? He posed three questions: Should already printed material in the students' textbook and electronic media transmit information-based activities of physics classroom? Did students really learn during class, or did they simply write everything teachers said, hoping somehow to understand the material later? Are large lectures stimulating passiveness, sleep inducing or both during the physics classroom teaching?

The main concern for physics educators and policymakers was that students had lost interest in physics as a major subject (Osborne, Simon, & Collins, 2003). Perkins, Beale, Pollock, and Wieman (2011) asked three questions for physics educators and policy makers: (a) what should students learn?(b) What were they learning? (c) How could teachers change teaching to improve students' conceptual understanding? Wieman and Perkins (2005) mentioned that physics educators and policymakers needed to ask themselves how they were educating all students in science especially in physics class? After getting 16 years of physics education, physics graduate students came into the laboratory inexperienced about the experimental work of physics. On the other hand, having conducted research for two to four years in physics laboratories, they worked as experienced physicists. Physics teachers should use computer simulations because they create images in students' brains about complex scientific phenomenon and provide an interactive, engaging and visual environment that promotes and supports conceptual understandings (Wieman, 2008).

The objectives of this study were to: (1)promote the interactive learning in physics classroom (2) change of Physics classroom environment, (3)provide opportunities to evaluate conceptual understanding of secondary school physics students, (4) contribute knowledge about computer simulation and (5) changes systematic instructions in physics teaching. This study was limited to secondary school physics teachers who were members of the American Modeling Teachers Association (AMTA) and used physics educational technology (Ph.ET) simulations in their physics classes from 2013 to 2014 in New York schools.

2. Literature Review

Many students thought and said, "Physics is difficult" (Ornek, 2008, p.30).Driver, Guesne, and Tiberghien, (1985); Goldberg and Nidderer, (1991 stated that educators had been working to explore students 'difficulties on physical concepts since the early 1990s). Redish (1994) studied what were the reasons that students thought physics was a difficult subject. He found that physics as a subject required students to apply a number of understanding approaches: First, they need to understand text material; second, they need to understand algebra and geometry concepts, for instance, tables of numbers, graphs, equations, diagrams, and charts. Thus, Students' poor understanding of text material, algebra and geometry made learning physics difficult for them.

To change instruction in the physics class, Brown (2006) suggested computer simulation models that physics teachers would be able to access remotely in and out of their physics classrooms. Computer simulations were a computer-generated reality of concrete objects, for example, an atomic structure. Aldrich (2004) stated that computer simulations showed pictures in 3-dimensional multimedia arrangements. For a better learning of physics, why do not physics teachers integrate computer simulation in the physics classroom instructions?

Adegoke and Chukwunenye (2013); Sethi (2005); Steinberg (2000); Stieff and Wilenskey (2003); Zacharia (2003) found that simulations enhanced student achievement. On the other hand, Cummings, Marx, Thornton, and Kuhl, (1999); Kulik,(2002); Robertson(2003) found no significant variances in students' academic achievements using simulations in physics class teaching. These studies indicated contradiction between simulations and student achievement in the classroom. Adegoke and Chukwunenye (2013) conducted experimental research in secondary school physics classes. For the treatment, they divided students into three groups: (a) computer- simulated experiment only; (b) computer simulated experiments and hand on the experiment, and (c) hand on experiment only. They found that students achieved best among the three groups who used both the computer simulated experiments and hand on experiment.

Students in the hand-on the experiment group only achieved poorly in the physics for the practical test and the physics achievement test. They concluded that computer simulated experiments enhanced student achievement in physics for the practical test. These results were similar to the findings of Steinberg (2000), Stieff and Wilenskey (2003), Zacharia (2003), and Sethi (2005). Bayrak (2008) also concluded that the students involved in hand on experimental groups who had the instruction through the computer simulations were more effective than did the students who attended traditional instruction in the physics classroom.

Tambade (2013) agreed with Bayrak (2008) that the integration of computer simulations in the classroom activities was useful, realistic and helpful for applying principles of physics into practices. However, Cummings, Marx, Thornton, and Kuhl (1999), Kulik (2002), and Robertson (2003) found no significant impact of computer simulation on students' academic achievement when they used the computer simulations in the physics classroom teaching. In addition, Steinberg (2000) used simulations on air resistance to paper and pencil activities in an introductory university physics tutorial. The findings showed that students on a common examination question did not show any significant difference in their academic achievement. Kelly, Bradley and Gratch (2008) found similar results with comparative simulations in equipment based laboratory practices. Twelve students participated in the laboratory experiment. Six used the simulations and the remaining six used the laboratory equipment. The data used to make the comparisons were graded on pre and post laboratory reports. The findings showed that the achievement on these reports were not markedly different.

Other studies showed that simulations were beneficial to students' academic achievement if teachers used them properly and effectively. Computer simulations created images in students' brains of complex scientific phenomena and provided an interactive, engaging and visual environment. These deeper conceptual understandings enabled the students to form connections and relationships between ideas and concepts and improved their performance in real life work experiences (Weiman, 2005).

Teachers delivered lectures in the physics classroom using textbook contents and boring exercises. Weiman, (2005) argued that transporting students' thinking from novice to expert, teachers should use computerized simulations that was a logical approach teaching physics .In that approach, students understood the real world by computer simulation interaction in a virtual world (Sahin, 2006).

Michael (2001) found that computer simulations based experimental teaching, was not effective on creative activity of students than lecture-based teaching. Michael conducted an experiment in which he found no differences in product creativity between the computers simulated group and the hand on experiment group. He selected seventh-grade students and divided them into an experimental group and a controlled group. The experimental group used Gryphon Bricks in which Michael created a virtual environment that allowed students to work Lego-type bricks. The controlled group used classic Lego bricks. He used the Creative Product Semantic Scale to evaluate product creativity. He found that there were no differences between the two groups concerning product creativity, novelty, or practicality.

Roberts and Blakeslee (1996) studied computer simulations in a lower secondary school science classroom. They focused on hands-on scientific instructions. They studied a variable in conjunction with varying academic instructional techniques. The subjects of the study were eight students of diverse competence. In the study, fifty percent of the experiment time was in the science classroom when the teacher was present in the classroom. The remaining fifty percent time of the study was away from the classroom without the presence of the teacher. Roberts and Blakeslee reported three findings of computer simulations: (1) when teachers used a pedagogical style based on student needs versus student learning gains, computer simulations were effective for conceptual understanding. (2)Students learned more efficiently when teachers directly taught students to build basic science knowledge and engaged them in activities. (3) Students improved their learning when teachers varied performance style between direct instruction and student exploration. Consequently, computer simulation understanding was only one of a number of important variables in science education.

Adams (2010) found that how students used simulations to build a mental framework of physics concepts. She interviewed hundreds of individual student in which the students draw what they thought as they interacted using simulations. The investigation showed that the unseen elements in simulations and the use of analogy both helped students' construction of their understanding of physics concepts.

AERA Panel on Research and Teacher Education (2005) reviewed research of student simulations from 1980s and 1990s that included classroom management. Two studies incorporated classroom management. In the first study, Strang, Landrum, and Lynch (1989) used computerized simulations to find student achievement when teachers taught spelling of English language. The subjects of the study were Sixty-one of secondary school English class students. The findings of the study showed that students improved encouragement, feedback, and prompts. In the second study, Gorell and Downing (1989) conducted an experimental study. They determined whether computer simulations were supportive for students to analyze classroom behaviors for solving problems. The results showed that the simulation group students improved classroom behaviors for solving problems.

Brush and Saye (2000) pointed out the problems of student-centered activities in the classroom. They conducted the study in a high school classroom in which students used simulations and worked together to complete a social studies project. They studied problems that students faced in completing the project and the problems that teacher faced in helping students, and strategies to support student-centered activities. They suggested that factors, which affected the student achievement activities were; student orientation to the unit problem, student collaboration and student accountability mechanisms.

Evertson and Weinstein (2006) stated classroom management as "the actions teachers take to create an environment that supports and facilitates both academic and social-emotional learning" (p. 4). They suggested that teachers should focus on the three areas of action for classroom management: (a) actions that are taken when students arrive in the classroom,(b)actions that are taken to initiative interactions among students and instruction among teachers and students, and (c)actions taken to predict reactions to misbehavior of students in classroom. Evertson (2006) reported effective teachers prepared reliable, creative and instructional responses to emergent problems in the classroom.

Taylor (2009) pointed out that classroom management was one of the greatest concerns of teachers and administrators because it affects the classroom instruction, which in turn affects students' achievement. Quality classroom instruction required classroom management skills. He suggested that teachers and administrators should focus on simulated classroom management skills. Huppert, Lomask, and Lazarowitz, (2002) found that computer-assisted learning, such as computerized simulations are helpful in the problem-solving process which was a complex activity. Simulations use instructional device, which require a highly structured method to understand the scientific phenomena. They conducted a study on the Growth Curve of Microorganisms based on a computer simulation program. The purpose of their study was to examine the computer simulations' effect on students' academic achievement and on their mastery of science learning skills in relation to their cognitive stages. They selected 10thgrade biology students to use problem-solving skills and then divided them into a control group and experimental group. The findings of the study indicated that the students in the experimental group achieved significantly better academic achievement than the students who were in the control group. The study proved that the higher the cognitive operational stage, the higher students' achievement was. In the control group, students in the concrete, transition and operational stages did not differ. In addition, girls achieved equally with boys in the experimental group. Students' academic achievement showed the potential effect of the computer simulation program on the cognitive skills.

Davies and Graff (2005) found that a lot of computer simulations use did not lead to significantly higher achieving passing grades. Kuh, Cruce, Shoup, Kinzie & Gonyea (2008) found that students success was because of student academic achievement, engagement in educational activities, satisfaction working with teachers and their classmate, gaining of desired knowledge, skills and capabilities, determination and attainment of educational objectives, and performance in their practical life . Kuh, Cruce, Shoup, Kinzie, and Gonyea (2008) conducted an experiment and found the net effect of time on assignment and engagement during the first year of college students. They assessed two models: In the first Model, they assessed that first-year grade point average on students' background characteristics and their first-year experiences. They comprised variables: demographic characteristics of students, pre-college experiences of students, and their prior academic achievement as predictors of grade point average (GPA). They accounted for 29 percent improvement in first-year student grades. They found that prior academic achievement had the significant effects on first-year students GPA. After adding student engagement, they found that the model accounted 13 percent of the variance in first-year GPA. That 13 percent of the variance increased the total variance explained to 42 percent. Then, they added first-year experiences to the model. They found that the demographic characteristics, pre-college experiences, and prior academic achievement were statistically significant on the students' academic achievement. Similarly, Pascarella and Terenzini (2005)found that students engagement was small but had a high influence on the first-year students .They concluded that a one-standard-deviation increase in student engagement increased a students' Grades point average by about 0.04 points during the first year of college.

Holmes (2012) argued that students having 3.5 or higher grade point average (GPA) are considered as a high achieving student and accepted in a majority of universities for admission and qualify for jobs in markets. Furthermore, students having a full-time job, a family, and a 3.2-grade point average could also be considered for admission in the majority of Universities. Although, Grade point average was the most generally considered characteristic of high achieving students and students who have low achieving were very driven, intelligent and had an excitement for learning. These students liked the prospect of getting novel skills and succeeded in universities environment that allowed them to partake in different experiences. Universities' advisors had to consider students based universities program details instead of high achieving in grade point average of students.

3. Research Methodology

The target population consisted of physics teachers who were members of the Science Technology, Engineering and Mathematics Teachers of New York City (STEM teachers NYC) and American Modeling Teachers Association (AMTA). They used simulations in their physics classes for the 2013 and 2014 school years. We constructed the survey based on the literature review and used a 6-point Likert scale to evaluate the response on simulations in physics class management effect on student academic achievement. We asked the teachers to circle the number that related to their level of agreement: 1. strongly disagree, 2. disagree, 3. slightly disagree, 4. slightly agree, 5. agree, and 6. strongly agree. In the case of the dependent variables, teacher view of student academic performance, we used1.Never, 2.Rarely, 3.Sometimes, 4.Often, 5.Most of the time, and 6.Always. For student academic achievement, the percent of students taught by each physics teacher that achieved a GPA of B or better was used.

We provided the opportunity to all physics teachers of the (STEM teachers NYC) and AMTA to participate in this study. We also obtained permission from the chairperson of (STEM teachers NYC) to distribute the survey instrument to physics teachers through the email and Google survey. All respondents were anonymous.

Eighty-two physics teachers completed the survey about instructional practices in the physics class and returned the completed survey on Google survey form. Out of eighty-two survey forms, we selected fifty-two for this study. A panel of five physics Teachers established content validity. We calculated reliability for each scale using a Cronbach Alpha Analysis of internal consistency based on participants' responses. Table 1 presents the items that retained in each scale after an analysis of internal consistency. We deleted the item 21 from the classroom management scale and item 58, 60, 63, and 64 from the teachers' views of student academic achievement scale.

Table 1
Survey Dimensions – Reliability Coefficients

Survey Dimensions	**Survey Item Number**	**Number of Items**	**Raw Score**	**Alpha**
Simulations in Physics class	1, 2, 3, 4, 5, 6, 7	7	7-42	.941
Classroom Management	15, 16, 17, 18, 19, 20	6	6-36	.709
Use of Simulations	8, 9, 10, 11, 12, 13, 14	7	7-42	.892
Teachers' views of students' performance	59, 61, 62	3	3-18	.668

4. Data Analysis and Interpretation

Teachers used the following types of simulations in physics class during 2013 and 2014: physics Educational Technology (PhET), interactive physics, applets, video loops of phenomena, flash simulations (some online, some homemade), visual quantum mechanics and a number of Physics PhET and others, poets, physical analog and computer. Electronic workbench, PhET simulations PhET, Vpython other java apps PhET, and student-generated simulations (VPython) were also used. The table 2 presents use of simulations. Only 7.4 percent teachers reported that they had no use of simulations in physics class.

Table 2
Use of Simulation in Physics Class

Simulation	Use of Simulations	No of Teachers	%
1	Before Hands-on experiments	5	9.3
2	After Hands-on experiments	8	14.8
3	Both before and after hands-on experiments	27	50.0
4	Instead of hands- on experiments	10	18.5
5	I do not use-simulations	4	7.4
Total		54	100

Table 3 shows the results for the regression analysis in which Class Management was an independent variable and percentage of students achieving a grade point average of B or better was the dependent variable.

Table 3
Regression Model: Percentage of Students who Achieved a Grade Point Average (GPA) of B or better

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.354[a]	.125	.108	22.8019%	.125	7.166	1	50	.010

a. Predictors: (Constant), Class Management

Using a linear regression analysis, we calculated the variance for use of simulations in physics class management to determine their relationship to the dependent variables of the percentage of students who achieved a grade point average of B or better. Classroom management was significantly related to the dependent variable of the percentage of students who achieved a grade point average of B or better, $F(7.166)=12.50$, $p<.001$, indicating that class management accounts for 12.5 percent of the variance of the percentage of students achieving a grade point average of B or better.

5. Discussion and Conclusion

Physics Class management accounts for 12.5 percent of the variance of the percentage of students who achieved a grade point average of B or better in their physics classes. To improve the percent of students who achieved a grade point average of B or better, teachers should focus on class management. Taylor (2009) stated that classroom teaching affected student achievement more than other activities that did in the classroom; quality classroom teaching required quality classroom management skills. Gorrell and Downing (1989) found that computer simulations were best at helping students learn to analyze phenomena and solve problems. Kuh, Cruce, Shoup, Kinzie, and Gonyea (2008) suggested that students' success closely linked with students' academic achievement in educational focusing activities: attaining of preferred knowledge, learning skills and capabilities, achieving educational objectives and having post-college performance in real life. Sahin (2006) stated that computer simulations could be supportive tools for classroom instruction because students could interact and see a real world experience through them. Computer simulations might be incorporated in the Pre-service and in-service Teachers' training program because teachers could engage students in the practices associated with the task or practice through an underlying set of organized lessons. Simulations provide a unique tool that made learning more fun and more effective. Educators could integrate simulations into the curriculum with appropriate activities.

6. Recommendations

Future researchers should consider the following potential areas:-

The first potential research area is what are the topic-specific questions that students formulate in working with the simulations, how do they address these questions, and how does that result in their understanding? By exploring these issues with a number of students, it will provide a greater understanding of topic specific learning and how better to teach physics, with or without the use of simulations.

Future researchers may:

1. consider replicating this study using different subjects, for instance, chemistry, biology and mathematics for measuring student academic achievement;
2. conduct experimental research with Science Technology, Engineering and, Mathematics Teachers of New York City (STEM teachers NYC), American Modeling Teachers Association (AMTA), American Association of Physics Teachers (AAPT) and American Physical Society (APS) physics teachers during summer workshops where teachers use simulations;
3. conduct research studies of teaching techniques for promoting productive classroom discussions and using simulations for conceptual understanding of scientific phenomena;
4. employ an action research process in which they could evaluate variables through classroom observations and interactions;
5. investigate how teachers can teach STEM through flight simulations;
6. instruct with simulations of real classrooms taught by simulator teachers.

References

Adams, W. K. (2010). Student engagement and learning with PhET interactive simulations. *Multimedia in physics teaching and learning proceedings* (pp. 1-12). Boulder: Maggio 2010; publicaton online.

Adegoke, B. D., & Chukwunenye, N. (2013). Improving students' learning outcomes in practical physics, which is better? computer simulated experiment or hands-on experiment? *IOSR Journal of Research & Method in Education (IOSR-JRME), 2*(6), 18-26.

AERA Panel on Research and Teacher Education., Cochran-Smith, M., & Zeichner, K. M. (2005). Studying teacher education: The report of the AERA Panel on Research and Teacher Education. Mahwah, N.J:

Lawrence Erlbaum Associates.

Aldrich, C. (2004, September 14). Simulations and the future of learning: An innovative and perhaps revolutionary approach to e-learning. *An innovative (and perhaps revolutionary) approach to e-learning*. Pfeiffer, San Francisco:, USA.

Astin, A. W. (1993). *What matters in College? Four critical years revisited.* Francisco, CA: Jossey-Bass.

Bayrak, C. (2008). Effects of computer simulation programs on university students' achievement in physics. *Turkish Online Journal of Distance Education (TOJDE), 9*(4), 48-53.

Brown, J. (2006). New learning environments for the 21st century: Exploring the edge change. *The magazine of higher learning, 38*(5), 18-24.

Brush, T., & Saye, J. (2000). Implementation and evaluation of student centered learning unit: A case study. *Educational Technology Research and Development, 48*(3), 79-100.

Carpenter, S. I. (2009). Virtual worlds as educational experience: Living and learning in interesting times. *Journal for Virtual World Research, 2*(1), 1-21.

Cummings, K., Marx, J., Thornton, R., & Kuhl, D. (1999). Evaluating innovation in studio physics. *American Journal of Physics, 67*(7), 38-44.

Davies, J., & Graff, M. (2005). Performance in e-learning: online participation and student grades. *British Journal of Educational Technology, 36*(4), 657-663.

Driver, R., Guesne, E., & Tiberghien, A. (1985). *Children's ideas in scinece.* Duit: Milton Keynes: Open University Press.

Evertson, C. M., & Weinstein, C. S. (2006). Classroom management as a field of inquiry. *Classroom Research*.

Goldberg, F., & Nidderer, H. (1991). *Research in physics learning: Theoretical* *issues and empirical studies.* Kiel: Kiel: IPN-University of Kiel.

Gorrell, J., & Downing, H. (1989). Effects of computer-simulated behavior analysis on pre-service teachers' problem solving. *Journal of Educational Computing Research, 5*(3), 335-347.

Holmes, H. (2012). Serving high achieving students through honors tracks. *Academic Advising Today, 35*(4).

Huppert, J. L., & Lazarowitz, R. (2002). Computer simulations in the high school: Students' cognitive stages, science process skills and academic achievement in microbiology. *International Journal of Science Education, 24*(8), 803-821.

Kelly, J., Bradley, C., & Gratch, J. (2008). Science Simulations: Do they make a difference in student achievement and attitude in the Physics laboratory? *Online Submission*.

Knapp, M. S. (1997). Between systemic reforms and the mathematics and science classroom: The dynamics of innovation, implementation, and professional learning. *Review of Educational Research, 67*(2), 227-266.

Kuh, G. D., Cruce, T. M., Shoup, R., Kinzie, J., & Gonyea, R. M. (2008). Unmasking the effects of student engagement on first-year college grades and persistence. *The Journal of Higher Education, 79*(5), 540-563.

Kulik, T. (2002). *School mathematics and science programs benefits from instrctional technology.* Arlington: National Science Foundation.

Mazur, A. (2014, September 24). *Mazur Group*. Retrieved from http://mazur.harvard.edu: http://mazur.harvard.edu

Michael, K. Y. (2001). The effect of a computer simulation activity versus a hands-on activity on product creativity in technology education. *Journal of Technology Education, 13*(1), 31-43.

Miller, R., Michalski, W., & Stevens, B. (2012, October 16). *21st Century technologies: Promises and Perils of a dynamics future.* Retrieved from http://www.oecd.org: http://www.oecd.org/futures/35391210.pdf

Ornek, F. (2008). What makes physics difficult? *International Journal of Environmental & Science Education, 1*, 30-34. Retrieved November 7, 2014, from http://www.ijese.com/V3_N1_Ornek_etall.pdf

Osborne, J., Simon, S., & Collins, S. (2003). Attitudes towards science: A review of the literature and its implications. *International Journal of Science Education, 25*(9), 1049-1079.

Pascarella, T., & Terenzin, P. (2005). How college affects students, A Third decade of research San Francisco: Jossey-Bass. *Journal of Student Affairs in Africa, 2*(2).

Perkins, K. K., Beale, P., Polluck, S. J., & Wieman, C. (2011). A thoughtful approach to instruction:Course transformation for the rest of US. *A Journal of Science Teaching, 40*, 70-76.

Redish, E. F. (1994). The implications of cognitive studies for teaching physics. *American Journal of Physics, 62*, 796-803.

Roberts, N., & Blakeslee, G. (1996). The dynamics of learning in a computer simulation environment. *Journal of Science Teacher Education, 7*(1), 41-58.

Robertson, H. (2003). Toward a theory of negativity: Teacher education and information and communication technology. *Journal of Teacher Education, 54*(4), 258-268.

Sahin, S. (2006). Computer simulations in science education: Implication for distance education. *Turkish Online Journal of Distance Education(TOJDE), 7*(4), 132-146.

Sethi, R. (2005). Using virtual laboratories and online instrction to enhance physics edcuation. *Journal of Physics Teacher Education Online, 2*(3), 22-26.

Stein, M. K., & Wang, M. C. (1988). Teacher development and school improvement: The process of teacher change. *Teaching and Teacher*

Education, 4, 171–187.

Stieff, M., & Wilenskey, U. (2003). Connected chemistry: Incorporating interactive simulations in the chemistery class. *Journal of Science Education and Technology, 12*(3), 285-302.

Steinberg, R. (2000). Computers in teaching science: To simulate or not to simulate? *American Journal of physics, 68*, 37-41.

Strang, H. R., Landrum, M. S., & Lynch, K. A. (1989). Talking with the computer: A simulation for training basic teaching skills. *Teaching and Teacher Education, 5*(2), 143-153.

Tambade, P. (2013, June 10). *Investigating effect of computer simulation in physics*. Retrieved from EDITLIB: http://www.editlib.org/noaccess/29940

Taylor, B. (2009). *Classroom management impacts on student achievement: Tip to thrive.* Jackson State University, Education. Retrieved from http://knowledgeportal.pakteachers.org/sites/knowledgeportal.pakteachers.org/files/resources/classroom%20management%20impacts%20student%20achievements.pdf.

Wieman, C., & Perkins, K. K. (2005). Trasnforming physics education. *Physics Today, 58*(11), 36-41.

Zacharia, Z. (2003). Belief, attitudes, and intentions of science teachers regarding the educational use of computer simulations and inquiry -based experiments in physics. *Journal of Research in Science Teaching, 40*, 792-823.