Sustainable Equity: Avoiding the Pendulum Effect in the Life Sciences

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Abstract

In order to understand and resolve the disproportionate number of women in the sciences it is necessary to look at historical educational trends. Through the ages there is evidence of a 'pendulum effect' where there have been major shifts focusing science education either on male or females. To be able to realistically establish sustainable equity in the natural and life sciences it is necessary to reexamine not only the curriculum verbiage used in the text but also teaching styles that are used to present the material. One approach is introducing more hands-on learning to supplement the 'banking' approach traditionally used in introductory science classes. Hands-on learning engages visual, kinesthetic as well as auditory pathways and allows students to move from abstract thinking to dealing with the concrete.

While there have been numerous studies done, they have historically focused on the effect of hands-on learning in K-12 schools. There is still much research that needs to be done on all types of science curriculum, especially at the post secondary level. We conducted several studies at Saint Xavier University with students in the Introductory Biology and Women in Science Courses. We examined the effects of various pedagogies on class performance in a non-majors science course. We examined the effects of no labs, a few labs or weekly labs on student performance. Significant improvements were seen within sexes (10%), and with female students (13%), while male students showed modest improvement (2%). While this is not the only way to achieve sustainable equity in natural sciences, this appears to be an effective pedagogical tool in stabilizing the 'pendulum effect'.

Introduction

Why teach science? Science teaches individuals about the material world in which they live, helps develop critical reasoning skills, and even serves as an important component of cultural heritages.[1] However, fewer and fewer individuals are interested in science and technical subjects. The Nuffield Foundation's 2008 report determined that this disinterest largely stems from shortcomings in the curriculum, pedagogy and assessment; but more importantly, they found that sciences education fails to provide a satisfactory education for many individuals, especially female students, enrolled in the classes.[2] With the rapid increases in technology, scientific and technological literacy is of increasing relevance for the modern global citizen. There is

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[1]Maria Acaceli Ruiz-Primo, Derek Briggs, Heidi Iverson, Robert Talbot and Lorrie A. Shepard. "Impact of Undergraduate Science Course Innovations on Learning" *Science* 331, No.6022 (2011): 1269 - 1270.

[2]"Science Education in Europe: Critical Reflections" (A Report to the Nuffield Foundation, 2008). Http://www.kcl.ac.uk/content/1/c6/01/32/03/SciEdinEuropeReportFinal2.pdf

mounting evidence that traditional lectures and recitations do not guarantee that students will obtain an understanding of critical concepts. One concern for fostering scientifically literate citizens is how to obtain an “equitable distribution of opportunities to learn” in science.[3]

The National Science Foundation's (NSF) Research on Gender in Science and Engineering (GSE) program seeks to broaden the participation of girls and women in science, technology, engineering and mathematics (STEM) education fields by supporting research, the diffusion of research-based innovations, and extension services in education that will lead to a larger and more diverse domestic science and engineering workforce. They have found a myth that persists at the college level that changing the STEM curriculum runs the risk of watering down important "sink or swim" coursework. In reality, studies have found that the mentality of needing to "weed out" weaker students in college majors—especially in the more quantitative disciplines—disproportionately weeds out women. This is not necessarily because women are failing. Rather, women often perceive "Bs" as inadequate grades and drop out, while men with "Cs" will persist with the class. Effective mentoring and "bridge programs" that prepare students for challenging coursework can counteract this. Changing the curriculum can lead to recruitment and retention of both women and men in STEM classrooms and majors. In entry-level computer science courses, having students work in pairs on programming to greater retention of both genders in computer science majors.

These discoveries by NSF point towards the shifts in focus in education of females and males, this has been, and still is especially true in the sciences. These shifts influence both genders. A pendulum shift occurs when the main attentions of the educators are placed on one gender to the exclusion of the other. As the pendulum swings, both women and men are detrimentally affected since one side is always excluded from focus. The ‘privileged’ gender receives more attention, however they are handicapped by not having the creative thoughts and ideas from the excluded gender.

The purpose of this paper is three fold. First, we will highlight the history of the pendulum effect and demonstrate how this educational shift in the sciences is deserving of this name. Secondly, we will examine literature of four key pedagogical factors that are used to help stem the pendulum effect. Finally, we will add knowledge to the field through our own research. Our research explores the preconceived notions of what both science majors and non-majors believe a scientist looks like, as well as examining a way to offset this pendulum effect by integration of new pedagogical practices.

History

This history of the pendulum effect does not claim to be comprehensive; it aims to demonstrate extreme instances of the shift of focus in the education of males and females in the sciences.

[3]T.A. Romber and A. Collins, “The Impact of Standards-Based Reform on Methods of Research in Schools,” in Handbook of Research Design on Mathematics and Science Education, eds. A. E. Kelly and R. A. Lesh (Mahwah, NJ: Erlbaum, 2000), 73-85.

From the 1830's to about the 1890's both boys' and girls' schools offered courses in algebra and geometry and used similar texts. During this time, natural history became a field of study that was an appropriate woman's sphere, upon closer investigation, one can see major shifts in the pendulum as men and women begin to negotiate their positions in various disciplines and sub-disciplines. From 1890 -1940 Women's colleges began to require Latin for admission. Girls' secondary schools offered Latin and the liberal arts, rather than science, in an effort to better prepare students for college. As science became associated with business ventures like engineering and mining, males saw new career opportunities in science, and shifted toward science courses and away from the liberal arts. After the Second World War, this shift of males in sciences was even more evident with the new military focus. Boys were pushed towards mechanical arts courses like woodworking or automobile repair, while female students were often required to take home economics.[4] Individuals of one sex wishing to take courses typically reserved for individuals of the opposite sex would have to defy sex/societal norms. Girls wishing not to be labeled as "lesbian" may choose to not take science courses that they perceive to be more "male" (i.e., physics or chemistry), and boys not wanting to be thought of anything less than fully masculine may take these courses.[5]

The recent federal government initiative to increase the quality of Science Technology Engineering and Mathematics (STEM) education is linked to the hope of producing more highly qualified college STEM graduates.[6] According to the National Science Board (2008), in 2005 women represented only 26% of the college-educated work-force in scientific and engineering occupations even though women represented close to half of the total number of college-educated individuals in the work force. In 2003 women represented 29% of the physical scientists and 11% of the engineers. Overall the number of women in science and engineering occupations has risen since 1993 except for computer science and mathematics which has actually dropped 2%.[7]

We must remember however that while we are addressing the needs of the individuals that are marginalized at any point in history we need to ensure that we do not create a new group of marginalized individuals. Indeed, as Sommers has shown a 'female focused teaching approach' is proving to be very detrimental to male students by limiting their access to information and discouraging their interest in the sciences.[8] The creation of this new group only guarantees that the pendulum continues swinging.

How To Stabilize The Pendulum

It is been demonstrated that there have been historical shifts, like the swinging of a pendulum, between the education of males and females in the sciences. This shifting is still evident today,

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[4]S. Reese,. "Gazing into the Future" *Techniques: Connecting Education and Careers* 84, number 5, (2009): 14-19

[5]G. Unks. "Thinking About the Gay Teen," *The Gay Teen: Educational Practice and Theory for Lesbian, Gay, and Bisexual Adolescents.* New York: Routledge, (1995) 3-12

[6]National Science Board. *Science and engineering indicators* Arlington, VA: National Science Foundation. (2008)

[7]National Science Board. *Science and engineering indicators* Arlington, VA: National Science Foundation. (2008)

[8]Christina Hoff Sommers, "The War against Boys," *Atlantic Monthly* (May 2000): 59-74.

so it needs be asked, how might this swinging pendulum be stabilized? Adapting and integrating into standard practice the latter two of Ladson-Billings criterion for culturally relevant teaching will help to alleviate and perhaps eventually eliminate the pendulum effect.[9] These criteria are student development/maintenance of cultural competence, and student development of a critical consciousness in order to challenge the status quo. Culturally relevant pedagogy requires teachers to connect students' culture to the content being presented in class. Critical consciousness must be achieved to move culturally relevant pedagogy beyond the individual level. Students must learn to examine cultural norms and values, so that they can critically assess the status quo.[10]

We believe that it is just as critical to have gender relevant pedagogy. Ladson-Billings states that culturally relevant teaching is not just for students who may speak different languages, but includes providing students the opportunity to surpass any negative influences (such as a lack of representation in the textbooks or curriculum) presented by the dominant culture.[11] Much focus is given in research on how to alter the curriculum to meet cultural needs, but the way the content is taught has a deeper effect on students.[12] Changing the way material is presented not only has an effect on the range of people that can relate to the material, but also encourage students to dismantle stereotypes inculcated by cultural norms. Through similar ways in which culturally relevant pedagogy can be obtained-gender relevant pedagogy can be obtained through gender neutral presentation of material, being sure to give gender examples that offset the majority in the field, making sure that historical references encompass the contributions of both genders, and including hands on activities. Each of these will be explored in turn.

While it would be a laborious and cumbersome endeavor to try and rewrite all of the scientific literature to be gender neutral we can ensure that the new information that is being added to the field and the manner in which we present information in our classes is done in a gender neutral manner supporting both sexes equally. By doing this we can work towards the presentation of gender neutral, or at least gender equitable, materials.

In the 1970's a great deal of research examined how language impacts gender equality. The culture that defines object, ideas, and perceptions will associate those items of privilege and power with the powerful and privileged groups in that culture.[13] There were even studies that identified language as biased against women, casting them in secondary roles or even characterize women as invisible, less familiar and less active.[14] Harrigan and Lucic found that members of a women's organization and psychology students were very interested in, and had

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[9]G. Ladson-Billings.. "But That's Just Good Teaching! The Case For Culturally Relevant Pedegogy," *Theory Into Practice* 34, no.3 (1995) 159-165.
[10] *Ibid*
[11]G. Ladson-Billings.. "But That's Just Good Teaching! The Case For Culturally Relevant Pedegogy," *Theory Into Practice* 34, no.3 (1995) 159-165.
[12]*Ibid*
[13]A. Bodine.. "Androcentrism In Prescriptive Grammar: Singular They, Sex-Indefinite, He, and He or She" *Language in Society* 4, (1975): 129-146.
[14]J.P. Stanley. *Prescribed passivity: The Language of Sexism* in Views on Language (Eds) R. Ordoubadian and W. Raffler-Engel (Eds.), Murfreesboro, TN: Inter-University Publications, 1975.

made greater conscious efforts to change, their language than faculty, medical students or English students.[15] The motivation for the student groups seemed to be whether or not their authorities were requiring non-biased language. This demonstrates the importance of having faculty utilize the gender-neutral pronouns as part of their curriculum. For example, t~~T~~he pronoun 'they' should, where appropriate, take the place of 'he'. This small change can be easily integrated into the presentation of material and make male and female students feel less like they are being singled out and establish a ‘we’ rather than an ‘us and them’ mentality.

Although many people are incorporating these strategies into their teachings it is not mainstream and we still must remain vigilant. In 1978 Moulton, Robinson and Elias concluded that “using male terms in their ‘gender-neutral’ sense induce people to think of male even in contests that are explicitly gender neutral.” So even with the use of the pronoun they, the male bias is so inculcated in society, that this neutral pronoun still brings to mind a male persona.

This was evidenced in two courses at Saint Xavier University, where students were asked to draw a representation of a scientist. Despite growing up in an era where the pendulum is shifted towards women in science, the majority of both science majors and non-majors produced a facsimile of an older, Caucasian male. In the mixed non-majors biology class 78.9% of the students drew male scientists, 15.8% drew female scientists, and 5.2% drew a combination of both. An interesting point is that the course was entitled “Women in Science,” and taught by a female instructor. These results were mirrored in a junior/senior level majors only genetics class where 74.5% drew male scientists, 23.4% drew female scientists, and 2% drew a combination of both. Incidentally, this course was also taught by a female instructor. And it is also of interest to note that 46% of the instructors in the Department of Biological Sciences are female, and the majority of instructors at Saint Xavier University are female. While this bias is so deeply rooted, it is necessary to use gender neutral pronouns to prevent future generations from having the same ideologies and to keep from reinforcing the stereotypes.

Given this firmly embedded imprint of the male scientist, when presenting material it is important to try and use examples that are understood by, and accessible to all students. In physics classes it is not uncommon to find examples, which are being used to help explain very abstract, complex ideas that are geared more towards the male students in the class. The examples of baseball, projectiles, and engines are identifiable to the males, and some females in the class, but statistically leave the vast majority of the females feeling at best disinterested, and at worst alienated, by their inability to relate to the example much less the more complex concept that the 'simple' example is meant to convey. Previous research has shown that female students tend to be more interested in natural phenomena, so presenting physics concepts in a biological, medial, or even sociological context will give female students a greater connection to the example and allow the example to accomplish its goal of explaining the complex material without the students having to first decipher the example and then make the connection.[16] Male

[15] J.A. Harrigan and K.S. Lucic,. Attitudes about sexism in language: It's what you say. Sex Roles 19, (1988): 129-140.
[16] P. Häußler, “Measuring student's interest in physics – design and results of a cross-sectional study in the Federal Republic of Germany.” *European Journal of Science Education* 9 (1987) 79-92.

students, however, are uncomfortable with examples that do not tie directly to the subject matter. To make concepts accessible to both sexes there must be a balance of both types of examples to prevent either group from feeling alienated.

History has often been written by men, about men, and women's roles are discounted if they are even included. To help ensure a gender neutral and relevant pedagogy, history must be told as completely as possible. One of the best examples of this is Rosalind Franklin's role in the discovery of the structure of DNA. For many years James Watson and Francis Crick were given the credit for the discovery. It wasn't until twenty five years later that the first acknowledgement of Franklin's contribution appeared in Watson's "The Double Helix." Even then, it was buried under allegations that Franklin could not accurately interpret her own data and should have shared her work with Wilkins, Watson and Crick. Franklin had to struggle to be heard and overcome oppression, to ignore or trivialize her contribution is not only an injustice to her, but also to aspiring female scientists who may glean hope and inspiration from her perseverance. Unfortunately, Franklin is not alone in being passed over in the annals of history. While history tends to focus on the majority, it is critical to use gender examples that represent the minority in the field. Examples of this could be men in nursing or women in mechanical engineering.

Ensuring the accuracy of history is only a piece of the puzzle to establishing gender equity in the sciences. To be able to realistically establish sustainable equity in the natural and life sciences it is necessary to reexamine not only the curriculum and verbiage used in the text, but also to reexamine teaching styles that are used to present the material. One approach is integrating more hands-on learning to supplement the 'banking' approach traditionally used in introductory science classes. The banking approach, the traditional approach to education, as defined by Paulo Freire, is that the teacher lectures and the students passively sit by, absorbing and then regurgitateing back the information.[17] Hands-on learning engages visual, kinesthetic as well as auditory pathways and allows students to move from the abstract thinking to dealing with the concrete. Indeed, not only does the integration of hands-on learning in science cultivate the application of the theoretical to the real in the lab scenario, it helps to bridge achievement gaps.[18]

Numerous studies examine the effects of hands-on science upon other subject areas such as reading, language arts and mathematics. Some historical references found that reading and

[17]Paulo Freire,. *Pedagogy of the Oppressed*. New York: Continuum, 2000.

[18]There are numerous studies examining the effects of hands-on science upon other subject areas such as reading, language arts and mathematics. Some historical references Shymansky, J., Hedges, L., and Woodworth, G. A "Reassessment of the Effects of Inquiry- Based Science Curricula of the 60's on Student Performance" *Journal of Research in Science Teaching*, 27, no. 2, (1990): 127-144. and Kyle, W. C., Jr., Bonnstetter, R. J., and Gadsden, T., Jr., and Shymansky, J. A. "What Research Says About Hands-On Science," *Science and Children*, 25. no. 7, (1988): 39-40. found that reading and other language art skills were significantly influenced in positive ways by the inclusion of hands-on science programs that were studied. Dade County Florida found that students that had science kits in a specific region outperformed other students that did not have the kits in science. The science kit students also achieved higher scored in reading comprehension, mathematics computation and mathematics applications. Valdez, Valdez, J. D. (2001). Teaching Hands-On/Minds-On Science Improves Student Achievement in Reading: A Fresno Study Fresno Unified School District—Urban Systemic Program Fresno, California,found that not only did the students with inquiry-based science instruction perform better on SAT reading, and they found that minority ethic groups' reading scores increased at higher rates than their non-minority counterparts. This suggests that hands-on, inquiry-based science content may provide an effective means of reducing the tenacious achievement gap that has existed between ethnic groups.

other language art skills were significantly influenced in positive ways by the inclusion of hands-on science programs that were studied.[19] Valdez found that not only did the students with inquiry-based science instruction perform better on SAT reading, and they found that minority ethic groups' reading scores increased at higher rates than their non-minority counterparts.[20] This suggests that hands-on, inquiry-based science content may provide an effective means of reducing the tenacious achievement gap that has existed between ethnic groups.

While there have been numerous studies done, they have historically focused on the effect of hands-on learning in K-12 schools-There is still much research that needs to be done on all types of science curriculum, especially at the post secondary level Ruiz-Primo, et al. made three recommendations for improving scientific research of instructional innovations[21]. These suggestions were the result of an expansion of an NSF research study focused on characterizing undergraduate course innovations found in the literature and then attempt to quantify their impact on student learning in the STEM courses. The three recommendations are the following:

(1) "all studies need to include descriptive statistics (sample sizes, means, standard deviations) for all treatments and control groups on all testing occasions"

(2) "researchers should attempt to randomly assign students to treatment and control conditions" and finally

(3) "researchers should be attentive to the quality of their outcome measures; if measures are not valid and reliable, subsequent interpretations can become equivocal."[22]

While the pedagogical approaches of group work and hand-on learning have been extensively studied in primary schools, very little quantitative work had been done to examine the effects of instructional innovations in STEM courses.

Our Research

In order to investigate strategies which could be effective in increasing student success in post-secondary education, we conducted a study where we compared student performance with three pedagogical strategies. To help ensure the quality of our research we were cognizant of Ruiz-Primo et al.s recommendations of randomly assigning students to groups, including descriptive statistics, and assuring the validity and reliability of our results. While we could not randomly assign students to the various courses, and believe that it would be unethical to change back to a

[19] Shymansky, J., Hedges, L., and Woodworth, G. A "Reassessment of the Effects of Inquiry- Based Science Curricula of the 60's on Student Performance" *Journal of Research in Science Teaching*, 27, no. 2, (1990): 127-144. and Kyle, W. C., Jr., Bonnstetter, R. J., and Gadsden, T., Jr., and Shymansky, J. A. "What Research Says About Hands-On Science," *Science and Children*, 25. no. 7, (1988): 39-40.

[20] J.D. Valdez.. "Teaching Hands-On/Minds-On Science Improves Student Achievement in Reading: A Fresno Study." Fresno Unified School District—Urban Systemic Program Fresno, California (2001)

[21] Maria Acaceli Ruiz-Primo, Derek Briggs, Heidi Iverson, Robert Talbot and Lorrie A. Shepard. "Impact of Undergraduate Science Course Innovations on Learning" *Science* 331, No.6022 (2011): 1269 - 1270.

[22] Maria Acaceli Ruiz-Primo, Derek Briggs, Heidi Iverson, Robert Talbot and Lorrie A. Shepard. "Impact of Undergraduate Science Course Innovations on Learning" *Science* 331, No.6022 (2011): 1269 - 1270.

more ineffectual standard of teaching, the students in the course were random students taking an introductory non-majors biology course, Biology 101, at Saint Xavier University. This course was selected because it is the first exposure that non-biology majors have to the biological sciences at the university level. The strategies, outlined below, were employed in different sections of Biology 101 over a period of three semesters over three academic years. The courses were all taught by the same instructor. There were approximately 30 students in each of the classes, with one third being male. This is representative of the student body at Saint Xavier University. A number of exam questions were very similarly worded to allow for comparison of class performance on questions addressing specific topics. Class grades, as well as self-reported student satisfaction with the course, were also compared.

The three pedagogical strategies employed various levels of inclusion of hands-on activities for the students to help to explain some of the more abstract concepts of the course. The following strategies were used: (1) a complete banking approach where students had only lecture, (2) a minimal amount of hands-on learning where students had labs integrated every other week of the semester, and (3) an increased amount of hands-on learning where students had labs integrated into each week.

For our total number of students we did have between 31 and 32 per treatment group; however we did not have an even distribution of males and females (Table 1). The results demonstrated that there were significant grade improvements seen both between and within the sexes with the addition of weekly labs as evidenced by a ten percent increase in overall student grades, and the greatest improvement was seen within the female students with a fourteen percent increase (Graph 1). The male students, while still showing improvement, showed only a modest grade increase of six percent.

We used a one-way ANOVA analysis to determine if variation of the three pedagological strategies varied between genders, and if there was an improvement in overall class performance with these groups. Using this analysis we found that there was statistically significant improvement in overall class performance with additional inclusion of labs with a p value of 0.004 when compared to an alpha level of 0.05. We were also 95% confident that there was a statistically significant variation within the female students between the banking, some lab, and weekly lab approach (p value =0.003). We failed to reject our null hypothesis, that there was no difference between the three approaches, with our male students (p value = 0.42). We do however believe that while there is no statistically significant difference there is a pedagologically significant difference, since we saw an almost 6% improvement in class scores for males.

When the exam questions were compared, a similar pattern with a little more than three percent increase in ‘correct’ answers with each incremental increase in lab exposures was demonstrated (Graph 2). A statistically significant difference was seen between number of responses correctly answered and increased lab exposure, with a one-way ANOVA analysis of incorrect answers resulting in a p value of 0.0005.

The student evaluations for the course all demonstrated student satisfaction with the course and the instructor, additionally there were many favorable comments with regards to the labs. For example, with the inclusion of a few labs some of the student comments were: "Really enjoyed the examples, would like to see more.", and "Experiments are not as boring as lecture." With the inclusion of weekly labs there were more comments on how labs "made hard stuff more clear." Prior to teaching the course with the integrated labs, a chief conferral was that there may be some student push-back on the labs, since the course is not designated as a lab course, but that was clearly not the case. Indeed, the only 'negative' comments were that there should be more lab exercises involved.

Conclusion

Through historical analysis we have shown that a gender neutral education is something worth striving for to nurture as many capable budding scientists as possible. The pedagogical focus on one sex over the other always leaves one sex losing out. In reality all individuals and societies lose out on potential discoveries that might have been made by qualified and motivated individuals that were turned away by the structure of a science course and attracted to another discipline. To be as effective as possible, science courses should integrate the hands-on element that labs provide not merely to be gender neutral, but to improve the educational experience of all students.

Three strategies have been discussed to reduce the gender bias in the classroom. The first is pronoun usage. It is very important to keep in mind the work of Harrigan and Lucic (1988), which discovered that the driving force of students' motivation to make conscious efforts to change their language seemed to be whether or not their authorities were requiring nonbiased language. It is very important that faculty are trained to utilize the gender-neutral pronouns as part of their curriculum by using the pronoun 'they', wherever appropriate, instead of the gender specific pronoun 'he'.

Secondly, using examples that are accessible to both sexes will permit a greater percentage of the class to relate. If more people can relate to the examples, then understanding complex concepts becomes easier and the class fairer and more relevant. A simple and effective way to include members of both sexes in the sciences is to be sure to not merely refer to scientists as male but to list examples of female scientists in the fields. It is also important to do the opposite when the minority in a given field is males. It might seem that providing easily understood examples would be the equivalent of dumbing down the course. The worry here is that individuals are leaving the sciences. It is not our intention to decrease the rigor associated with science courses. On the contrary, we find that utilizing this approach allows one to increase the rigor while still reaching the majority of students regardless of gender in the classroom.

Finally, our research helped to demonstrate that the integration of hands on learning into current pedagogical structures help in the comprehension of abstract concepts for both sexes. While statistical analysis demonstrated this difference for female students, we believe that the failure to reject our null hypothesis for our male students does not invalidate the results. The male students did still benefit by an increase in their class performance, which can be seen by their class averages. We believe that some of the failure to garner statistical support may result form the decrease in the number of male students that we had in the course. While it would be scientifically beneficial to rerun the experiment with the same number of male and female students in the classroom, it would be unethical to not allow students to have access to a pedagological technique that we know increases their success.

By including hands-on activities we are able to increase 'minds-on' learning in the classrooms across genders, where the students were not just participating in wrote memorization by also engaged by the material. While this is not the only way to achieve sustainable equity in natural sciences, this hands on kinesthetic approach appears to be an effective pedagogical tool in stabilizing the pendulum effect. While this is by no means a solution to the problem, in our own personal experience we have seen it act as a great stepping stone in the right direction.

There are still many unanswered questions when dealing with the issue of gender equity in science. This paper is not claiming to present a holistic solution to the systemic problem of gender inequity in higher education. What of individuals that are trans-gender? Or, is it necessary to teach "Women in Science" classes in this day and age of political correctness? Much research still needs to be done, and hopefully through the implementation of some of the techniques discussed in this paper, brilliant minds will be fostered to help offer solutions to these and other questions.

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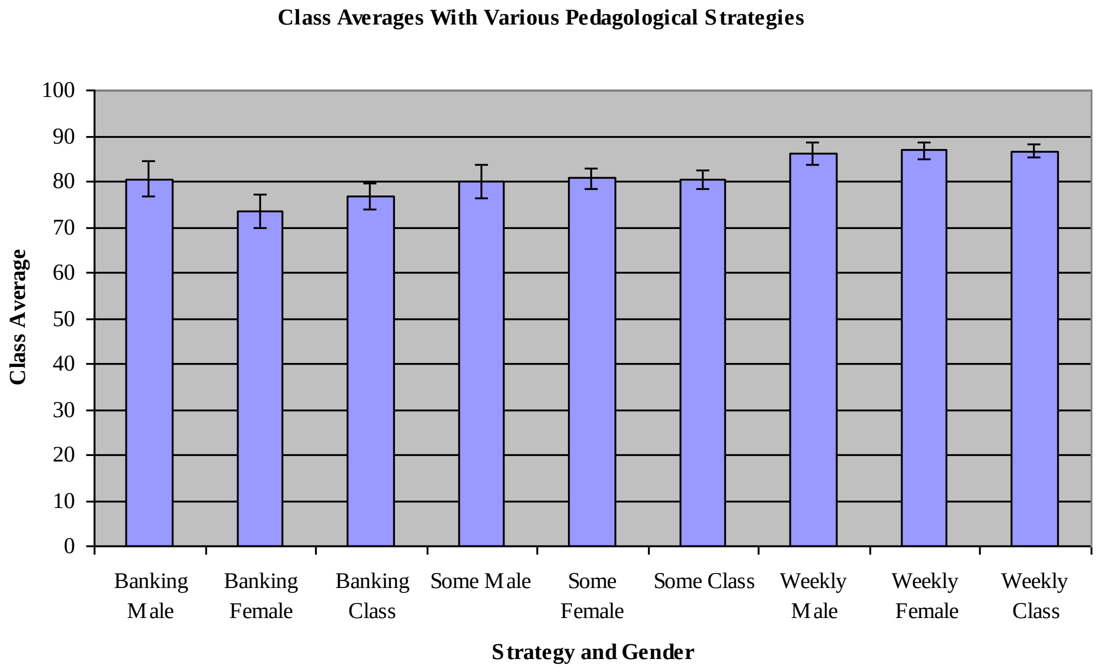
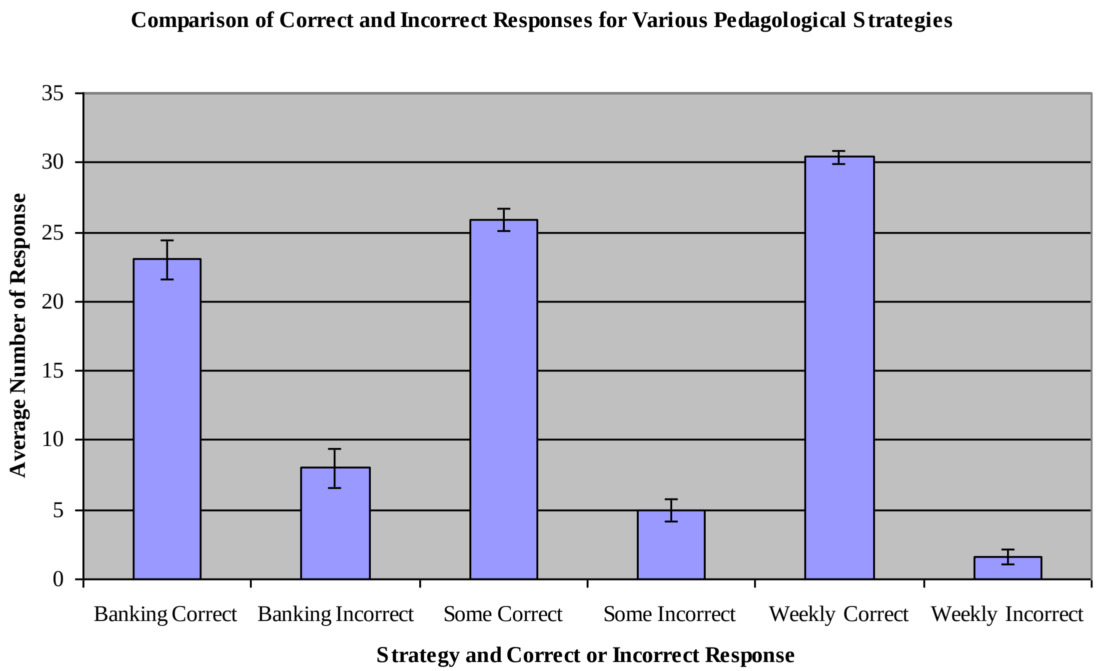
Table 1

	Male		Female		Class Total	
		Mean ± S.E.		Mean ± S.E.		Mean ± S.E.
Banking	N = 14	80.6 ± 3.9	N = 17	73.4 ± 3.7	N = 31	76.7 ± 2.7
Some Labs	N = 11	80.0 ± 3.7	N = 20	80.7 ± 2.2	N = 31	80.4 ± 1.9
Weekly Labs	N = 11	86.2 ± 2.5	N = 21	86.7 ± 1.8	N = 32	86.6 ± 1.4

Graph 1


Class Averages With Various Pedagological Strategies
Class Average
100
90
80
70
60
50
40
30
20
10
0
Banking Male
Banking Female
Banking Class
Some Male
Some Female
Some Class
Weekly Male
Weekly Female
Weekly Class
Strategy and Gender

Graph 2


Comparison of Correct and Incorrect Responses for Various Pedagological Strategies
Average Number of Response
35
30
25
20
15
10
5
0
Banking Correct
Banking Incorrect
Some Correct
Some Incorrect
Weekly Correct
Weekly Incorrect
Strategy and Correct or Incorrect Response