

# Attitudes Toward Science of Students Enrolled in Introductory Level Science Courses at UW-La Crosse

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## ABSTRACT

Nearly fifty percent of students may lose interest in science by the third grade, and the number of students preparing for a science-related career is declining. Several factors, including gender, expected achievement and previous science experiences could influence a student's attitude toward science. This study analyzed the attitudes toward science of students enrolled in entry-level general education courses at the University of Wisconsin-La Crosse in the areas of personal confidence, usefulness of the subject, perception of the subject as a male domain, and perception of the teacher's attitude. Males were found to have more confidence than females, and females perceive science as a male domain more than men. Expected achievement and attitude toward science were shown to be strongly related. The number of science and math courses taken in high school has a direct impact on a student's attitude toward science.

## INTRODUCTION

Extensive research has shown that a person's attitudes are learned, as opposed to being inherited. Many factors can influence a person's attitude, including previous experiences and social influences. Attitude toward science can be defined as, "favorable or unfavorable feelings about science as a school subject," (Morrell & Lederman, 1998), which is the definition used for this study. The type of science courses taken, previous science experiences, science teachers, and various other factors can influence these attitudes toward science (Morrell & Lederman, 1998). The impact of a student's attitude toward science is incredibly important. Recent research has shown that nearly fifty percent of students may lose interest in science by the third grade (Weinburgh, 1998). Participation in science is also being affected, as the number of students preparing for a science-related career is on the decline (Chapman, 1997).

For the course of this study, we were interested in finding how different independent variables like gender, expected grade, number of science and math courses taken in high school, and current science course enrolled in correlated with attitudes toward science.

"Of all the variables that may influence attitude toward science, gender has generally been shown to have a consistent influence," (Weinburgh, 1998). Research on the differences in attitudes toward science of men and women is frequently conducted and has produced valuable results. Several studies have shown that men have better attitudes toward science than women, and that men are more apt to continue studying science (Weinburgh, 1998). In addition, females tend to be more adapted to school and learning, yet males continue to maintain better attitudes toward science and are more motivated to succeed in science (Simpson & Oliver, 1985). These results, showing that females can succeed in school yet still have lower attitudes toward science, support the continued under representation of women in the sciences. According to a study of bachelor degrees awarded between 1966 to 2001 in Science and Engineering fields, women hold nearly half of all the degrees awarded; however, the gap between the number of women receiving Science and Engineering degrees as opposed to other degrees has increasingly widened (National Science Foundation, 2004).

Expected achievement is another factor that is heavily influenced by attitudes toward science. As would be expected, positive attitudes toward science lead to better results on achievement measures of science capability (Weinburgh, 1998). A student's attitude toward science is more likely to influence achievement in science than achievement influencing attitude (Schibeci & Riley, 1986).

In addition to achievement, previous experiences in science can heavily correlate with a student's attitude toward science. Research has demonstrated that, "attitudes toward science change with exposure to science, but that the direction of change may be related to the quality of that exposure," (Gogolin & Swartz, 1992). In addition, the number of math and science courses taken in high school has been shown to directly effect the major chosen in

college (Maple & Stage, 1991). Unfortunately, several researchers, including Simpson and Oliver, have found that students' attitudes toward science steadily decline with each year of school completed (1985).

The purpose of our study was to analyze three specific areas that may relate to a student's attitude toward science. Three questions we sought to answer were:

(1) Do women have more negative attitudes toward science than men, in the areas of confidence, usefulness, teacher perception, and male dominance?

(2) Does a correlation exist between a student's expected achievement in a science course and a student's attitude toward science?

(3) Does the type of high school attended, either public or private, and the number of science and math courses taken in high school have any correlation with a student's attitude toward science?

Previous to conducting our research, we expected to find females having a more negative attitude toward science than men and that females would still consider science a male dominated field. We also suspected there would be a correlation between expected achievement and attitude toward science. In addition, we hypothesized the number of science and math courses taken in high school would also correlate with a student's attitude toward science.

## METHOD

To complete our research, we conducted a 47-statement Modified Fennema-Sherman Attitude Scale. The statements were in the form of a Likert scale, with each statement having five choices, ranging from A to E, with A indicating strongly agree, C being neutral, and E indicating strongly disagree. Within the scale were four subscales measuring personal confidence about the subject matter, usefulness of the subject's content, if the subject is perceived as a male domain, and perception of teacher's attitudes.

After conducting the surveys, data was coded and entered into a database. During data entry, statements reflecting a positive attitude were scored 5-1 (A=5, B=4, C=3, D=2, E=1); statements reflecting a negative attitude were scored in reverse, from 1-5 (A=1, B=2, C=3, D=4, E=5). Each of the four subscales had 12 statements, except for the scale measuring if the subject is perceived as a male domain, which only had 11 statements. For the attitude subscales with 12 statements, six of those statements were considered positive and six were considered negative. In the case of the male dominance subscale, six statements were considered positive, and only five were considered negative.

An overall score was then calculated for each subscale by simply adding the scores from the positive and negative statements for each subscale. The highest score for each subscale was 60, except for the scale of male dominance, which had a high score of 55. The scores for these four attitude subscales were then used as dependent variables in our study.

We also inquired about demographic information including sex, class standing, major (if declared), expected grade in the course the student was enrolled in, type of high school the student attended (public or private), the number of science courses the student took in high school, and the number of math courses the student took in high school. For the number of science or math courses taken in high school, there was no distinction made of whether these courses were only a semester long or were a full academic year. The demographic items were then used as independent variables.

To analyze the data, a Multivariate Analysis of Variance (MANOVA) was conducted for each independent variable (sex, course, class standing, expected grade, major, type of high school, number of science courses, and number of math courses), with the four dependent variables of confidence, usefulness, male dominance, and perception of teacher attitudes. The results for each were then analyzed for significance using Wilks' Lambda, with an alpha value of 0.05. For tests having significance, a One-Way Analysis of Variance (ANOVA) was then conducted, followed by pairwise or multiple comparisons to find the source of the differences and significance.

The surveys were conducted throughout the third week of April, during the spring semester of 2005 at the University of Wisconsin-La Crosse. Students participating in the study were enrolled in one or more of the following introductory level general education science courses: BIOLOGY 105, CHEMISTRY 103, PHYSICS 104, MICROBIOLOGY 100, or EARTH SCIENCE 101. Only one section of each course was used for the study, and the section chosen from each course was randomly done, except for MICROBIOLOGY 100, which only had one section. The surveys were given during the lecture portion of the course, as opposed to during lab meetings.

Participation in the study was strictly voluntary. Students indicated their agreement to participate in the study by completing the survey, as was outlined in the directions of the survey. Prior to giving the survey, proper approval was obtained from the Institutional Review Board (IRB) for the Protection of Human Subjects at UW-La Crosse.

## RESULTS

For our study, the sample size consisted of 397 students. Of these students, 115 were male (29%) and 282 were female (71%). It may be helpful to note the overall population of UW-La Crosse is roughly 40% male and 60% female. Further frequency statistics obtained through the use of SPSS (Statistical Software for the Social Sciences), found that 221 students were Freshman (55.7%), 80 were Sophomores (20.2%), 67 were Juniors (16.9%), 26 were Seniors (6.5%), and three were noted as Other (0.8%). Table 1 lists all the frequencies of the demographic information obtained from this study.

Table 2 shows means and standard deviations of students' attitudes in each subscale (dependent variables), by the independent variables of course enrolled in and gender. Table 3 lists means and standard deviations of students' attitudes in each subscale (dependent variables) by the independent variables of expected grade and gender. These descriptive statistics demonstrate the differences in the mean values of the subscales based on certain independent variables.

Some interesting results of additional data analysis found that 77.3% of students took more than three science courses in high school and 83.9% took more than three math courses in high school. Also, 23.5% of males expected to receive an A in the course, while only 16.5% of females expected and A; of those expecting a C, 77.8% of them were female, while 22.2% were male.

It may also be interesting to note that of all the students enrolled in the College of Science and Allied Health, 75% were women.

**Table 1. Frequencies**

Factor	Level	Frequency	Percent
<i>Sex</i>	Male	115	29.00
	Female	282	71.00
<i>Class Standing</i>	Freshman	221	55.70
	Sopomore	80	20.20
	Junior	67	16.90
	Senior	26	6.50
	Other	3	0.80
<i>Course</i>	BIO 105	122	30.70
	CHM 103	98	24.70
	PHY 104	82	20.70
	MIC 100	43	10.80
	ESC 101	52	13.10
<i>Expected Grade</i>	A	73	18.40
	AB	96	24.20
	B	139	35.00
	BC	49	12.30
	C	36	9.10
	D	2	0.50
<i>High School</i>	Public	375	94.50
	Private	22	5.50
<i>Science Courses</i>	One	2	0.50
	Two	11	2.80
	Three	77	19.40
	More	307	77.30
<i>Math Courses</i>	One	1	0.30
	Two	6	1.50
	Three	57	14.40
	More	333	83.90
<i>College</i>	Undeclared	80	20.36
	BusAdmin	22	5.60
	HPR	79	20.10
	LibStudies	47	11.96
	SAH	164	41.73
<b>Total</b>		<b>397</b>	<b>100.00</b>

**Table 2. Descriptive Statistics**

Sex	Course	N	Confidence		Usefulness		Male Domain		Teacher's Attitude	
			Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Male	BIO	45	48.31	7.84	47.47	9.68	42.69	9.90	43.34	7.28
	CHM	18	50.00	7.28	50.33	8.88	43.61	9.21	43.67	6.70
	PHY	22	53.14	8.87	54.32	8.44	44.86	10.46	50.50	7.27
	MIC	6	37.50	10.17	34.83	7.68	43.17	7.91	38.83	5.56
	ESC	24	42.58	9.50	38.29	7.61	41.50	7.64	41.30	8.52
	Total	115	47.74	9.30	46.65	10.54	43.03	9.30	44.10	8.01
Female	BIO	77	46.34	8.84	50.05	8.64	49.32	4.84	44.66	6.22
	CHM	80	44.16	8.69	48.96	8.74	48.41	4.77	43.16	6.37
	PHY	60	50.80	8.17	54.20	6.58	49.18	4.25	48.33	7.51
	MIC	37	39.65	9.87	40.43	10.82	48.00	5.24	43.47	6.17
	ESC	28	42.21	7.82	39.07	10.56	48.07	4.37	42.14	6.39
	Total	282	45.38	9.33	48.27	10.07	48.74	4.71	44.61	6.84

**Table 3. Descriptive Statistics**

Sex	ExpGrade	N	Confidence		Usefulness		Male Domain		Teacher's Attitude	
			Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Male	A	27	54.26	6.16	51.33	8.29	43.78	9.18	50.04	6.35
	AB	29	49.79	6.18	47.83	9.08	44.34	6.97	45.10	7.20
	B	35	46.74	8.05	46.83	9.84	42.09	10.36	42.69	6.72
	BC	16	42.19	11.26	40.88	13.18	39.50	11.58	39.19	8.80
	C	8	33.75	7.01	37.38	10.85	46.88	5.64	36.50	5.63
	Total	115	47.74	9.30	46.65	10.54	43.03	9.30	44.10	8.01
Female	A	46	52.46	6.30	53.26	8.97	49.96	4.28	48.39	6.59
	AB	67	48.55	7.67	49.19	9.50	49.09	4.72	47.21	5.57
	B	104	43.95	8.61	47.15	10.11	48.51	4.50	43.13	6.53
	BC	33	41.33	9.23	45.70	11.37	48.67	4.81	42.97	6.91
	C	28	37.46	7.77	45.61	9.00	47.39	5.22	39.75	5.73
	Total	278	45.50	9.14	48.33	10.09	48.79	4.65	44.62	6.82

MANOVA tests found that the independent variables of sex, class standing, major, expected grade, course, and number of science courses all had a Wilks' Lambda p-value  $\leq .001$ , indicating there were areas of significance between the independent and dependent variables. The independent variable of number of math courses produced a Wilks' Lambda p-value of 0.234; however, significance was still found with one dependent variable. For the independent variable of type of high school, the Wilks' Lambda p-value was 0.72, and there were no locations of significance.

Following the MANOVA results, ANOVA tests and pairwise or multiple comparisons found the following significant differences among the variables:

- Males have more confidence than females
- Females perceive science as a male domain more than males do
- Students enrolled in PHY 104 have higher attitudes in the areas of confidence, usefulness, and perception of teacher than students enrolled in any of the other courses
- Students expecting to earn an A in their respective course hold the highest attitudes on the scales of confidence, usefulness, and perception of teacher
- Senior/Other level students exude the highest attitudes on the scales of confidence, usefulness, and perception of teacher
- On the scales of confidence, usefulness and perception of teacher, students with majors in the college of Science and Allied Health (SAH) have the highest attitudes

- On the scale of perception of subject as male dominated, students with majors in the college of Liberal Studies have the highest attitudes (see the field as male dominated)
- Students having more than three science courses in high school have higher attitudes in the areas of confidence, usefulness, and perception of teacher
- Students having more than three math courses in high school have higher attitudes on the scale of usefulness
- The type of high school attended (public or private) has no significance with the dependent variables

## DISCUSSION

Common to previous research conducted on the attitudes of men and women toward science, our study found males having more confidence in the subject matter of science than females. In addition, females perceived science as a male domain more than males did. This result is interesting since there tend to be more females committing to science-related majors at UW-La Crosse. However, since the population of this study contained many Freshman and many non-science majors, these results do seem probable.

Moreover, the findings of Seniors/Others having higher confidence in the subject matter, better sense of the usefulness of the subject matter, and higher perception of the teacher's attitudes, support the idea of experience leading to better attitudes. It would appear that more exposure to school and/or science could lead to more positive attitudes toward science. In addition, the finding that students having more than three science courses in high school have a higher attitude in the scales of confidence, usefulness, and perception of teacher's attitudes supports the reasoning that more experience leads to better attitudes toward science.

Similarly, students enrolled in majors falling under the College of Science and Allied Health (SAH) all had higher attitudes in the areas of confidence, usefulness, and perception of teacher's attitudes. This finding could also go to show that experience will affect attitudes toward science. It would seem likely that students in SAH have probably had more science-related courses, and therefore have developed a better attitude than students in other colleges. However, in the measure of science being a male domain, SAH students were second to those enrolled in the College of Liberal Studies, demonstrating that more exposure to science courses could also reduce the perceptions of science being male dominated. Interestingly, students who classified themselves as undeclared seemed to have quite high attitudes toward science, coming in second after SAH students. This result could be due to undeclared students taking a broad line of study that may expose them to more science courses than students enrolled in other colleges than SAH. It may also be a promising result in that undeclared students have a somewhat positive attitude toward science, which could lead them to choose a science-related major in the future.

The analysis of the independent variable expected grade found a not so surprising result; students expecting to receive an A had the highest attitude in the three scales of confidence, usefulness, and perception of teacher's attitudes. Following those expecting an A, were students expecting an AB, then B, BC, and finally C. It would seem logical that those students having a better attitude toward science would in turn expect to do better in a science course.

As for the courses themselves, students enrolled in Physics were found to consistently have the highest attitude on the scales of confidence, usefulness, and perception of teacher's attitudes. On the other hand, students in the Earth Science and Microbiology courses had the lowest attitudes. This finding could be the result of the fact that Earth Science and Microbiology are more often taken by students not majoring in a science-related field and seen only as a general education requirement, where Physics, Chemistry and Biology may be taken more by science-related majors as they are prerequisites for some science-related majors. In other words, there may be more students already seeking a science-related course of study in the Physics, Biology, and Chemistry courses as opposed to the students taking Earth Science and Microbiology courses.

It is interesting to notice that the number of math courses taken in high school only had significance with the usefulness of the subject. Considering that many science courses use at least basic levels of math, it would seem that previous math experiences might have an effect on science attitudes.

Finally, the finding that type of high school had no significant effect on attitudes toward science may not be completely accurate. From our sample, only 5.5% of the students attended a private high school, which may not be a large enough proportion to truly measure the difference in attitudes toward science.

All of the results of this study could lead to future investigations into attitudes toward science. As careers in science continue to grow rapidly, it is worth investigating further how and when students form their attitudes toward science and what can be done to improve those attitudes.

## LIMITATIONS

In future studies, it may be helpful to acquire the actual grade obtained by each student that completed the survey. Comparisons could then be done on the actual grade obtained versus a student's expected grade. In addition, the actual grade could even be used as a covariate in the analysis of attitudes toward science. Moreover, obtaining either a student's overall American College Test (ACT) score or ACT science score could have been more useful in analysis. Also, students in general education science courses that are not preparatory classes for science majors could be surveyed to get a more general perspective and eliminate any bias created by science majors in the general education courses.

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