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STUDENTS' ATTITUDES TOWARD INTRODUCTORY PHYSICS COURSE

ÖĞRENCİLERİN FİZİĞE GİRİŞ DERSİNE KARŞI TUTUMLARI

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ABSTRACT: The problem examined in this study deals with students' attitude toward physics among the freshmen and sophomore students who were taking first introductory physics course. In the study there were 176 students, and they were chosen sample of convenience from Florida Institute of Technology, Melbourne, Florida. 125 subjects were male students, and 51 subjects were female students. The survey instrument used had 18 statements relating to measure students' attitude toward physics. It was found that there was a significance result between male and female students' attitude toward physics. Male students have more positive attitude toward physics than female students. Also the result supported that there was a significance difference among the students' academic areas and students' attitude toward physics. Generally, the department of physics and space students' attitude is more positive than others. More negative attitude was found in Biology and Environmental Science and Oceanography students than the other academic departments.

Keywords: Physics, attitude, introductory physics course

ÖZET: Bu çalışma üniveritede ilk kez fizik dersi alan öğrencilerin fizik dersine karşı tutumlarını belirlemek üzere yapılmıştır. Çalışmaya Amerikanın Florida eyaletindeki Florida Institute of Technology üniversitesinden toplam 176 (125'i erkek, 51 de kız) öğrenci katılmıştır. Öğrencilerin fiziğe karşı tutumlarını ölçmek için 18 adet anket sorusu kullanılmıştır. Sonuçta kız ve erkek öğrencilerin fizik dersine bakış açısı arasında istatistiksel olarak önemli derecede farklılık bulunmuştur. Erkek öğrenciler kızlara göre daha pozitif bir bakış açısına sahip olduğu ortaya çıktı. Ayrıca öğrencilerin akademik alanları ile fizik dersine karşı bakışları arasında da önemli derece farklılıklar ortaya çıkmıştır.Genel olarak fizik ve astronomi öğrencilerinin tutumları diğerlerine göre daha pozitif bulunmuştur. Biyoloji, Çevre Bilim ve Oşinografi bölüm öğrencilerinin fizik dersine bakış açısı diğer bölümlere göre daha negatif çıkmıştır..

Anahtar sözcükler: Fizik, tutum, fiziğe giriş dersi.

1. INTRODUCTION

Attitude was explained by Allport (1954), as "The term itself may not be indispensable but what it stands for is" (p. 45). Even if one's behavioral intentions and subsequently behavior, and the relative personal importance of attitudinal and normative considerations, a pedagogical approach that even consider student's attitudinal interrelationships may provide promise toward positively enhancing science-related attitudes. Ajzen (1989) expanded the theory of reasoned action to the prediction of behavioral goals in his theory of planned behavior. Based on this model, many researchers have examined attitudes by studying the variables that influence it or by examining its relationship to a specific behavioral goal such as achievement (Albert, Aschenbrenner, & Schamolhover, 1989).

In addition to increasing interest in student's attitudes and their relationship to student behavior, there has developed a real concern about gender differences in the academic area. The American Association of University Women (AAUW) (1991) reported that as girls grow up they lose confidence in their academic abilities and lower their career aspirations.

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1.1. Purpose:

The purpose of this study was to examine gender differences in students' attitudes toward physics and identify any differences between academic major and attitudes toward physics.

1. 2. Significance of Study:

In fact, physics is a challenging subject. The time and effort required for the successful completion of any physics course tend to rank among the highest of courses offered at a comparable level at the university. What are the reasons that gender differences play very important role to taking physics course? Is there any distinction between their academic major and attitudes toward physics? To understand and investigate this kind of divergence, this study is going to play very important role. Also the research results are important in two ways:

First, if there is a difference between male and female students' attitudes toward physics, what kinds of approaches can be made by the university or high school teacher to change this attitude or what can we do as educators to change this attitude? Are they resistant to change? The more research that could be made the reasons of these kinds of difference attitude sources and finds them some remedies.

Second, if there is a difference between students' academic areas and their attitudes toward physics, we should find this discrepancy and its reasons. The high school teachers and university professors could change their attitudes toward students to teach physics better or what kinds of prevents could be made by the educators?

1. 3. Research Questions:

The goal was to answer the following questions:

1. Are there gender differences in student attitudes toward physics?
2. Is there a distinction between attitudes toward physics and student major area?

1. 4. Hypotheses:

Null Hypotheses to be tested:

1. There is no gender difference between male and female students' attitudes toward physics (H_o: m_1-m_2=0; m_1: male students mean; m_2 : female students mean).
2. There is no divergence between students' attitudes toward physics and their major areas.

2. LITERATURE REVIEW

Research in science education indicates that gender may also influence attitudes toward science. Simpson and Oliver (1985) in multidimensional study among approximately 4,000 students in grade six through ten, found that boys exhibited significantly more positive attitudes toward science than girls. This was true with each grade level. Baker (1983) found girls to have more negative attitudes toward science than boys, but still to have higher science grades. Pogge (1986) came on, in a study of 1200 students enrolled in grades four, five, and six, that a majority of the students have a positive attitude toward science. This was true for all grade levels. Lowery, Browyer and Padilla (1980) reported that attitudinal differences between the sexes within both the control and experimental group. In both groups the boys showed more positive attitudes toward science than girls. Barrington and Hendricks (1988) reported no gender differences with regard to attitudes toward science with gifted and average students. Johnson (1987) found that girls showed less interest in physical science concepts. Talton and Simpson (1986) explained that self-vari-

ables accounted for 38% to 55% of the variance in student's attitude toward science; family variables accounted for 13% to 19% of variance; and classroom environment variables accounted for 46% to 73% of the variance.

Bohardt (1975) has shown that students' attitudes and feelings toward science remain positive until the 6th or 7th grade. Oliver and Simpson (1987) reported that rural and city students with high science self-concept were more likely to continue to take science courses beyond the minimum requirement. Ethington and Wolfe (1988) reported that the number of math and science courses taken in the high school by females in 1980 was the predominant factor in their model of influences on fields of study. The greatest direct impact on selection of majors was the number of math and science courses taken in the high school; in addition this number served as a mediating variable for all indirect influence, other significant effects were the initial choice of quantitative field of study as high school sophomore and student's background characteristics. Talton and Simpson (1985) found that both males and females had similar patterns of relationships between favorite subjects and attitude toward them.

According to *Physics at the Crossroads* (Hilborn, 1996), the physics community must make an important decision to improve physics education. *Physics at Crossroads'* stated goals reflect the ideas of introductory physics students becoming actively involved and learning in the context of the real world. The *Physics at the Crossroads* report suggests that if the revitalization were to occur, a wider range and a large number of students would be attracted to physics courses. Harrison et al. (1999) focused on one-student cognitive and affective changes, which occurred during the 11th grade in heat and temperature concepts. Classes of five grade 11 boys were taught heat and temperature using the physics by inquiry materials (McDermott, 1996) during 40-45 minutes periods over eight weeks. Three of the five students demonstrated conceptual development whereby their understanding of heat and temperature was restructured in a scientific direction. Four of the five students progressively adopted scientifically precise language, and the consistent verbal and written use of scientific terminology by three of the students supported the belief that they understood the concepts they described (Harrison, Grayson, & Tregust, 1999).

Summary of findings of previous studies:

Boys exhibited significantly more positive attitudes toward science than girls for every grade level (Lovery, Brewyer, Padilla, 1980; Oliver and Simpson, 1990, and Pogge, 1986; Eryılmaz, 1992; Özyürek and Eryılmaz, 2001). Girls have more negative attitudes toward science than boys, but they still have higher science grades (Baker, 1986). Hendicks (1988) found no gender differences with regard to attitudes toward science with gifted and average students.

3. METHODOLOGY

3. 1. Population:

The target population consists of all university freshmen and sophomore students enrolled in the first year introductory physics courses in Florida. The accessible population is freshmen and sophomore students enrolled in the first year introductory physics courses at the Florida Tech, Melbourne, Florida, in the U.S.

3. 2. Subjects:

The study sample was chosen from accessible population using a sample of convenience. In the study, there were 176 students. 125 subjects were male, and 51 subjects were female students. Physics professors at Florida Institute of Technology in the study agreed and allowed to use the survey developed by researcher.

3. 3. Instrument:

There was one instrument in the study consisting of 18 statements of to be measured student's attitudes toward physics. Researcher has developed this instrument because a thorough literature review indicated that there was no such a instrument measuring the same contents. This instrument similar to Likert scale but instead of five scales (strongly agree, agree, disagree, etc.), this has ten options to choose feeling toward physics. For example: If the student thinks a statement is very true of them, they are going to circle 10; if he or she thinks a statement is not at all true of them, they are going to circle 1. If the statement is more or less true of them, they are going to choose the number between 1 and 10 that best describes their feeling (See appendix). This instrument is more flexible and has more choice than Likert scale. Because ten different scales could give more accurate result, rather than five different scales can.

In the survey there are four validity threats: mortality, location, instrumentation, and instrument decay. A mortality that arises in longitudinal studies, but in this study there was no longitudinal period or treatment period. Subjects were used only once. The missing data was not important, because the percentage of missing data was lower than five percent. Therefore, there was no mortality problem. The location was students' their normal classroom; therefore, there was no effect to responses. Instrument decay can occur in interview surveys if the interviewers get tired, but in this study survey consists of 18 short statements and would not take much time to get tired or rushed or these kind of negative effects. The internal reliability of the survey was calculated by using Cronbach's Alpha formulae and found 0.95.

3. 4. Procedures:

This instrument was used at Florida Tech freshmen and sophomore students who were taking first physics introductory course at the Florida Tech before. At that time there were about 185 enrolled students could participate this research. Total 176 students took this survey. Table 1 shows the distribution of the students and their academic areas. To do this survey, it was asked physics department professor. And then data were collected.

Table 1: Students and Their Academic Areas.

	Male	Female	Total
Aeronautics	4	0	4
Biology	6	11	17
Computer Science	11	0	11
Engineering	91	24	115
Env.Sc.Oceanog.	2	4	6
Physics & Space Sc.	7	7	14
Science & Math Ed.	4	5	9
Total	125	51	176

N = 176

After collecting data, the results were classified first as male and female to calculate ANOVA test. Second, the data were classified as academic areas (physics, engineering, etc.) to calculate ANOVA interactions as detail explanation given below.

3. 5. Data Collection and Analysis:

Before doing any calculations and statistics, the eighteen survey questions were classified as positive and negative statements. Negative statement (for example in the survey question number two, four, etc., see appendix) scores were subtracted from 11 and then the total scores summed up for each student. After defining total score for each student from the survey, first, it was used ANOVA to compare whether there are differences between female and male students' attitudes toward physics or not.

Secondly, to investigate and show distinction between students' majors and their attitudes toward physics, also it was used the ANOVA interactions. In order to test a hypothesis involving two or more variable means, we use the analysis of variance (ANOVA) technique. And then after calculating ANOVA inter-

actions among the academic areas and students' attitude toward physics, the Scheffe test was used for every two academic area. The Scheffe test uses an F-ratio to test for a significance difference between any two variable conditions. To compare female and male students' responses, the alpha level was considered as a 0.01.

Limitations:

There are some source of confounding variables that might be important for students to selecting of any academic area and attitudes toward physics. These are: age of the participants, high school background, GPA, teacher differences, etc. must be considered and important, but we cannot control these kinds of extraneous variables at this time in the research.

4. RESULTS

Table 2 presents female and male students mean, standard deviations (SD), degree of freedom (df), and F score.

It can be seen that the result of F ratio of the female and male students is $F(1,175) = 27.24$ $p< 0.01$. It means the data support that there is a significance difference male and female students' attitudes toward physics. Male students' attitudes are more positive than females.

Table 2: Number of students (n), mean, Standard deviation, df and F value of the male and female students.

	n	mean	SD	df	F
Male	125	118.7	29.9	1,175	27.24
Female	51	89.9	40.3		

*a = 0.01 N= 176

After, to find out if there is any difference between academic areas and students' attitudes toward physics, the ANOVA interactions were calculated. The table 3 shows the results.

The results of all academic areas ANOVA interactions show that there is a significance difference every academic areas and students' attitudes toward physics with $F(6,169) = 9.36$ $p< 0.01$. Therefore, to find out which academic area shows significance difference from another one we have to use Scheffe test. The table 4 shows this Scheffe's test results.

Table 3: Academic areas and mean, standard deviation and F ratio.

	n	mean	SD
Aeronautics	4	102.25	14.97
Biology	17	74.35	30.13
Computer Science	11	106.90	32.67
Engineering	115	115.89	32.61
Env. Sc. & Ocean.	6	62.82	18.71
Phys & Space Sci.	14	140.71	36.77
Sci & Math Edu.	9	86.33	29.21
	df	F ratio	
All academic areas	6,169	9.36*	

*a = 0.01 N= 176

The result obviously shows and supports that male students' attitudes toward physics are more positive than female students'. Also there is a significance difference between students' academic areas and their attitudes toward physics. It can be seen from table 4 that in every interaction between physics and space students and the other academic area students, there are significance differences. Another word, physics and Space departments students' attitude toward physics more positive than the other academic areas. Also according to Scheffe test result, the most negative attitude toward physics comes from biology and environmental science and Oceanography students.

5. DISCUSSION and CONCLUSION

The findings from this study suggest that male students have shown a more positive attitude toward physics than female students, and also there are differences among the students' academic areas and their attitudes toward physics. Also more research is needed to determine why some types of academic fields and female students produce different attitudes than others. The conformational identification of significant differences between female and male students and also their academic areas of the subject research result must be considered during the both daily lesson presentation and general curriculum review. Also the educators must consider the existence of the relationships with an insight into the potential attitudinal influences of their pedagogical activities. Rather than finding out years later that there was no change in students' attitude toward physics (especially female students) in the positive direction, the content of the textbooks or teachers' attitudes toward students or etc. need to change. Educational community has realized that "Reform is needed in science education" (Hart & Robottom, 1990, p.584).

There are some implications for further research.

The first is the practical need to continuing researches that examines strategies in the classroom for improving all students' attitudes toward physics, especially those of female students. *The second* is the need to explain the question of why and when attitudes begin to change. *The third* is gender differences that it needs to be studied by race, students' background, teachers' attitudes toward them, or etc. in order to find out any differences or relationships.

Table 4: The results of Scheffe's test.

Interactions	df	F ratio
Aeronautics & Biology	6, 169	0.4
Aeronautics & Engineering	6, 169	0.7
Aeronautics & Envir. Sci.and Oceanography.	6, 169	3.63
Aero. & Computer Sci.	6, 169	0.06
Aero. & Physics and S Sci.	6, 169	4.49
Aeronautics & Science and Math Education	6, 169	0.68
Biology & Engineering	6, 169	24.93*
Biology & Environmental Sc., and Oceanography	6, 169	0.57
Biology & Computer Sci.	6, 169	6.90*
Biology & Physics and Space Science	6, 169	32.98*
Biology & Science and Math Education	6, 169	0.82
Engineering & Envi. Sc., and Ocean.	6, 169	15.66*
Engineering & Comp. Sci.	6, 169	0.79
Engineering & Physics and Space Science	6, 169	7.50*
Engineering & Science and Math Education	6, 169	7.11*
Envi. Sc. ,and Ocean. & Computer Science.	6, 169	7.35*
Env. Sc., and Ocean. & Physics and Space Sc.	6, 169	24.84*
Env. Sc., and Ocean. & Science and Math Ed.	6, 169	1.93
Computer Science & Physics and Space Science	6, 169	6.86*
Computer Science & Science and Math Ed.	6, 169	2.04
Physics and Space Sc. & Science and Math Ed.	6, 169	15.80*

*a = 0.01 N= 176

REFERENCES

Ajzen, I. (1989). Attitude structure and behavior. In A. R.. Pratkanis, S. J. Breckler, & A. G. Greenwald (Ed.). Attitude structure and function , 241-274. Hillsdale, NJ: Erlbaum.

Albert, D., Aschenbrenner, K. M, & Schmalhofer, F. (1989). Cognitive choice process and the attitude-behavior relation. Attitudes and behavioral decisions (pp. 61-99). New York: Spriger-Verlag.

Allport, G. W. (1954). Attitudes in the history of social psychology. In G. Lindzey (Ed.), Handbook of Social Psychology. Reading MA: Addison-Wesley.

American Association of University Women. (1991). Summary: Shortchanging girls, shortchanging America. Washington, DC.: Author.

Baker, D. R. (1983). The relationship attitude, cognitive abilities, and personality to science achievement in the junior high school. Paper presented at the annual meeting of National Association of Research in Science Teaching, Dallas, TX.

Barrington, B. L., & Hendricks, B. (1988). Attitude toward Science and Science knowledge of intellectually gifted and average students in 3rd, 7th, and 11th grades. Journal of Research in Science Teaching, 25, 679-687.

Bohardt, D. C. (1975). Attitudes toward process-based science instruction by students and grades through eight. Dissertation Abstracts International, 35, 7631A.

Eryılmaz, A. (1992). Students' preconceptions in introductory mechanics. Unpublished Masters Thesis, METU.

Ethington, C. A., & Wolfe, L. M. (1988). Women's selection of quantitative undergraduate fields of study: Direct and indirect influences. American Educational Journal, 25, 157-175.

Harrison, A., Grayson, J. D., & Treagust, F. D. (1999). Investigating a grade 11 students' evolving conceptions of heat and temperature. Journal of Research in Science Teaching, 36 (1), 55-87.

Hart, E. P., & Robottom, I. M. (1990). The science-technology-society movement in science education: A critique of the reform process. Journal of Research in Science Teaching, 27, 575-588.

Hilborn, R. (1996). Physics at the crossroads. A report published by American Association of Physics Teacher.

Johnson, S. (1987). Gender differences in science. Parallel in interest, experience and performance. International Journal of Science Education, *9*, p.467-481.

Lowery, L. R., Bowyer, J., & Padilla, M. J. (1980). The Science Curriculum improvement study and student attitude. Journal of Research in Science Technology, 17, 327-355.

McDermott, L. C. (1996). Physics by inquiry. New York: Wiley.

Oliver, J. S., & Simpson, R. D. (1990). A summary of major influences on attitude toward and achievement in science among adolescent students. Science Education, 74 (1), 1-18.

Özyürek, A., & Eryılmaz, A. (2001). Factors affecting students towards physics. Eğitim ve Bilim, 26 (120), 21-28.

Pogge, A. F. (1986). The attitudes toward science and science technology of the teachers and students at Baldwin International School, Quincy, Illinois (Doctoral dissertation, University of Iowa, 1986). Dissertation Abstracts International, 17, 07A.

Simpson, R .D., & Oliver, J. S. (1985). Attitudes toward science and achievement motivation profiles of male and female science student's in grades six through ten. Science Education, 69, 511-526.

Talton, L. & Simpson, D. (1985). Relationships between subject preference, gender, and attitudes toward science. Paper presented at the annual meeting of National Association for Research in Science Teaching, French Lich Spring, IN.

Talton, L. & Simpson, D. (1986). Relationships between peer and individual attitudes toward science among adolescent students. Science Education, 69 (1), 19-24.

APPENDIX: The Survey

Your Gender ☐ Male ☐ Female

Your Major: ☐ Aeronautics ☐ Biology ☐ Chemistry ☐ Communication
☐ Engineering ☐ Mathematics ☐ Physics
☐ Science Education ☐ Other ———

Each of the statements below expresses a feeling toward physics. Please respond to the following statements by circling the number that best describes your thought. For example, if you think a statement is very true of you, circle 10; if you think a statement is not all true of you, circle 1. If a statement is more or less true of you, circle the number between 1 and 10 that best describes you.

	Not at all true of me / Very true of me
	1 <——————> 10
1. Physics is very interesting to me. ……..	1 2 3 4 5 6 7 8 9 10
2. I don't like physics and I am afraid to take it. ……..	1 2 3 4 5 6 7 8 9 10
3. Physics is fascinating and fun. ……..	1 2 3 4 5 6 7 8 9 10
4. I am always under a terrible straining physics class……..	1 2 3 4 5 6 7 8 9 10
5. I am comfortable with physics and at the same time it is stimulating……...	1 2 3 4 5 6 7 8 9 10
6. In general, I have good feeling toward physics. ……	1 2 3 4 5 6 7 8 9 10
7. Physics makes me uncomfortable, restless, irritable, and impatient……..	1 2 3 4 5 6 7 8 9 10
8. I dislike physics……	1 2 3 4 5 6 7 8 9 10
9. I approach physics with hesitation…….	1 2 3 4 5 6 7 8 9 10
10. I really love physics. ……..	1 2 3 4 5 6 7 8 9 10
11. I have enjoyed studying physics. ……	1 2 3 4 5 6 7 8 9 10
12. It makes me nervous to even think about doing physics experiments or problems…...	1 2 3 4 5 6 7 8 9 10
13. I like physics because of my teacher……...	1 2 3 4 5 6 7 8 9 10
14. Physics is not usable in daily life situations, and is not important to learn……...	1 2 3 4 5 6 7 8 9 10
15. I feel definite positive reaction to physics……..	1 2 3 4 5 6 7 8 9 10
16. I participate in physics discussions often, and it is enjoyable……	1 2 3 4 5 6 7 8 9 10
17. The textbook is not helpful.……	1 2 3 4 5 6 7 8 9 10
18. I would be happy to take more physics courses…….	1 2 3 4 5 6 7 8 9 10