Factors Influencing Enrollment in Kansas High School Physics
by
Todd VanGorden and Tim Slater

Physics concepts are an important part of the foundation for many occupations. However, enrollment in high school physics courses is low. Nationally, fewer students enroll in physics than in other high school science course (Farmer, 1993). The purpose of this descriptive study is to identify major factors that influence high school physics enrollment in Kansas. These factors include both school-based influences and student-based influences. Although the results of this study are descriptive rather than prescriptive, the results provide insights for increasing high school physics enrollment.

The American Institute of Physics reported that in the 1986-87 school year 18% of American high schools rarely or never teach physics (Neuschatz and Covalt, 1988). If students are not given opportunities to take physics, or if physics enrollments are not adequate, the US may develop severe shortages of engineers and scientists. This may limit US competitiveness in global science and technology for the 21st Century.

Only a few studies have been conducted to determine physics enrollment influences. A study in Texas by Crawley and Black (1992) discovered that students in Texas have enrollment intentions that are determined by their attitude toward enrollment and their degree of perceived behavioral control. Grade level, career goals, and family members were found to influence students' attitudes and support enrollment. On the other hand, conflicts with other courses and extracurricular activities and a fear of failure were found to inhibit students' physics enrollment.

Surprisingly, gender was not reported to play a strong role in shaping personal beliefs about the consequences of enrolling in physics in the Texas study. An earlier study with conflicting results regarding gender is the research of Ormerod and Duckworth (1975). They found physics (and chemistry) to be preferred and more widely chosen by boys than girls. These authors also reviewed research regarding the influence of science teachers on students' attitudes toward science. Initial British and American studies showed conflicting results of science teacher influence (British -- teacher not influential, American -- teacher influential). However, later studies (Kahn and Weiss, 1973, and Ramsey and Howe, 1969a and b) concluded that the role of the teacher is important in the development of students affective behavior over education. Efficiency, style, and personality of science teachers can affect attitudes toward science.

Sobolewski (1993) reviewed educational data from schools in New York state and considered variables of school facilities, community size, and the teacher's years of experience and educational background to influence physics enrollment. This researcher found that large communities have disproportionately lower high school physics enrollments than do smaller communities.

Recently, the authors of this article conducted a study to identify the factors influencing enrollment of physics classes in Kansas high schools. This study involved

Todd VanGorden, Director; Science Education Center; Pittsburg State University; Pittsburg, KS 66762; and Tim Slater, Montana State University; Department of Physics; Bozeman, MT 59717
the analyses of data from two questionnaires that were administered to students in 13 Kansas high schools.

The first questionnaire was administered to 200 sophomores and juniors from five Kansas high schools. This questionnaire contained only two questions: 1. Did you enroll in physics? and 2. Why or why not?

After reviewing the responses to the initial questionnaire, the second questionnaire was developed and sent to 589 high school juniors. The second questionnaire consisted of 17 statements (see Figure 1) in which students were asked to respond to on a 5-point Likert scale ranging from “strongly disagree” to “strongly agree.” Approximately half of the statements were written in the tense describing the statement as being a positive factor, and half in the tense considering the statement as not being a factor, influencing physics enrollment. This questionnaire contained two additional questions: 1. Did you enroll in physics? and 2. Are you male or female?

The initial questionnaire contained two reoccurring responses: "I do not know why I did/did not enroll in physics" and "I do not know what physics is." This suggests that these factors influencing physics enrollment are important even though they were not noted in previous studies reviewed prior to this study. Questions 16 and 17 on the second questionnaire are a result of those responses. As pointless as these statements might appear, a number of individuals not enrolling in physics agreed that "I do not know what physics is" (25.8%).

This study identified two major factors affecting student enrollment in high school physics: 1) students' perceived need to enroll in physics; and 2) school influences.

Students who enroll in high school physics are likely to see a need to enroll in physics in college. These students do not think physics is too difficult for them, nor will a fear of failing physics or a possible lowered GPA prevent many from enrolling in physics. On the other hand, students who did not enroll in physics were concerned with failure and a lowered GPA.

The majority of students enrolling in physics have a positive view of the teacher—the teacher is liked by the student, and the student thinks the teacher has a good reputation.

1. Physics is too difficult for me.
2. I will need physics for college.
3. I think the physics instructor has a great reputation.
4. If I take physics I will have too much homework.
5. I am interested in physics.
6. I like the physics instructor.
7. I have a fear of failing physics.
8. If I enrolled in physics, it would interfere with my extracurricular activities (sports, clubs, etc.)
9. My parents want me to take physics.
10. I can't take physics because other courses I need conflict with the physics course.
11. I want to enroll in physics because I have friends enrolled in physics.
12. My brothers or sisters want me to take physics.
13. If I take physics, I will hurt my grade point average.
14. I can't take physics because I haven't taken the prerequisites (such as algebra or chemistry).
15. I want to take physics because my boyfriend / girlfriend has enrolled in physics.
16. I have no idea why I didn't enroll in physics.
17. I do not know what physics is.

Figure 1. The 17 statements listed on the second questionnaire.
Approximately half of the students not enrolling in physics were neutral in response to the reputation of and a liking for the physics teacher. These results support the studies reviewed in Ormerod and Duckworth (1975) in which the role of the teacher is an important factor in students' attitudes toward science. Students who know the teacher are more likely to enroll in physics than those who do not. Also, teachers with a good reputation throughout the school will likely attract students to physics, or any subject taught. The results of this study are also consistent with Sobolewski (1993); the experience of the teacher was found to be a latent variable influencing physics enrollments.

Many of the students were also neutral in their views of the need for physics in college and the difficulty of physics. Of students not enrolling in physics, 25% did not know what physics is. Another 25% reported a neutral to this statement on the questionnaire. These students have not been convinced of the benefits of taking physics, nor do they know what to expect from the course or the teacher.

Another factor significantly affecting enrollment is conflicting schedules of needed, required, or wanted classes with the physics classes. (For example, one school participating had band scheduled at the same time as the only physics course. Furthermore, prerequisites may prevent some students from enrolling in physics. School counselors, administrators, and physics teachers need to work together to provide a strategic schedule for physics to prevent conflicts with other important courses. In addition, counselors need to strongly encourage students to take physics prerequisites early in their high school career so that the option to take physics remains open.

The differences between males and females in the authors' study contradicted the results of Crawley and Black (1992). However, they did agree with Ormerod and Duckworth (1975) in that higher percentages of males were interested in physics than that of females, although only a slightly higher percentage of males enrolled in physics (27%) than females (25%). Females seem to see a need to take physics (perhaps college) and therefore enroll in it even though they might not be interested in the subject.

In order to increase high school physics enrollment, science teachers (physics in particular), counselors, and other teachers need to provide students with reasons to enroll in physics. Students who see a need for physics, students who become interested in physics, and students who view the teacher as positive and caring will likely enroll in physics. Grote (1994) found that he could significantly increase enrollments by talking to selected classes in school, performing demonstrations, and passing out brochures to inform students about physics. Students who know what to expect are more likely to take physics than those who do not. Students' fears about enrolling in physics should be addressed, particularly those of female students. Efforts to encourage female science enrollments have been made, and should be continued.

Grote (1994) also reports on the importance of showing care for students. He recommends to each teacher to find methods of showing students he or she cares, fitting his of her own personality. Grote suggests giving cards or notes to students for birthdays, congratulations, and before athletic or academic competitions. Students are likely to respond with interest in the course when teachers show interest. Furthermore, classroom activities can be related to student hobbies and interests, such as physics night at the basketball game, or by giving problems related to students' interests.

Robinson (1991) found similar methods valuable for increasing physics enrollments. Teachers should first change their attitudes
about having a wider range of students enrolling. Students from less well-prepared math and science backgrounds should be permitted and encouraged to enroll in physics. Robinson also recommends more effective physics instruction by using many demonstrations and laboratory activities, which are attractive to a wider range of students. Finally, the course should be made relevant to students' lives by incorporating the strategies of Grote with the use of current events in the world via newspapers, magazines, and television.

The results of the authors' study support the recommendations of Grote and Robinson. The attitude, expertise, and reputation of the physics teacher are vitally important in the attraction of high school students to physics. Physics teachers (and essentially all teachers) must be aware of the direct influence they have on enrollment and interest in their courses. These influences must be addressed to prevent many talent pool shortages in scientific careers. The US must be capable of competing in a changing global society.

References


