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RETAINING STUDENTS IN THE SCIENCES

Many students entering college for the first time are not ready to succeed in college-level science courses, irrespective of their major. Science educators at our college have observed that unsuccessful students in entry-level science courses often have inadequate basic skills, such as poor reading comprehension, weak computational skills, and insufficient writing abilities. We were curious about skills and skill levels that successful students brought to help them pass a beginning science course. We decided to study the grade distribution of students in entry-level biology, chemistry, physics, astronomy, geography, and geology courses in relation to their reading, writing, and math levels.

Our study was designed to answer this question: What reading, math, and writing levels are necessary for success with a grade of C or better in entry-level science courses? We also wanted to determine which combinations of math, reading, and writing levels are the best predictors of success.

We selected 248 students from 10 entry-level science courses, using a random-number-generating program. These courses included General Biology (Majors), Preparation for General Chemistry, Introductory Physics, Biology Concepts, Introductory Chemistry, Solar System (Astronomy 1), Physical Geography: Weather and Climate, Introductory Geology, Human Biology for Allied Health, and Fundamental Chemistry.

Five students from each grade category—A, B, C, D, and Y/F—were included for each course (in one chemistry course we found only three D students). Student withdrawals (W) were not used (as some non-academic reasons for withdrawal are possible). However, we did include the Y grade (instructor withdrawal) because some faculty prefer it to giving an F. We had 48% females and 52% males in the study, evenly distributed within the different ethnic groups: 59.7% White/others, 29.8% Hispanic, 4.4% Native-American, 3.2% Asian-American, and 2.8% African-American. This sample population reflected the ethnic composition of our college. Using a chi-square for analysis, we found no biases of ethnicity or gender by grade level.

The math, reading, and writing levels of these students were determined either by previous courses taken and passed with a C or better, or by a college-administered assessment test (reading assessment was the Nelson-Denny Reading Test; math and writing assessments were created internally by faculty).

We used a chi-square statistical analysis with cross-tabulations of variables in two-way tables to make group comparisons. This method was appropriate to the stratified random sample in which we investigated the relationship between past curricular experience and present science classroom performance. [This analysis reveals the probability of a relationship between two variables—for example, the relationship between previous math and current science grades.]

Reading level had a significant relationship with the five grade categories, indicating that the most successful science students performed well at the highest reading levels. More than 75% of all students reading at or above the 15th grade level were successful (C or better); and of all students reading at 13th or 14th grade level, 60.6% were successful.

Math level also had a significant relationship with the five grade categories; the most successful science students had completed a course above intermediate algebra. More than 75% of these students were successful; of all students completing only intermediate algebra, 60.4% were successful.

We also found a significant relationship between combined reading and math levels and success in the sciences. Students reading at the 13th grade or higher were much more successful in the sciences if they had completed a course above intermediate algebra. Of all students with this combination, 82.1% were successful.

We were unable to reach a firm conclusion about the influence of writing on success in the sciences. This may be due to the fact that nearly 75% of all students sampled were already at or above the Writing I level (freshman composition).

Our conclusion was that a combination of reading and math proficiency is a strong predictor of success in

the sciences. The findings from our study indicated that students reading at least at 13th grade level who had completed a math course above intermediate algebra had an 82% success rate in their entry-level science class.

Recommendations

We recommend to interested students, counselors, and program planners that students enrolling in entry-level science courses should have:

- A minimum of 13th grade reading-level proficiency to enroll in entry-level science courses.
- Successful completion of a course at or above the intermediate algebra level before taking any entry-level science course.
- Successful completion of freshman composition or higher.

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CREATIVITY IN TESTING

Can testing be a learning tool, a medium for pooling ideas and concepts, or a situation where students can internalize information learned and retain more? Open-note and group tests can offer such learning opportunities.

Open-Note Tests

Some instructors argue that open-note tests compromise effectiveness because students do not have to learn the material—it is "all right there in front of them." Well, is it *really* there? How do we or our students know that their class notes will be useful resources? Students should be encouraged to take notes and given a method by which to judge the effectiveness of their note-taking. Review students' notes, make suggestions for improvement, lead students through note-taking exercises, and offer them opportunities to judge their note-taking methods. Employed early in the semester, this testing format allows time for students to diagnose, practice, and improve their techniques.

Group Tests

Students are either organized into assigned groups or choose their own. Students may work through exam questions with others or work individually and then share their results. In the group-testing format, students teach the procedures they use to work the problem, verbalizing their processes and results.

Students indicate that group testing reduces anxiety and increases their ability to concentrate. They report that in explaining problems to group members, they gain a better understanding of what they are doing, gain confidence in doing it, and feel proud of their performance.

Expanding Learning Opportunities

Not every test is appropriate for the group- or open-note format. However, the ultimate goal is achieving valuable learning outcomes that will continue beyond the classroom.

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