PREDICTING SUCCESS IN PHYSICAL SCIENCE AT MINNESOTA VALLEY LUTHERAN HIGH SCHOOL USING THE TERRANOVA COMPREHENSIVE ACHIVEMENT TESTS

by

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Using the TerraNova Comprehensive Achievement Test

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Abstract

The usefulness of the TerraNova Comprehensive Achievement Test in predicting success in Physical Science, a freshman level science class, was explored in this study. The eighth grade TerraNova math, science, and reading composite scores for 123 students at Minnesota Valley Lutheran High School were compared to their first and second semester grades in Physical Science. Results indicated that a combination of the math and reading composite scores was the most useful in predicting first semester grades, and a combination of the math, science, and reading scores was the most useful in predicting the second semester grades.

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CHAPTER I: THE PROBLEM

Introduction

The first year of high school can be both the most exciting and the most stressful time up to that point in a person's life. The excitement and stress can be caused by the new social atmosphere of high school, high expectations, and a focus on the skills needed in the future for college and/or an occupation.

Problem Statement

Some students struggle with the increased level of difficulty in science classes during their freshmen year. Since high school science classes, especially the physical sciences, integrate mathematics on a regular basis with textbooks that use a higher level of vocabulary than textbooks previously used in elementary school, students with less math or reading skills may find science classes less enjoyable. Early identification of students who struggle may be an important step to get them the help they need and to keep them from getting discouraged.

Purpose of the Study

The goal of this non-experimental ex post facto study was to determine if the TerraNova Comprehensive Achievement Test (2000, second edition), which most of the incoming Minnesota Valley Lutheran High School (MVLHS) students take in the eighth grade, can be used to predict success in the required freshman MVLHS course, Physical Science. This study gives information about the predictive ability of the TerraNova Comprehensive Achievement Test and will help the high school serve its students by meeting their academic needs and by maintaining their interest in science.

Research Questions

This study looked at the following questions using the recent MVLHS students' eighth grade TerraNova Comprehensive Achievement Test results and final grades in Physical Science:

1. What was the relationship between students' first semester grades in the MVLHS Physical Science course and their eighth grade TerraNova Comprehensive Achievement Test composite science, math, and reading scores?

2. What was the relationship between students' second semester grades in the MVLHS Physical Science course and their eighth grade TerraNova Comprehensive Achievement Test composite science, math, and reading scores?

Definition of Terms

Standardized Test.

A test that is administered and scored in a consistent manner under controlled conditions.

TerraNova Comprehensive Achievement Test.

A standardized test developed by CTB/McGraw-Hill (California Testing Bureau is a division of the McGraw-Hill publishing company) used in elementary schools that is a comprehensive test of basic skills.

Physical Science.

The branch of science that studies non-living things. Many students in ninth grade take a class called Physical Science that is the introduction to Physics (the science of motion, space and time) and Chemistry (the science of composition, structure and properties of matter).

Assumptions and Limitations of the Study

This study focused on the students in the graduating classes of 2009 and 2010 at MVLHS. The teachers, textbook, style of instruction, and method of assessment were consistent during the two years being studied.

The results of this study may be difficult to apply to schools that have enrollments dissimilar to MVLHS (9-12 enrollment: 250), since different sized high schools have more or less offerings in the science curriculum during the first two years. The size of the sample and the size of the high school were also limiting factors. The use of the final grades in courses may limit the usefulness of this study outside of MVLHS, since they are subject to an individual teacher and his or her methods of instruction and assessment.

Methodology

This study used the eighth grade standardized test results and the ninth grade science grades of 104 students from the MVLHS graduating classes of 2009 and 2010. The scores were analyzed using a multiple regression to determine the usefulness of using eighth grade standardized test results to predict success in ninth grade science.

Summary

Many students look forward to studying science at the high school level, so it is important that teachers have accurate information about their students to keep them engaged and excited about science. Because most eighth grade students take standardized tests, examining their usefulness in predicting future successes or challenges is beneficial. Since science, math, and reading skills are all used in Physical Science, it is useful to know the predictive ability of each of them.

CHAPTER II: LITERATURE REVIEW

Introduction

The transition for students from eighth grade to high school can be stressful. The reasons for this stress are the focus of a number of recent studies. The first year of high school has been shown to be a critical life event for many (Chung, Elias, & Schneider, 1998), and the success or failure of students during their freshman year can set the tone for the rest of high school (Hertzog & Morgan, 1999) and college (Newman, Myers, Newman, Lohman, & Smith, 2000). Success in the freshman year can have long term effects on their academic lives. (Kerr, 2002). While entering the new atmosphere of a school building, many of the incoming ninth graders, some of whom are still physically developing, lack both the social and academic skills that are needed to successfully adapt to their new environment (Kerr). Once students are in high school, they realize that they are one step closer to college or to starting a career and feel the pressure to perform well so they can be successful (Isakson & Jarvis, 1999).

Science teachers of the incoming ninth grade students also experience stress. High school science teachers have a great deal of influence on their students' post-secondary aspirations and ultimate career choices (Osborne & Collins, 2000; Pustjens, Van de Gaer, Van Damme, & Onghena, 2004). Since students may not develop close relationships with high school teachers as they did with their elementary teachers, the high school teachers may have difficulty helping them through the transition (Reyes, Gillock, Kobus, & Sanchez, 2000). Some students may see their new high school teachers as stricter and as less supportive than their previous teachers, leading them to think that their teachers are not interested in their well-being (Reyes et al.).

Differences in Planning and Instruction

The styles of both lesson planning and instruction at the high school level may cause the students stress. Middle school teachers tend to plan lessons with the goal of building knowledge on what a child already knows. High school teachers tend to plan in a backwards direction by looking at the final goal and then planning all the way back to the root knowledge, not necessarily checking if the review of primary content was necessary (Galton, 2002). High school teachers may use different instructional techniques that require new or more advanced skills from the students (Kerr, 2002). Some students may interpret the fact that teachers do not usually check work daily in high school as a sign that high school is easier than past educational experiences (Newman et al., 2000). Since a typical high school science teacher might teach both upper level Physics or Chemistry classes and the freshmen level science class, the teacher might find it difficult to communicate and demonstrate the basic skills to the ninth grade students after teaching more advanced topics to upperclassmen (Hertzog & Morgan, 1999). High school teachers tend to feel that setting higher standards and demanding more of ninth graders is necessary, leading the freshmen to view their teachers as indifferent and unsupportive (Newman et al.). With the addition of the larger number of teachers in the high school setting, students may feel unnoticed and anonymous (Reyes et al., 2000). While the students' attitudes may decline toward academics during the freshmen year, some researchers caution against using student attitudes as a motivation for changing the science curriculum (Cleaves, 2005).

Students may feel more stressed when they realize that the effort that once earned them good grades in eighth grade nets them lower grades in high school (Reyes et al.,

2000). Students' grades usually drop from their eighth grade to ninth grade year (Reyes et al.; Isakson & Jarvis 1999). The combination of more difficult work, the need to study harder, and the feeling that teachers are less supportive may create a sense for the students that they may no longer be able to experience the academic success they had in elementary and/or middle school (Newman et al., 2000). This is especially true for the lower level students who do not plan to attend college (Newman et al.; Reyes et al.). Reyes et al. found that students who start high school with better grades perform the best scholastically during the last two years of school. The lower performing students tend to be distracted by the social aspects of high school and start disconnecting from the academic environment (Newman et al.; Isakson & Jarvis). Students who have difficulty the first semester are less able to recover or improve during the second semester and actually tend to further deteriorate (Kerr, 2002). Identifying these struggling students earlier in the year may help prevent greater problems from occurring later (Isakson & Jarvis).

High School Science

Many students entering high school list science as the subject they look forward to the most (Galton, 2002). They see the use of Bunsen burners as a rite of passage and anticipate an academic experience that is dominated by practical experience (Jarman, 1993). However, much of their excitement is lost during their first year of high school because they feel science is either too easy or the "same work as primary school" (Galton, p. 257). While looking forward to the practical experience of lab activities, they soon see their science class as a repetition of topics and experiences they have already

covered during middle school (Jarman). Students may do well on the tests, but that does not guarantee that they enjoy the subject (Galton, Gray, & Ruddock, 1999 & 2003).

Transition Strategies

While there is published research available on the transition from middle to high school, it can be considered an area that has a lot of possibilities for research (Hertzog & Morgan, 1999). Ninth grade students are unlike their high school peers and have unique needs, yet many high schools offer little support for the incoming ninth graders (Kerr, 2002). It has been shown that almost any transition program that is developed and well-implemented can make the transition less traumatic for the average student (Herzog & Morgan). The transition program could include peer mentoring and tutoring (Pantleo, 1999), allowing students to restart a class during the second semester (Hertzog & Morgan), block scheduling to reduce the number of teachers, establishing homeroom or advisory groups (Kerr, 2002), or requiring low achieving students to give up an elective to attend remedial classes (Hertzog & Morgan). The main goal of any quality transition plan is creating a more personalized and responsive learning environment (Kerr). A transition approach that includes summer classes for struggling students between their eighth and ninth grade years to better prepare them for high school is seldom used, but could be explored further (Kerr). Schools that are able to coordinate a large, comprehensive transition strategy have more of an impact on long term student success than smaller programs (Smith, 1997).

Among the ingredients needed for a good transition program is buy-in from all of the stakeholders: parents, teachers, administrators (Hertzog &Morgan, 1999), and

students. Since parental influence on academic achievement becomes weaker during high school (Newman et al., 2000), many transition programs struggle.

Uses of Standardized Tests

Although many studies have looked at the transition between eighth grade and high school, there does not appear to be much research using the standardized test scores of eighth grade students as a predictor of future success in high school. A standardized aptitude test like the SAT is used by high schools to help forecast how well students will perform in college but is not usually taken by middle school students. Most students take a standardized achievement test during their last year of middle school. Achievement tests are more of a measure of school curriculum and effectiveness, while an aptitude test has the goal of predicting future success (Popham, 1999).

There is much disagreement on the proper usage of standardized achievement tests. Some argue that standardized tests do not actually show that a student has mastered the content (Roeper Review, 2007) and that half or more of what is tested is not taught in the schools that take the tests or is not in the textbooks used (Popham, 2001). In order to show a spread of scores among the test takers, content is removed, especially content that might be mastered by the majority of the test takers (Popham). Others state that with the modern emphasis on standardized tests, many students suffer from test anxiety which can lessen the validity of the test scores (Kohn, 2000). Even with all of the public pressure and scrutiny, many schools misuse achievement test data and poorly communicate the results to the stakeholders (Stiggins, 2007).

Although the critics of achievement testing can be quite vocal, the usage of standardized tests has become quite widespread. Since they were first developed by the

United States Army during World War I to help identify new officers, achievement test usage has spread throughout all levels of the education system (Popham, 2001). While no research can be found that uses achievement tests to predict student success in high school, it has been shown that students that do well on math standardized tests tend to choose science electives more often than those that do poorly (Uerz, Dekkers, & Beguin, 2004).

Summary

Research has shown that the transition from eighth to ninth grade can be stressful, especially for lower-ability students. In addition to a more complex social environment, students need to adapt to the higher expectations and different styles of instruction in high school. Since many students look forward to studying science at the high school level, it is important that the teachers have good information about their students to keep them engaged and excited about science. Considering that most students take a standardized test during their eighth grade year, it is worth looking at the tests' usefulness in predicting future successes or challenges. Since science, math, and reading skills are all used in Physical Science, it is useful to know the predictive ability of each of them.

CHAPTER III: METHODOLOGY

Introduction

Since the first year of high school is stressful and some students struggle with the increased level of difficulty in science classes, it is good to study the reasons for their struggles and how their success in high school can be predicted (Isakson & Jarvis, 1999). The different skills and content of math, reading, and science are intermingled in the high school science curriculum. This study focuses on the skills and content bases of the three subjects and their ability to predict students' success in physical science during their freshman year of high school.

Research Questions

This study looked at the following questions using the recent MVLHS students' eighth grade TerraNova Comprehensive Achievement Test results and final grades in Physical Science:

1. What was the relationship between students' first semester grades in the MVLHS Physical Science course and their eighth grade TerraNova Comprehensive Achievement Test composite science, math, and reading scores?

2. What was the relationship between students' second semester grades in the MVLHS Physical Science course and their eighth grade TerraNova Comprehensive Achievement Test composite science, math, and reading scores?

Research Design and Procedures

This study uses a stepwise multiple regression analysis to analyze how well scores on a standardized test taken in eighth grade predict a student's success in Physical Science. The majority of the data for this study already existed in the student records that are maintained at MVLHS. The researcher did request additional records from four

elementary schools that did not send complete records to MVLHS prior to the students' freshman year. Three of the four schools were able to locate the necessary data and their students were included in this study. The students that attended elementary school at the fourth school were excluded from the study. The data was recorded in a spreadsheet with six columns: student, Physical Science first semester grade, Physical Science second semester grade, math composite score, reading composite score, and science composite score.

Population and Sample

This study involved the students at MVLHS who graduated from eighth grade in the years 2005 and 2006. These two years were chosen since the TerraNova Comprehensive Achievement Test became the widely used standardized test for eighth graders in the Wisconsin Evangelical Lutheran Synod in the year 2005. Any students who did not take the TerraNova Comprehensive Achievement Test during their eighth grade year were excluded from the study. There were a total of 123 students in the two classes, 104 of whom had taken the TerraNova Comprehensive Achievement Test during their eighth grade year. All of the students received grades in both semesters of Physical Science during their freshman year. Nineteen students either came from elementary schools that did not administer the test during the eighth grade year at that time or from schools that were unable to locate the data required for this study. The 104 subjects of the study come to MVLHS from nine different elementary schools which range in enrollment from 35 to 240 students.

Instrumentation

The TerraNova Comprehensive Achievement Test (2000, second edition) was used as the predictor variable in this study. It is a standardized achievement test that is published by CTB McGraw Hill of Monterey, California. The elementary schools from which many of MVLHS students graduate started using the TerraNova Comprehensive Achievement Test for their eighth grade classes starting in the year 2005.

The dependent variables for this study consist of the first and second semester grades for the students in Physical Science, the freshman level course required for all students at MVLHS. The Physical Science curriculum and assessment practices remained the same for the two years of students that were studied. The first semester content included the scientific method and an introduction to Physics. The second semester content included electricity, magnetism, and an introduction to Chemistry.

Data Analysis Procedures

The Statistical Program for Social Sciences, version 15.0, (SPSS, 2006) was used to analyze the data. A Multiple Regression using the Stepwise Method was conducted to look at each of the variables (math composite, reading composite, and science composite) to determine how each variable added to the significance of the analysis when predicting the first or second semester course grade.

Limitations

There are four limitations in applying this data to high schools that are different from MVLHS. First, high schools with enrollments larger than 250 students, the size of MVLHS, are likely to have more course offerings available to freshmen. A second

limitation is that high schools use different textbooks and have a different Physical Science curriculum than MVLHS.

A third limitation of this study is the use of course grades. Course grades are subject to an individual teacher and his or her methods of instruction and assessment. The teachers that taught Physical Science at MVLHS remained the same during the two years studied for this project, but a change in teachers might change the results of the study.

The usage of a standardized test is a fourth limitation to this study. As stated in Chapter 2, the TerraNova Comprehensive Achievement Test is an achievement test, not an aptitude test. Achievement tests are designed to score a student's mastery of content, not to predict future success.

CHAPTER IV: RESULTS

Introduction

The purpose of this study is to determine how useful the TerraNova Comprehensive Achievement Test is in predicting the success of students in the two semesters of ninth grade Physical Science. A statistical program (SPSS 15.0) was used to analyze the effectiveness of the math, reading, and science composite scores of the TerraNova Comprehensive Achievement Test to see which combination of the three scores had the most predictive value on the first and second semester course grades in Physical Science.

Data Analysis

The first and second semester grades were analyzed separately when compared to the composite test scores of math, reading, and science. In each case, the composite test scores were used as the independent variables and the physical science semester grade was used as the dependent variable to run a stepwise multiple regression. A stepwise multiple regression first selects the most predictive independent variable. The program then selects another independent variable and adds it to the model with the most predictive independent variable. If the addition of the new variable allows for a greater prediction, it is kept. The program then continues to add independent variables until a model is achieved that has the best combination of independent variables in predicting the dependent variable.

First Semester

The stepwise multiple regression analysis of the first semester (see Table 1) determined that the math composite test score (Model 1) was the most useful of the three

composite scores in predicting the students' success in Physical Science. The addition of the reading composite score to the math composite score in Model 2 allowed for a greater level of prediction of the first semester grades. The level of prediction from the math alone (R^2 = .475) increased when the reading was added to make Model 2 (R^2 = .515). The addition of the science composite score to Model 2 was not useful in making a better prediction, which is shown by its absence from the tables for semester one.

Table 1

Model Summary – First Semester: Using the TerraNova math, reading, and science composite scores to predict success in first semester Physical Science.

Model	*R*	R^2	Adjusted R^2	Standard Error of Estimate
1	.689	.475	.469	1.60945
Math Composite				
2	.717	.515	.505	1.55448
Math Composite				
Reading Composite				

The number of subjects in this study (104) is adequate for statistical analysis of the study's questions regarding the first semester (see Table 2). Both of the models had a high level of significance $p < .01$ meaning that there is little probability that the scores were in their arrangement by pure chance. The decrease in F-value from Model 1 (F = 92.139) to Model 2 (F = 53.556) shows that the addition of the reading score to the math score increases the degree of prediction in the first semester.

Table 2

ANOVA – First Semester

Model		Sum of Squares	*df*	Mean Square	*F*	Significance
1						
	Regression	238.671	1	238.671	92.139	.000
	Residual	264.214	102	2.590		
	Total	502.885	103			
2						
	Regression	258.826	2	129.413	53.556	.000
	Residual	244.058	101	2.416		
	Total	502.885	103			

Table 3 illustrates the usefulness of the math and reading scores in Model 2. The *t* value for the math composite (*t* = -6.649) compares to the t value for the reading composite in Model 2 (*t* = -.2888). This shows that while the addition of reading to the model makes Model 2 more useful than Model 1, the math composite score is still more useful than the reading score in predicting success. However, the two scores put together do allow for a greater prediction than math alone.

Table 3

Coefficients – First Semester

Model	Unstandardized Coefficients B	Standard Error	Standardized Coefficient Beta	*t*	Significance
1 (Constant)	9.648	.677		14.247	.000
Math Composite	-.079	.008	-.689	-9.599	.000
2 (Constant)	10.623	.736		14.434	.000
Math Composite	-.064	.010	-.555	-6.649	.000
Reading Composite	-.029	.010	-.241	-2.888	.005

Second Semester

The stepwise multiple regression for the second semester also determined that the math composite score was the most useful of the three composite scores in predicting success in Physical Science (see Table 4). The math composite score was designated Model 1. The addition of the science composite score to the math composite score (Model 2) allowed for a greater level of prediction (R^2 = .524) than Model 1 (R^2 = .440). Model 3 added the reading composite score to the math and science scores to develop an even greater level of prediction (R^2 = .572) than Model 2.

Table 4

Model Summary – Second Semester: Using the TerraNova math, reading, and science composite scores to predict success in first semester Physical Science.

Model	*R*	R^2	Adjusted R^2	Standard Error of Estimate
1	.664	.440	.435	1.46488
Math Composite				
2	.724	.524	.515	1.35707
Math Composite				
Science Composite				
3	.756	.572	.559	1.29442
Math Composite				
Science Composite				
Reading Composite				

Table 5 shows that the number of subjects in the study (104) is sufficient enough to achieve a significance of $p < .01$ for each of the three models in the second semester. While all three models are significant in predicting the second semester Physical Science course grades, the addition of the science composite in Model 2 ($F = 55.665$) and then the reading composite in Model 3 ($F = 44.461$) increase the level of prediction from the math composite alone ($F = 80.229$).

Table 5

ANOVA – Second Semester

Model		Sum of Squares	*df*	Mean Square	*F*	Significance
1						
	Regression	172.161	1	172.161	80.229	.000
	Residual	218.878	102	2.146		
	Total	391.038	103			
2						
	Regression	205.032	2	102.516	55.665	.000
	Residual	186.007	101	1.842		
	Total	391.038	103			
3						
	Regression	223.486	3	74.495	44.461	.000
	Residual	167.552	100	1.676		
	Total	391.038	103			

The stepwise multiple regression analysis of the second semester shows that the three composite scores are all very similar in predicting success in the Physical Science second semester course grade (see Table 6). While the math composite score was selected as the most predictive and designated Model 1, the science composite score was added in Model 2 and had a similar *t*-value (math $t = -4.619$ and science $t = -4.225$). When the reading composite was added in Model 3, the three composite scores again had similar t-values (math $t = -3.406$, science $t = -3.511$, and reading $t = -3.319$).

Table 6

Coefficients – Second Semester

	Unstandardized Coefficients		Standardized Coefficient		
Model	*B*	Standard Error	Beta	*t*	Significance
1 (Constant)	8.273	.616		13.422	.000
Math Composite	-.067	.008	-.664	-8.957	.000
2 (Constant)	8.747	.582		15.031	.000
Math Composite	-.042	.009	-.416	-4.619	.000
Science Composite	-.036	.008	-.381	-4.225	.000
3 (Constant)	9.620	.614		15.662	.000
Math Composite	-.032	.009	-.312	-3.406	.001
Science Composite	-.029	.008	-.311	-3.511	.001
Reading Composite	-.029	.009	-.269	-3.319	.001

Summary

This study shows that success in Physical Science can be predicted using the math, reading, and science composite scores from TerraNova Comprehensive Achievement Test. The math composite score combined with the reading composite score was the most useful predictor of success for the first semester, with the math score more heavily contributing to the prediction than the reading score. The math, reading, and science composite scores almost evenly combined as the most useful predictor for the

second semester. To explain this finding, Chapter 5 includes a discussion on the content of the curriculum in each of the semesters.

CHAPTER V: SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

The first year of high school has been shown to be a stressful period for many students. Teachers are able to help them through this difficult year by better understanding their needs and abilities. When the teachers of ninth grade students do not have much familiarity with the abilities of their pupils, teachers have a difficult time meeting the individual needs of every student.

This study used a standardized test usually taken in the eighth grade and looked at its usefulness in predicting success in Physical Science, the freshman science class at MVLHS. The composite test scores of math, reading, and science on the eighth grade TerraNova Comprehensive Achievement Test were compared to the first and second semester course grades in Physical Science.

Summary of the Results

While each of the composite test scores was useful in predicting success in both of the semesters of physical science, different combinations of the three scores were more useful in making predictions. The math composite score was the most useful of the three composite scores in predicting success in both the first and second semester, but the addition of one or more of the other two test scores increased the level of prediction in each of the semesters.

The combination of composite scores that best predicted success in the first semester was math and reading. The science composite score was not useful in improving the level of prediction allowed by the combination of the math and reading scores.

The combination of composite scores that best predicted success in the second semester was math, science, and reading. While each of the three scores was almost equally useful in predicting the success, the combination of the three scores in Model 3 allowed for the best level of prediction in the second semester.

Conclusions

As stated in Chapter 2, previous research has shown that the first year of high school is a stressful time for many students. The results of this study may allow schools to give better guidance regarding science education to freshmen students and their parents. It may also be a resource for teachers to reference as they plan the curriculum for a freshman level Physical Science class.

The study found that different combinations of the TerraNova Comprehensive Achievement Test composite math, reading, and science scores were very significant ($p<.000$) in predicting the success of freshmen in Physical Science during both the first and second semester. Some of the differences in the most predictive models between the first and second semesters may be influenced by the design of the Physical Science curriculum. The Physical Science class at MVLHS is designed to prepare the students for both Chemistry and Physics.

First Semester

The introduction to Physics took place during the first semester of Physical Science in both of the years involved in this study. The topics covered were the scientific method, forces, Newton's Law's of Motion, acceleration, work, and simple machines. The style of instruction for the first semester involved the usage of numerous mathematical formulas and required the students to regularly use their math skills.

Students that were strong in mathematical skills were able to do well on the math achievement test and were also more prepared to integrate numerous mathematical skills into a high school level science class. Most of the assessments during the first semester included word problems that required the students to use the formulas that were presented in the textbook and taught in class. This could be a reason why the math composite score was highly predictive for the first semester.

The reading composite score that was added to the math composite score to make the best predictive model might also be explained by looking at the curriculum and style of instruction. The students regularly had the assignment of reading sections of the textbook, both to prepare for class and review after a topic had been presented in class. Since the topics covered in the first semester were new to many of the students, good reading skills made it easier for them to prepare for class and review afterwards.

Second Semester

The remainder of the introduction to physics took place during the first two months of the second semester of Physical Science during the two years that were studied. The Physics topics covered in the second semester were electricity, magnetism, waves, and sound. The remainder of the second semester concentrated on the introduction to Chemistry, which includes matter, molecular theory, the periodic table, the elements, bonding, and chemical reactions. Few of the topics covered during the second semester required as much mathematical skill as the computations used during the first semester, so the assessments during the second semester centered more on vocabulary and understanding concepts than on mathematical computations.

The model that best predicted success in the second semester of Physical Science included the math, reading, and science scores. All three of the scores contributed almost evenly in predicting success on the semester course grade. Since the second semester curriculum and assessment were less weighted towards mathematical skills, this could be the reason why the reading and science scores were more useful as predictors than in the first semester.

Adapting the Curriculum

The results of this study have led the instructor of Physical Science to modify the curriculum, more specifically, the order in which the topics are presented. Since many of the students in Physical Science are just beginning the math classes of Pre-Algebra or Algebra, they are less prepared to succeed in Physical Science than students that are already taking Geometry during their freshman year. By teaching the topics that require more math skills in the second semester, more students should be able to experience success in the first semester. Once they have had the opportunity to gain more mathematical skill, more students may have success with higher level computations during the second semester.

Since the second semester data shows that math, reading, and science skills are almost equally useful in predicting success when studying beginning chemistry, moving those topics to the first semester might give more students the opportunity to succeed in high school science. Early success in science may help students handle the stresses they may face during their freshman year.

Recommendations

The results of this study lead to other questions and topics that may be useful for research. As stated in Chapter 2, the transition from eighth grade to high school invites research opportunities (Hertzog & Morgan, 1999). Now that this study has shown that the TerraNova Comprehensive Achievement Test is useful in predicting success in Physical Science, it would be interesting to look at how differently designed curricula affect success in Physical Science. Further research could quantify and compare the long-term effects of different eighth grade curricular models on students' success in high school science.

The use of achievement tests to predict future success is one of the limitations of this study. Since achievement tests are designed to focus on the knowledge that a student already has and not of what a student is capable, future research could look at using an aptitude test to predict success in high school science classes. Since an aptitude test is a measure of potential, these tests might give future insight into ways to increase the success of students.

Summary

This study has shown that the TerraNova Comprehensive Achievement Test can be useful in predicting the success of students in Physical Science. With knowledge of this study, a teacher can be better prepared to meet the needs of students during their transition into high school science.

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Appendix - Sample Letter to LES Principals

October 19, 2009

Principal
St. Paul's Ev. Lutheran School
126 S. Payne
New Ulm, MN 56073

Dear Principal,

Heath Dobberpuhl, a science instructor at Minnesota Valley Lutheran High School is working towards his master's degree at Martin Luther College. As part of a research project, he has requested permission to view elementary school records of MVL students to acquire data necessary for this work. However, some of the records of the elementary school students currently at MVL are not to be found here. We are seeking your permission for him to peruse the records and access information, without using names, to complete his work on this project. You can anticipate that his work will remain confidential and the privacy of these individuals will not be compromised.

We will need your permission in writing. It can be addressed to:

Heath Dobberpuhl
Minnesota Valley Lutheran High School
45638 561st Ave.
New Ulm, MN 56073

You can expect a phone call from Heath within the coming days to answer any questions that you may have.

Sincerely,
Tim Plath
MVLHS Principal