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ABSTRACT

In December 1990, faculty members of the Greenville Technical College (GTC) Physical Sciences Department met to develop methods for improving student achievement and preparedness in the physical sciences. Given the variety of student preparedness levels and lack of data on student backgrounds, the faculty agreed that student achievement and preparedness should be monitored through an ongoing assessment program. As part of the new program, an assessment was conducted of 219 students enrolled in first-year physical science courses at GTC during the 1990-91 spring semester through administration of American Testronic's High School Subject Test (HSST) in Physical Science. The assessment focused on the pre-college preparation of GTC students compared with other students, GTC's effectiveness in improving physical science competency, the need for remediation in the physical sciences among GTC students, differences between transfer and vocational students, and the identification of particular physical science concepts with which a majority of GTC first-year students are unfamiliar. Study results included the following: (1) 25% of GTC students scored below the 50th percentile on the HSST; (2) male students at GTC scored 12.3% higher on the HSST than female students; (3) taking less than three science courses at the college level did not appear to effect students' scores on the HSST, however there was a positive correlation between the number of high school science courses taken and students' scores on the HSST; (4) students enrolled in the College Transfer and the Associate in Science degree programs appeared to score higher on the HSST than students in other programs; and (5) students scored lowest in concept areas traditionally taught in a high school physics course, which may be the result of the low enrollment in physics in South Carolina high schools. Data tables and a discussion of GTC assessment goals and ongoing assessment activities are included. (PAA)

ASSESSING THE PREPAREDNESS AND ACHIEVEMENT OF GREENVILLE TECHNICAL COLLEGE STUDENTS ENROLLED IN A FIRST YEAR PHYSICAL SCIENCE COURSE

A Preliminary Report

Prepard by:
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December, 1990

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INTRODUCTION

In December of 1990, faculty members of the Greenville Technical College Physical Sciences Department met to delineate some methods for improving student achievement and preparedness in the physical sciences. A number of observations emerged that must be considered in any effort to determine these methods. It was noted that the Physical Sciences Department offers a multiplicity and diversity of physical science courses necessary to meet the needs of students entering associate degree study. These courses fall into four broad categories and fulfill the requirements of:

-science and engineering majors planning to transfer to a four year institution. (PRE-REQUISITE COURSES)

-non-science majors planning to complete their education at a four year institution. (TERMINAL COURSES)

- students requiring expertise in a specific concept area of the physical sciences. (i.e. the physics of sound for Sonology Technicians) (CONCEPT SPECIFIC COURSES)

- students enrolled in a 2 year associate degree program. (REQUIRED COURSES)

It was also noted that students enrolled in these courses have a wide range of academic histories in science and that the TEC faculty has a limited amount of data available about this past.

Given this diversity and multiplicity of course offerings, variety of student backgrounds, and lack of historical data, the science faculty agreed that student achievement and preparedness must be monitored through an on going assessment program. To follow is a description of the program agreed upon, along with some preliminary results.

PURPOSES AND DESIGN OF ASSESSMENT

The purposes of this assessment program is to determine if :

- changes need to be made in the Physical Science Department's curriculum and instructional methodology that will improve student achievement and preparedness.

- provide a baseline from which to establish separate placement standards to determine students' readiness for each type of associate degree program.

These changes and standards should enhance the Physical Science Department's continuing efforts to fulfill recent recommendations by the Southern Regional Education Board for student placement. (1) The SREB recommends that:

1.) Two-year colleges should identify and implement standards and assessments for placement of all students in associate degree programs in which credits are earned toward the baccalaureate degree and are transferable to senior institutions. These standards and assessments should relate to those competencies students need for study leading to a baccalaureate degree.

2.) Standards and assessments should be developed for associate degree programs that are oriented to immediate employment. These standards should reflect the level of learning skills needed to begin preparation in specific occupational programs.

3.) Faculty should play a vital role in determining the nature of those standards and assessments. The standards and assessments should be evaluated periodically by groups of institutions and faculty to determine the validity in indicating readiness.

More specifically the assessment is seeking to answer the following questions.

1. How does the pre-college preparedness of Greenville TEC students in the physical sciences compare with students nationwide, students entering four year colleges and students entering other two year colleges?

2. How effective is the instruction and curriculum at Greenville Tec in improving physical science competency?

3. Are there students entering Greenville Tec that require remediation in the basics of the physical sciences?

4. Are there differences in the preparedness and need for remediation between students planning to transfer to a four year college and those expecting to complete a program that will equip them for immediate employment ?

5. Are there certain physical science concepts with which a majority of Greenville TEC freshmen seem unfamiliar ?

PRELIMINARY RESULTS

METHODOLOGY

The first assessment consisted of Greenville TEC students enrolled in a first-year physical science course during the 1990-91 Spring quarter.

The primary methodology utilized was the administration of American Testronic's High School Subject Test (HSST) in Physical Science. (SEE Appendix I) This 50 item-40 minute multiple choice test was normalized in 1988 using a random sample of 25,741 high school students. The norms established are end -of- course norms, regardless of student's grade level.

The test is content specific and therefore provides information concerning mastery of course objectives and student performance compared to other students throughout the nation who have taken the same course. (SEE Appendix II) The HSST was administered to 219 Greenville TEC students

enrolled in a first year physical science course during the 1990-91 Spring Quarter.

An additional methodology used was the administration of a questionnaire. (See Appendix III) The survey instrument was completed by each student prior to taking the HSST test.

DISCUSSION OF FINDINGS:

Distribution of Percentile Scores

Data in Table I show the distribution of Percentile scores on the HSST for all students tested. Analysis of the data shows that approximately 25% of the students tested scored below the 50th percentile.

TABLE I

National Percentile Score Range	Percentage
0 to 9	0.5
10 to 19	2.0
20 to 29	1.0
30 to 39	10.5
40 to 49	10.5
50 to 59	18.4
60 to 69	9.5
70 to 79	22.0
80 to 89	18.3
90 to 99	7.4

Scores versus Student Gender

The data in Table II indicates that, on the average, male students scored 12.3 points higher in percentile rank than female students. This is equivalent to a raw score difference of 4.8 points. This difference is within ±10% of differences reported by two recent national studies. [2,3]

TABLE II

SCORES VERSUS STUDENT GENDER - 1990-91

SEX	AVERAGE NPERCENTILE	AVERAGE RAW SCORE	N	STD DEV NPERCENTILE
F	59.2	24.8	102.0	19.1
M	71.5	29.6	117.0	18.1
			N 219.0	

SUMMARY AND TENTATIVE CONCLUSIONS- Although the sample size is small in some of the groupings presented above, it is possible to begin to characterize the physical science preparedness of the students entering a first year physical science course at Greenville TEC. This preliminary analysis of the data indicates that the following may characterize these students.

1. Fifty percent of the high school graduates in the United States scored higher on the HSST than 25% of the students tested at TEC.

2. Male students scored 12.3 percentile points higher on the HSST than female students. This difference seems to exist nationwide.

3. There is a significant correlation between the total number of science courses students have taken and their score on the HSST. (r= 0.97 @ 0.0001)

4. The number of college courses taken by the students tested didn't appear to affect their score on the HSST. However this may be due to the nature of course taken. Further analysis of the data should verify this.

5. There is significant correlation between the number of high school science courses students have taken and their score on the HSST. (r= 0.98 @ 0.0005)

6. It appears from the data in Tables VI and VII, that students enrolled in the College Transfer and AS programs tend to score higher on the HSST than students in other programs. This is a very premature conclusion given the size of (n).

7. Students scored lowest in the concept areas traditionally taught in a high school physics course. This may be a result of the low enrollment in physics in South Carolina high schools. (only 16% of South Carolina students took a physics course in 1989). A

segregation of the data to compare students who took physics in high school versus those who didn't is now being prepared.

ON-GOING ASSESSMENT AND ANALYSIS

The type data gathered thus far is useful in establishing a profile of Greenville TEC freshmen in the physical sciences. Additional data is presently being obtained to reach the goals and purposes previously described.

The following testing has been completed -

-400 Freshmen enrolled in Chemistry 101 at Clemson
-100 Sophomores enrolled in Chemistry 101 at Clemson
-300 Freshmen enrolled in Astronomy 101 at USC
-All freshman enrolled in a Physical Science Course at Greenville TEC this quarter.

The following will be tested in the next few months:

-80 students enrolled in a chemistry class for non-science majors at Furman University,
-300 students enrolled in Physics 122 at Clemson
-200 students enrolled in Physics 207 at Clemson
-100 students enrolled in Astronomy 101 at Clemson

References:

(1) Southern Regional Education Board, "Access to Quality Undergraduate Education in the Two Year College", a report to the Southern Regional Education Board by its Commission for Educational Quality (1987)

(2) National Science Board, "Science & Engineering Indicators - 1987", a report to the chairman of the National Science Board (Nov. 1987)

(3) Educational Testing Service, "The Science Report Card", Trends and Achievement based on the 1986 assessment (Sept. 1986)

SCIENCE COURSES - Tables III, IV and V includes data comparisons between science courses taken and scores on the HSST.

Total Science Courses Versus Percentile Scores

The number of courses taken was determined from students' responses to Section IV of the Student Questionnaire. As expected HSST scores were highest for students who have taken the greater number of science courses. (r = 0.97 @ .0001) Care must be taken in drawing conclusions from the data in some of the brackets due to small sample size. (i.e n= 1,2, &7)

TABLE III

SCORES VERSUS THE TOTAL NUMBER OF SCIENCE COURSES - 1990-91

**SCIENCE COURSES TAKEN	AVERAGE NPERCENTILE	AVERAGE % CORRECT	AVERAGE RAW SCORE	N	STD DEV NPERCENTILE
1.0	51.3	44.3	22.2	7.0	20.3
2.0	55.9	47.3	23.6	39.0	15.7
3.0	63.3	51.5	26.2	60.0	17.0
4.0	69.5	56.7	28.3	52.0	17.0
5.0	70.4	58.7	29.9	30.0	23.5
6.0	69.4	57.9	28.9	21.0	18.8
7.0	74.5	58.0	29.0	2.0	2.5
8.0	87.2	73.6	36.8	7.0	6.6
9.0	92.0	80.0	40.0	1.0	0.0
				N 219.0	

** SUM OF HIGH SCHOOL AND COLLEGE COURSES

Number of College Science Courses Versus Percentile Scores

The data in Table IV list HSST scores as a function of total number of science courses taken in college. The data seems to indicate that students who have taken between zero and 3 science courses in college had similar scores on the HSST. (r = 0.83 @ .02) This might be interpreted to mean that their college courses had little effect on improving their physical science proficiency. However, if the college courses taken were predominantly in the natural sciences, then scores on the HSST would not show improvement. An alternate segregation of data (Number of college physical science course versus HSST) would better provide information relevant to the effectiveness of college physical science courses. This comparison is now being prepared.

Table IV

SCORES VERSUS THE NUMBER OF CCLLEGE SCIENCE COURSES - 1990-91

COLLEGE SCIENCE COURSES	AVERAGE NPERCENTILE	AVERAGE RAW SCORE	N	STD DEV NPERCENTILE
0.0	65.0	26.8	84.0	17.3
1.0	63.3	26.5	76.0	19.2
2.0	67.3	27.8	29.0	19.8
3.0	65.4	28.2	20.0	24.7
4.0	79.9	32.6	9.0	10.0
6.0	92.0	40.0	1.0	0.0
			N 219.0	

Science Courses Taken in High School Versus Percentile Scores

The data in Table V list HSST scores as a function of total number of science courses taken in high school weighted by number of courses taken in college. Since the students assessed were in a first-year physical science course, then it is reasonable to expect that on the average, most would have had one or less college science courses. 98 % of the students tested had taken an average of 1.3 or less college courses. Therefore, regardless of the number of high school science courses taken, students in this assessment have had approximately the same exposure to a college science course. If this is the case, the improvements in HSST scores shown in Table V has a significant correlation with the number of high school science courses taken. (r = 0.98 @ 0.0005)

TABLE V

SCORES---WEIGHTED BY COLLEGE SCIENCE COURSE PER HIGH SCHOOL CCURSE - 1990-91

H. S. COURSES	AVERAGE NUMBER COLLEGE COURSE	AVERAGE NPERCENTILE	AVERAGE RAW SCORE	N	STD DEV NPERCENTILE
1.0	1.3	51.8	22.6	27.0	18.4
2.0	0.9	59.3	24.6	63.0	16.5
3.0	1.0	69.0	28.6	81.0	18.8
4.0	1.2	74.8	30.8	44.0	16.1
5.0	1.8	79.0	33.0	4.0	14.2
				N = 219.0	

Course of Study

Table VI shows a comparison of Percentile Scores as a function of Course of Study. Considering the small value of (n) for some groups it appears that the average percentile scores are relative consistent regardless of course of study.

TABLE VI

SCORES VERSUS COURSE OF STUDY - 1990-91

MAJOR	AVERAGE NPERCENTILE	AVERAGE RAW SCORE	N	STD DEV NPERCENTILE
AA	65.2	26.1	17.0	13.5
AET	58.0	24.8	6.0	17.1
AS	69.0	28.8	52.0	19.4
COLLEGE TRANSFER	68.6	28.4	73.0	18.3
CRIMINAL JUSTICE	52.0	22.0	2.0	0.0
DENTAL HYGIENE	51.9	22.4	18.0	16.9
NONE	64.1	27.3	20.0	23.0
NURSING	50.4	22.0	8.0	19.4
RAD TECH	74.3	29.7	19.0	9.9
RESPIRATORY THERAPY	57.5	24.0	4.0	14.8
			N 219.0	

Scores Versus Course Enrolled In At Time of Test

Table VII list percentile scores as a function of the course students were enrolled in at the time of testing. The average of percentile scores grouped into the broad categories defined on page one are :

Pre-Requisite courses (CHT 154, PHY 204 & PHY 205) = 72.2
Terminal courses (AST 101 & 102) = 62.5
Concept Specific (RAD 146 & CHT 114) = 63.2
Required Courses (PHY 122 & 132) = 68.2.

TABLE VII

SCORES VERSUS COURSE ENROLLED IN AT TIME OF TEST IN 1990-91

COURSE	AVERAGE NPERCENTILE	AVERAGE % CORRECT	N	STD DEV NPERCENTILE
AST 101	58.0	49.3	21.0	21.8
AST 102	66.1	54.3	21.0	15.1
CHT 114	52.2	45.1	26.0	16.9
CHT 154	64.8	52.3	63.0	18.7
PHY 122	65.1	53.8	21.0	18.1
PHY 132	71.4	58.8	24.0	17.1
PHY 204	70.5	60.0	13.0	20.7
PHY 205	81.4	69.4	11.0	16.6
RAD 146	74.3	59.3	19.0	9.9
		N	219.0	

Percentage of Questions Answered Correct In Each Concept Areas

Table VIII gives a breakdown of the percentage of correct scores for each of the eight concept areas measurable with the HSST. The lowest scores are in the concept areas traditionally taught in a physics course. If compared to a traditional 10 point grading scale, the only concept area passed by the students assessed was the Volume/Density area. These results may reflect the fact that in 1989 only 50 % of South Carolina's high school graduates took a chemistry course and only 16% took physics.

TABLE VIII

AVERAGE NPERCENTILE SCORE FOR EACH CONCEPT AREA 1990-91

VOL\DEN	PART\NATURE	HEAT ENERGY	ATOMIC STRUCTURE	ENERGY\MOTION	SOLUTION	ELECTRIC	LIGHTANDSOUND
69.7	60	55.7	50.8	60.2	51.1	47.2	48.1

Appendix 1

American Testronic's High School Subject Test (HSST)
in Physical Science

Appendix 1 removed copyrighted material

Available:
8600 W. Bryn Mawr
Chicago, IL 60631

APPENDIX II

Content Classification—Physical Science, Form B

Content	Number of Items	Item Numbers	Mean	Standard Deviation	Lower Quartile	Median	Upper Quartile
Measurement, Mass, Volume, and Density	4	1-3,20	2.4	1.0	1.5	2.4	3.5
Particle Nature of Matter	5	4-6,15,42	2.3	1.2	1.3	2.2	3.4
Heat Energy	5	8-10,13,41	2.1	1.2	0.9	2.1	3.1
Structure of the Atom and Chemical Formulas	6	11,16-18, 21,47	1.9	1.3	1.0	1.9	3.2
Solutions and Behavior of Matter	9	12,14,22, 24,31,34, 44,48,50	3.8	1.8	2.4	3.8	5.6
Energy and Motion	8	19,23, 26-30,39	4.2	1.7	2.5	4.1	5.8
Electricity	6	7,25,33, 35,40,43	2.3	1.3	1.4	2.3	2.7
Light and Sound	7	32,36-38, 45,46,49	2.6	1.4	1.1	2.5	3.9
Total	50		21.6	7.4	15.7	21.6	29.2

APPENDIX III

COURSE IN WHICH YOU ARE COMPLETING THIS SURVEY _____COURSE#_____

STUDENT QUESTIONAIRE # _____ (Please bubble this number in on the Scantron form)

Please provide as accurately possible the following information. **You may, at your own descretion, omit any of the requested data in section one.**

SECTION I -

NAME _____

SOCIAL SECURITY NUMBER_____STUDENT ID #_____

SECTION II - Give the names of any science courses taken beyond high school.

_____

_____

AGE _____SEX_____ SAT SCORES -MATH _____VERBAL_____TOTAL_____

HIGH SCHOOL DIPLOMA FROM (Name of School)_____

City _____State_____ Years of College_____

SECTION III -Parents Education (Check Highest Level Completed)

	Less than High School	High School	(College) 2yrs	4yrs	MASTERS	PhD
Father -	_____	_____	___	___	___	___
Mother-	_____	_____	___	___	___	___

SECTION IV -PLACE A CHECK BY THE COURSES TAKEN IN HIGH SCHOOL.

SCIENCE	MATH
____ Physical Science	_____Algebra I
____ Biology I	_____Algebra II
____ Biology II	_____Trigonometry
____ AP Biology	_____Analytic Geometry
____ Chemistry I	_____Pre-Calculus
____ Chemistry II	_____Calculus
____ AP Chemistry	_____Computer Programming
____ Physics	OTHER_____
____.AP Physics	_____

Which of the following instruments have you had experience using?

1.___Telescope 2.___Microscope 3.___Barometer 4.____Spectroscope 5.____Stop Watch

6.___ Volt/ohm/amp meter 7.___Spectrophotometer 8.___ Calculator 9.___Thermometer

Which of the following activities have you done?

1. ____Visited a planetarium 2. ____ A Science Project 3. ____Read a book about science

4. ____ Talked about science with friends 5. ____ Fixed something electrical _____mechanical