A Framework for Technical Skills Development

John H. George Annette M. Burden

Youngstown State University

Abstract

In recent years it has become increasingly clear that many students who desired to matriculate into Engineering Technology programs at Youngstown State University (YSU) lacked the necessary mathematics and problem solving skills. The focus of this innovation was to establish a framework that would increase the retention of inadequately prepared students. As a result, attention was concentrated in trying to reach these students prior to entry into one of our technical or engineering programs. This paper begins with a brief description of the courses involved and outlines the procedure taken to establish a viable framework.

Background

Introduction to Engineering Technology (STECH 1505) and Algebraic and Transcendental Functions (MATH 1513) are required courses for an Associates Degree in Civil and Construction Engineering Technology, Electrical Engineering Technology, and Mechanical Engineering Technology. Unfortunately, many of the students who desired to matriculate into one of these technology programs lacked sufficient mathematical skills for either MATH 1513 or its prerequisite, Intermediate Algebra with Trigonometry (MATH 1504) as evidenced by their low mathematics placement test scores. These students were labeled "high risk" and forced to enroll in Elementary Algebraic Models (MATH 1501) for remediation. However, even with mathematics remediation, these students still lacked the appropriate skills that were needed for successful completion of the technology program. Therefore, in an effort to raise the skill level of these high risk students and lower the failure rate without sacrificing standards, a two-pronged attack was launched in January 2002. On the mathematics end, a coordinator was appointed for MATH 1501. In order to insure that all students received the same basic algebra instruction the coordinator first standardized all sections of MATH 1501. The coordinator then instituted a mandatory lab component, introduced supplemental computer drill and assessment, off-hour website tutoring by MATH 1501 instructors, and math based simulations. On the Engineering Technology end, a new pilot course, Technical Skills Development (STECH 1500) was developed as an intervention to help the under prepared students. All high risk Engineering Technology students were strongly encouraged to enroll in MATH 1501 and STECH 1500 concurrently so as to take advantage of the lead in time of students who lacked the mathematical skill set to begin any Engineering or Engineering Technology program. The combination provides an immersion in mathematical development. The approach employed in STECH 1500 was to teach the necessary skills according to the precepts of contextual learning. Groundwork was laid on orienting students to engineering as a problem solving activity, algebraic equation and unit manipulation, composite shape usage, engineering graphing techniques, hypothesis formulation & testing, and the entire engineering lab writing process.

In coordination with the Math Department, students who elected to take the combined STECH 1500 / MATH 1501 option were tracked. Although a short-term goal was to improve on and better coordinate the STECH 1500 / MATH 1501 combination offering, the ultimate goal was to provide a stronger mix of students as evidenced by improved performance in follow-up technical and math courses.

Course Descriptions

The following course was established to provide students with an introduction to the nature of the chosen career area as well as to give under prepared students the opportunity to hone basic skills before enrollment into Introduction to Engineering Technology, STECH 1505:

STECH 1500 - Technical Skills Development (4 semester hours):

This course was designed to develop the technical, analytical and problem solving skills of students planning to enter an engineering or technical course of study. The course was planned to consist of three (3) hours of lecture and three (3) hours lab per week. Grading A, B, C, NC.
Prerequisite or concurrent: MATH 1501.

STECH 1500 is intended for any student pursuing an engineering or technical course of study. STECH 1500 is a required course for any of the Associate of Technology (ATS) degrees in Electrical Utilities Technology (EUT) and an optional (remedial) class for other YSU students in a science, engineering, or technical specialty.

The following existing course was used as a companion course to help under prepared students strengthen their basic algebraic skills and prepare them for the rigor of future ATS mathematics requirements:

MATH 1501 - Elementary Algebraic Models (5 semester hours):

Topics include arithmetic of integers and of rational numbers; linear equations and inequalities in one variable; polynomials, factoring, algebraic fractions, radicals and quadratic equations; linear systems in two variables; graphs. Grading is A, B, C, NC. This course does not count toward a degree. Prerequisite: Level 1 on Mathematics Placement Test or MATH 1500.

MATH 1501 is a remedial course and is intended for any student that does not have the appropriate skills to begin a college level mathematics course. Students are given a mathematics placement test prior to registration for a mathematics course. Students that score at a level 1 on the placement test are required to enroll in MATH 1501.

The following existing course was originally established to provide students with an introduction to the nature of career areas in engineering technology as well as to give under prepared students the opportunity to hone basic skills:

STECH 1505 - Introduction to Engineering Technology (3 semester hours):

Topics include the role of the technician, technologist, and their relationships to the engineer; technical methods as applied to analysis, design, layout and testing; an introduction to BASIC programming on microcomputers; a study of the basic mathematical, scientific, computer, and communicative techniques as applied to the work of engineering technicians. Grading is A, B, C, D, F. Prerequisite or concurrent: MATH 1504.

Although MATH 1513 is generally the companion course for STECH 1505, MATH 1504 is typically the companion course for the high risk students taking STECH 1505. Therefore, MATH 1504 is described and MATH 1513 is not considered here:

MATH 1504 - Intermediate Algebra with Trigonometry (5 semester hours):

Topics include relations and functions with graphing by algebraic techniques; solving nonlinear equations and inequalities, right triangle trigonometry, and applications of algebraic and geometric concepts. Grading is A, B, C, D, F. Prerequisite: Level 2 on Mathematics Placement Test or MATH 1501.

MATH 1504 is a required prerequisite course for all science or engineering majors. This course must be taken by any student who does not directly test into MATH 1513.

For complete course descriptions, the reader is directed to consult the Youngstown State University Undergraduate Bulletin, 2005-2006.

Methodology

STECH 1500 Technical Skills Development Contents (Intervention)

Two texts for this course have been employed. The primary text was a paperback—Spangler & Boyce, Mathematics for Technical and Vocational Students, A Work text, 2nd Edition, Prentice Hall, 2000. As the authors note in their Preface; ". . . this Work text is a textbook of practical mathematics applied to technical and trade work".

The first week of the course covered unit conversions, scientific notation, and percentage. Unit conversions were found to be one of the few weaknesses in the text. Supplemental materials for conversions were used and repeated regularly over the initial 8 weeks. The Given, Find: and Sketch approach to problem solving was started early and reinforced regularly. Engineering quadrille paper was required for all homework assignments.

A single class was spent on ratios. Although seemingly inadequate, additional reinforcement appeared throughout the text. Two weeks were spent on "practical algebra". This included substitution ("plug and chug") and formula manipulation. Experience indicated that this basic algebraic manipulation needed to be repeated and tested throughout the term. An initial attempt to coordinate introduction of formula manipulation with the concurrent math class (MATH 1501) was abandoned in favor of providing multiple looks at this elusive topic.

Since knowledge of MS Excel worksheets was needed later in the term for writing basic engineering style lab reports, in approximately the fourth week, application math exercises were coupled with Excel worksheet training. It was also deemed favorable to offer the first major exam at the end of the 4th week.

During the initial quarter of the course which was based on a semester term, discussions pertaining to the similarities and differences among engineering, engineering technology, craftsmen and scientists were initiated as time permitted. Students were typically given a brief written assignment pertaining to a career field and how good a fit this was with the student's interests.

The second 4 weeks of the term involved very basic geometry. Specifically this included

determining perimeters and areas for rectangles, triangles, trapezoids, circles, arcs, ellipses, etc. The authors of the text do a nice job of repetitively introducing the concept of composite shapes. The Pythagorean Theorem was also introduced. It appeared that students who genuinely had an interest in the technical fields did very well with this material.

Testing at the end of eight weeks included "old material" on unit conversions and formula manipulations as well as the new material.

The mathematical topics for the last half of the class included volumes and the rudiments of right triangle trigonometry. A fair amount of time was now spent in the second text for the course. This was also a paperback: Aird, Mechanics's Guide to Precision Measuring Tools, MBI, 1999. Initially, another paperback was used in the course; Aird, Automotive Math Handbook, MBI, 2000. Although both were excellent, the switch to the Precision Machining text was made since it fit well with several new labs. Specific topics from Spangler in gears and work and power were addressed as time permitted but took a back seat to Excel exercises and the writing of engineering style lab reports.

Lab exercises included:

- Creating a procedure for testing bounce of a "super ball"
- Use of composite shapes, block counting and weighing to approximate areas
- Parts measurements and comparisons
- Determination of areas and volumes for a stack of motor laminations.

Other available and applicable labs included:

- Torque determination off motorcycle transmissions
- Hypothesis testing on speed of waves vs. depth
- Checkerboard surveying
- Verification of Ohm's Law
- Linear Spring Testing

MATH 1501 Elementary Algebraic Models Contents

The text used initially was Martin-Gay, Interactive Math 2: Introductory Algebra, 2rd Edition, Prentice Hall, 2002 with the PHIM2™ Computer Assisted Instruction (CAI) product. The inability of the CAI to handle, manipulate, and administrate to multiple sections of MATH 1501 along with rapid advances in technology precipitated a switch to Martin-Gay, Beginning Algebra, 4th Edition, Prentice Hall, 2005 supported by an enhanced and far more robust CAI product: MyMathLab™. This CAI is embedded within the Course Compass environment, with Course Compass acting as the outer shell course management system. Using this product, students were able to advance at their own pace. Instruction included three lecture days and two lab days per week. The students were given a weekly reading assignment from the text that was expected to be completed prior to the lecture. Originally, weekly graded assignments were given which consisted of a mixture of assigned text homework problems, and algorithmically generated lab problems. With the second round of enhancements to MyMathLab , the text problems were dropped from the course and prerequisites were set within the lab assignments so that a minimum score of 70% (C) was needed on an assignment before a student was able to progress to the next assignment. Solutions were typed in by the student using a mathematics palette provided by the product. Since the assignments were algorithmically generated within MyMathLab™, students were permitted to redo assignments to enable them to attain the minimum requirement if needed. There were initially three algorithmically generated short answer tests as well as one algorithmically generated final exam. This was also modified to take advantage of the MyMathLab™ functionality in the following manner:

- Entrance Test (arithmetic skills) – added
- Chapter quizzes – added
- Midterm Review & Midterm Test – added
- Final Exam Review & Final Exam – added
- Test 1,2, and 3 – dropped

Prerequisites were also set for all tests so that a minimum score of 70% (C) was needed before a student was able to progress to the next course objective. Finally, a three hour review session was added the Saturday prior to exam week. This review was open to all MATH 1501 students.

MyMathLab™ also contained video lectures, animations, power points, and real time interactive help for students who were in need of additional support. The students genuinely appeared to be satisfied with the mixture of computer instruction and available math instructor help. The pass rate for MATH 1501 rose from 35% to 85% within the first year of this innovation.

Results:

Students desiring to matriculate into the engineering technology program would normally take the STECH 1505 / MATH 1513 combination

(see Youngstown State University Bulletin 2005-2006). However, students who require STECH 1505 fall into one of the following genres with respect to their mathematics component:

- ready for MATH 1513 having tested directly into it,
- ready for MATH 1513 having completed the MATH 1504 prerequisite in a prior term or at another institution,
- not ready for MATH 1513 having tested directly into MATH 1504, or
- not ready for MATH 1504 having tested into MATH 1501 (high risk students)

Due to the breakdown above, it has become far more commonplace for the high risk students to take MATH 1501 followed by the STECH 1505 / MATH 1504 sequence in the subsequent term. As stated earlier, since MATH 1501 is considered a remedial mathematics course, the students coming out of MATH 1501 are generally considered the highest retention risk for the Engineering Technology curriculum. Therefore, to get a better indication of whether the intervention of STECH 1500 made a difference in the pass rate of the high risk students, the results were split into three different categories. Each category was divided into a test group (TSD) and control group as detailed below.

Description Category 1:

The TSD group consisted of the 25 students who satisfied all of the following criteria:

- took MATH 1501 concurrently with the intervention (STECH 1500) between fall 2002 and fall 2004,
- were not enrolled in the Electrical Utilities Technology (EUT) program,
- received credit for both STECH 1500 and MATH 1501, and
  - o students who received credit (C or above) for both STECH 1505 and MATH 1504 taken concurrently in a subsequent term were assigned a value of 1 otherwise they were assigned a value of 0 (including withdraws)
  - o the 0's and 1's were averaged, μ_{TSD}, and the standard deviation, σ_{TSD}, was computed

The Control group consisted of the 39 students who satisfied all of the following criteria:

- took MATH 1501 without the intervention between fall 2002 and fall 2004,
- were not enrolled in the Electrical Utilities Technology (EUT) program,
- received credit for both STECH 1500 and MATH 1501,
  - o students who received credit (C or above) for both STECH 1505 and MATH 1504 taken concurrently in a subsequent term were assigned a value of 1 otherwise they were assigned a value of 0 (including withdraws)
  - o the 0's and 1's were averaged, $\mu_{control}$, and the standard deviation, $\sigma_{control}$, was computed

Category 2:

The TSD group consisted of the 23 students who satisfied all of the following criteria:

- took MATH 1501 concurrently with the intervention (STECH 1500) between fall 2002 and fall 2004,
- were not enrolled in the Electrical Utilities Technology (EUT) program,
- received credit for both STECH 1500 and MATH 1501, and
  - o students who received credit (C or above) for STECH 1505 in a subsequent term were assigned a value of 1 otherwise they were assigned a value of 0 (including withdraws)
  - o the 0's and 1's were averaged, μ_{TSD}, and the standard deviation, σ_{TSD}, was computed

The Control group consisted of the 29 students who satisfied all of the following criteria:

- took MATH 1501 without the intervention between fall 2002 and fall 2004,
- were not enrolled in the Electrical Utilities Technology (EUT) program,
- received credit for both STECH 1500 and MATH 1501,
  - o students who received credit (C or above) for STECH 1505 in a subsequent term were assigned a value of 1 otherwise they were assigned a value of 0 (including withdraws)
  - o the 0's and 1's were averaged, $\mu_{control}$, and the standard deviation, $\sigma_{control}$, was computed

Category 3:

The TSD group consisted of the 35 students who satisfied all of the following criteria:

- took MATH 1501 concurrently with the intervention (STECH 1500) between fall 2002 and fall 2004,
- were not enrolled in the Electrical Utilities Technology (EUT) program,
- received credit for both STECH 1500 and MATH 1501,
  - o students who received credit (C

or above) for MATH 1504 in a subsequent term were assigned a value of 1 otherwise they were assigned a value of 0 (includ ing withdraws)

- the 0's and 1's were averaged, μ_{TSD}, and the standard deviation, σ_{TSD}, was computed

The Control group consisted of the 40 students who satisfied all of the following criteria:

- took MATH 1501 without the intervention between fall 2002 and fall 2004,
- were not enrolled in the Electrical Utilities Technology (EUT) program,
- received credit for both STECH 1500 and MATH 1501,
  - students who received credit (C or above) for both MATH 1504 in a subsequent term were assigned a value of 1 otherwise they were assigned a value of 0 (including withdraws)
  - the 0's and 1's were averaged, $\mu_{control}$, and the standard deviation, $\sigma_{control}$, was computed

PHStat, a statistical add-on package for MS Excel, was used to run the F test on each of the three categories in order to determine if the squares of the variances were equal. Once this determination was made, the appropriate t-test was selected from PHStat in order to determine whether the mean of the TSD group was larger than the mean of the control group within each category. The following steps were taken to determine the results within each category:

Step 1: Identify

$H_0(\text{null hypothesis}): \sigma^2_{TSD} = \sigma^2_{control}$ (claim)

& $H_1: \sigma^2_{TSD} \neq \sigma^2_{control}$

Step 2: Use PHStat to compute the F-statistic

Step 3: Make the determination whether to accept or reject the null hypothesis

Step 4: Select the appropriate t-test from the results of step 3

Step 5: Identify

$H_0(\text{null hypothesis}): \mu_{TSD} \leq \mu_{control}$

& $H_1: \mu_{TSD} > \mu_{control}$ (claim)

Step 6: Use PHStat to compute the t-statistic

Step 7: Make the determination whether to accept or reject the null hypothesis

Category 1 Results Summary:

The F test (see Figure 1) indicated that the null hypothesis should not be rejected at a 0.05 level of significance. Therefore, the t-test for the difference between two means for small independent samples assuming equal variances was selected. The results of this test indicated that there was enough evidence to support the claim that the students in Category 1 TSD group (with intervention of STECH 1500) did better than the students in the Category 1 control group (without intervention of STECH 1500) (see Figure 1). From the second table of Figure 1, it can be seen that there was a significant increase in the mean pass rate of students in the TSD group (variable 1 column) as compared to the mean pass rate of those students in the Control group (variable 2 column). That is, **64.0% of**

F test: MATH1504/STECH1505 Ho = null hypothesis: sd^2 of TDS = sd^2 of control	
Data	
Level of Significance	0.05
Population 1 Sample	
Sample Size	25
Sample Standard Deviation	0.48989795
Population 2 Sample	
Sample Size	39
Sample Standard Deviation	0.48078291
Intermediate Calculations	
F-Test Statistic	1.038276922
Population 1 Sample Degrees of Freedom	24
Population 2 Sample Degrees of Freedom	38
Two-Tailed Test	
Lower Critical Value	0.463791874
Upper Critical Value	2.026968286
p-Value	0.897311302
Do not reject the null hypothesis: assume sd equal	
Calculations Area	
FDIST value	0.448655651
1-FDIST value	0.551344349

t-Test: Two-Sample Assuming Equal Variances Ho = null hypothesis: mean of TDS ≤ mean of control		
	Variable 1	Variable 2
Mean	0.64	0.358974359
Variance	0.24	0.236167341
Observations	25	39
Pooled Variance	0.237650951	
Hypothesized Mean Difference	0	
df	62	
t Stat	2.250030937	
P(T<=t) one-tail	0.014002838	
t Critical one-tail	1.669804163	
P(T<=t) two-tail	0.028005676	
t Critical two-tail	1.998971498	
Reject the null hypothesis: mean of TDS > mean of control		

Figure 1: Category 1 – F Test & t Test Results for STECH 1505/ MATH 1504 Combination

F test: STECH 1505 Ho = null hypothesis: sd^2 of TDS = sd^2 of control	
Data	
Level of Significance	0.05
Population 1 Sample	
Sample Size	28
Sample Standard Deviation	0.4973
Population 2 Sample	
Sample Size	48
Sample Standard Deviation	0.48925
Intermediate Calculations	
F-Test Statistic	1.0331782
Population 1 Sample Degrees of Freedom	27
Population 2 Sample Degrees of Freedom	47
Two-Tailed Test	
Lower Critical Value	0.4902856
Upper Critical Value	1.9148408
p-Value	0.8997795
Do not reject the null hypothesis: assume sd equal	
Calculations Area	
FDIST value	0.4498898
1-FDIST value	0.5501102

t-Test STECH 1504: Two-Sample Assuming Equal Variances Ho = null hypothesis: mean of TDS ≤ mean of control		
	Variable 1	Variable 2
Mean	0.6071429	0.375
Variance	0.2473545	0.239361702
Observations	28	48
Pooled Variance	0.242278	
Hypothesized Mean Difference	0	
df	74	
t Stat	1.9833126	
P(T<=t) one-tail	0.0255217	
t Critical one-tail	1.6657069	
P(T<=t) two-tail	0.0510433	
t Critical two-tail	1.9925435	
Reject the null hypothesis: mean of TDS > mean of control		

Figure 2: Category 2 – F Test & t Test Results for STECH 1505

the students passed STECH 1505/MATH 1504 when the STECH 1500 intervention was taken concurrently with MATH 1501 as opposed to a 35.9% pass rate when the intervention was not taken concurrently with MATH 1501.

Category 2 Results Summary:

The F test (see Figure 2) indicated that the null hypothesis should not be rejected at a 0.05 level of significance. Therefore, the t-test for the difference between two means for small independent samples assuming equal variances was selected. The results of this test indicated that there was enough evidence to support the claim that the students in Category 2 TSD group (with intervention of STECH 1500) did better than the students in the Category 2 control group (without intervention of STECH 1500) (see Figure 2). From the second table of Figure 2, it can be seen that there was a significant increase in the mean pass rate of students in the TSD group (variable 1 column) as compared to the mean pass rate of those students in the Control group (variable 2 column). That is, **60.1% of the students passed STECH 1505 when the STECH 1500 intervention was taken concurrently with MATH 1501 as opposed to a 37.5% pass rate when the intervention was not taken concurrently with MATH 1501.**

Category 3 Results Summary:

The F test (see Figure 3) indicated that the null

hypothesis should not be rejected at a 0.05 level of significance. Therefore, the t-test for the difference between two means for small independent samples assuming equal variances was selected. The results of this test indicated that there was enough evidence to support the claim that the students in Category 3 TSD group (with intervention of STECH 1500) did better than the students in the Category 3 control group (without intervention of STECH 1500) (see Figure 3). From the second table of Figure 3, it can be seen that there was a significant increase in the mean pass rate of students in the TSD group (variable 1 column) as compared to the mean pass rate of those students in the Control group (variable 2 column). That is, **57.9% of the students passed MATH 1504 when the STECH 1500 intervention was taken concurrently with MATH 1501 as opposed to a 39.1% pass rate when the intervention was not taken concurrently with MATH 1501.** This result was a pleasant surprise since it was not expected that the STECH 1500 intervention would have a significant effect on the MATH 1504 outcome.

In addition to the F tests and corresponding t-tests for each category the following information was also compiled:

- A bar graph (see Figure 4) showing withdrawal rates was compiled to compare each group relative to STECH 1505 and MATH 1504 initial attempts. The intent was to provide some baseline comparison of personal commitment and confidence in each of the two courses.
- Histograms (see Figure 5) were construct ed to qualitatively compare the members of the groups relative to grades in STECH 1505 and MATH 1504.

F test: MATH 1504 Ho = null hypothesis: sd^2 of TDS = sd^2 of control	
Data	
Level of Significance	0.05
Population 1 Sample	
Sample Size	38
Sample Standard Deviation	0.50036
Population 2 Sample	
Sample Size	46
Sample Standard Deviation	0.4934
Intermediate Calculations	
F-Test Statistic	1.028411389
Population 1 Sample Degrees of Freedom	37
Population 2 Sample Degrees of Freedom	45
Two-Tailed Test	
Lower Critical Value	0.530738758
Upper Critical Value	1.848400597
p-Value	0.921137046
Do not reject the null hypothesis: assume sd equal	
Calculations Area	
FDIST value	0.460568523
1-FDIST value	0.539431477

t-Test MATH 1504: Two-Sample Assuming Equal Variances Ho = null hypothesis: mean of TDS ≤ mean of control		
	Variable 1	Variable 2
Mean	0.578947368	0.39130435
Variance	0.250355619	0.24347826
Observations	38	46
Pooled Variance	0.246581459	
Hypothesized Mean Difference	0	
df	82	
t Stat	1.723785716	
P(T<=t) one-tail	0.044257505	
t Critical one-tail	1.663649185	
P(T<=t) two-tail	0.08851501	
t Critical two-tail	1.989318521	
Reject the null hypothesis: mean of TDS > mean of control		

Figure 3: Category 3 – F test and t Test Results for MATH 1504

Future Implications

The problems that we have encountered with low success rates of incoming Engineering and Engineering Technology students are unlikely to be unique. We like to think our approach to problem solution is novel but certainly not difficult to replicate. It is hoped this article will stimulate discussion on how other technical educators are grappling with the problem. Moving the STECH 1500 course down into the secondary level (e.g. Tech prep programs) appears to be a straightforward strategy.

Colleagues within computer science and business have also recommended breaking the STECH 1500 course into modules for different potential audiences for delivery along with appropriate MATH 1501 selections through a combination of on site and distance learning.

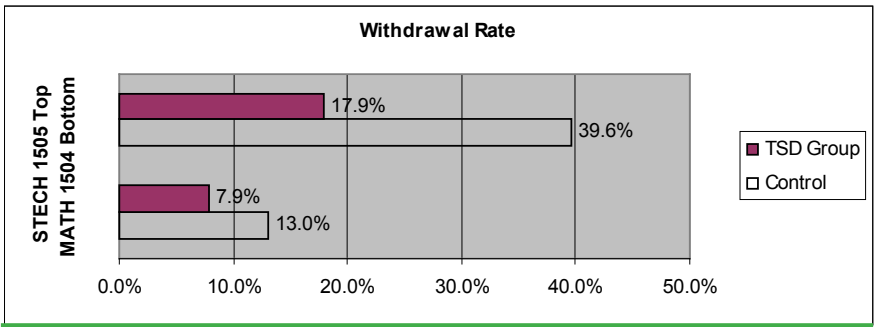

Figure 4: Withdraw Rates

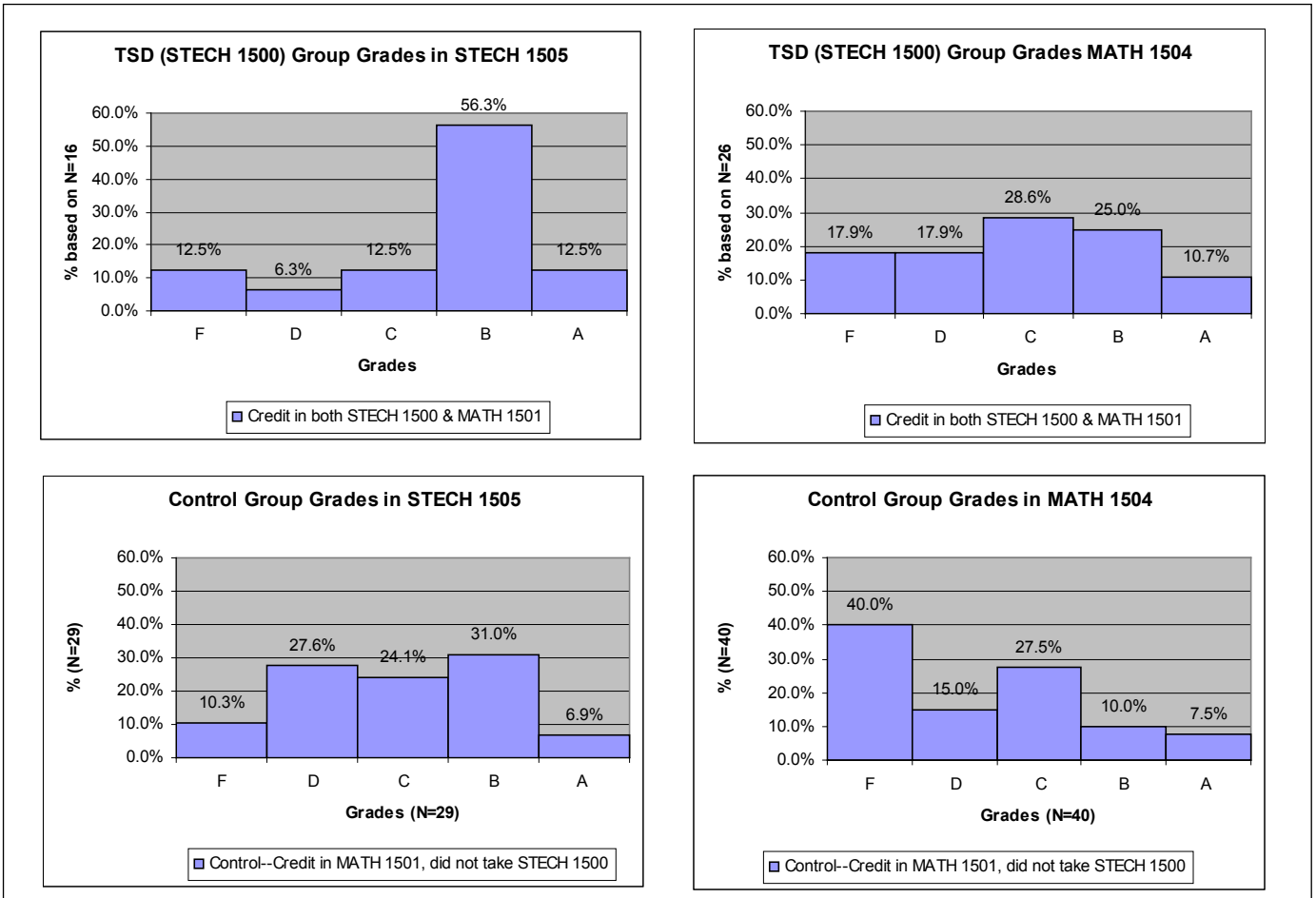

Figure 5: Compare top and bottom histograms for each of the two follow-up courses

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Annette M. Burden is an Assistant Professor of Mathematics at Youngstown State University. In addition to her teaching duties, she is the Math 1501 Coordinator and Developer/Director of the Mathematics distance learning program. Annette is also an upper level Mathematics course developer and tutor for Empire State College (SUNY). Annette is a member of the Association for Educational Communications and Technology; the International Society for Technology in Education, the American Mathematical Society; the Association for Women in Mathematics; the Mathematics Association of America; the National Council of Teachers of Mathematics; and the Ohio Council of Teachers of Mathematics. Annette was a recipient of the Distinguished Professor award for teaching at YSU in 2003,

the Ohio Magazine's Excellence in Education Award in 2004, and the NOCHE Teaching Excellence award in 2004. She has served on multimedia advisory panels for Prentice Hall and Mc-Graw Hill publishing companies. Annette also serves as a reviewer for Prentice Hall, Addison Wesley, Mc-Graw Hill, W.H. Freeman, and Haughton Mifflin. She has written *For All Practical Purposes: Interactive Assessment Text Supplement;* published by W.H. Freeman Media & Supplement Department and is currently writing a Differential Equations text with her husband Richard. Annette also holds a black belt in Tae-Kwon Do, is a competitive Ballroom dancer, and has two grown sons.

John H. George holds degrees in mathematics, mechanical engineering and education. His initial career lasted 5 years during which time he held positions as engineer at Shippingport Power Station, partner in a landscaping company and high school math and physics teacher. His second career spanned 20 years as an engineer in air moving products at Ametek and Emerson Electric. The highlight occurred in 1997-1998 when an industrial engineer, Wendell Davis and he co-developed a new process for motor assembly. For the past 7 years, his third career has been as a professor of mechanical engineering technology. In partnership with Marge Collins and Dr. Ramm Kasuganti of the business school; he developed a fully accredited management BS degree for technical associate degree graduates. Based on

a recommendation from Dr. Ted Bosela and with support of his Director, Dr. William Wood; he created the Technical Skills Development course in coordination with his co-author, Dr. Annette Burden. Mr. George is currently working on a textbook dealing with applications of instrumentation for mechanical measurements.