Corequisite Support for an Introductory Statistics Course

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Abstract
Many institutions of higher learning are now placing students with academic readiness needs directly into credit-bearing courses and providing them with additional support through corequisite courses or labs. What does the existing research say about the effectiveness of such an approach? This poster will examine some relevant articles and describe one institution's development of a corequisite course for introductory statistics. The creators developed materials for three major components of the course: study skills, mathematics, and statistics. This study will examine some initial data from the first year of the corequisite course, feedback gathered from students, changes made in the second semester of the course, and recommendations for the future.

Key Words: corequisite, support, introductory statistics

1. Introduction

Many institutions of higher learning are now placing students with academic readiness needs directly into credit-bearing courses and providing them with additional support through corequisite courses or labs. According to Spanning the Divide, "Even among recent high school graduates—those who should be most prepared for college—1 in 3 are required, often unnecessarily, to enroll in no-credit, remedial courses" (Complete College America, n.d., Far Too Many Students Start in Remediation section, para. 1). This piece includes examples of institutions that increased student success among students with academic readiness needs by adopting a corequisite remediation model. Sung-Woo Cho, Elizabeth Kopko, Davis Jenkins, and Shanna Smith Jaggars (2012) present results from a follow-up study at Community College of Baltimore County that showed that students with academic readiness needs who participate in the Accelerated Learning Program (ALP) have better outcomes in terms of completing the two introductory English courses than students who do not. In "Should Students Assessed as Needing Remedial Mathematics Take College-Level Quantitative Courses Instead? A Randomized Controlled Trial," A. W. Logue, Mari Watanabe-Rose, and Daniel Douglas (2016) describe a study conducted at The City University of New York in which students were randomly assigned to developmental elementary algebra, developmental elementary algebra with workshops, or college-level statistics with corequisite support. They found that students who were assigned to statistics with support had a success rate that was 16 percentage points higher than that of students assigned to algebra.

In "The Corequisite Reform Movement: An Education Bait and Switch," Alexandros M. Goudous (2017) says, "Contrary to popular belief, however, the corequisite model has not been studied thoroughly enough to justify its level of implementation in the nation" (para. 12). He suggests that the corequisite model is most successful under the following

conditions: students should have to commit to six hours, not just four or five; the student-to-teacher ratio should be low; the same instructor should teach both the regular course material and the supporting hours; only students who are just slightly under the academic readiness cutoff should be allowed to take a credit-bearing course with support; and ideally, nondevelopmental students should not be in the same class as those who require remediation.

2. Development of Corequisite Course

Eastern Kentucky University (EKU) has two introductory statistics courses offered by the Department of Mathematics and Statistics; both courses fulfill the General Education quantitative requirement. STA 270, Applied Statistics, is a four-credit-hour course with a prerequisite of college algebra. STA 215, Introduction to Statistical Reasoning, may be taken by students with academic readiness needs. It is a three-credit-hour course that currently uses the 4th Edition of *Statistics*: *The Art and Science of Learning from Data* by Alan Agresti and Christine A. Franklin as the text. According to the *Eastern Kentucky University 2019-2020 Undergraduate Catalog* (2019), the course description is the following: "Introduction to descriptive statistics, normal distributions, correlation and linear regression, sampling, experiments, chance phenomena, one- and two-sample estimation and hypothesis testing, chi-square tests, and use of statistical software" (p. 357).

Due to impending requirements being imposed at the state level, the department eliminated developmental mathematics courses and created corequisite courses for three entry-level quantitative courses, one of which is STA 215. The new corequisite course is STA 215P, Quantitative Support for STA 215. It is a one-credit-hour support course with two contact hours. In addition to the regular STA 215 text, the 5th Edition of *Prealgebra & Introductory Algebra*, by Elayn Martin-Gay is used in the course. According to the *Eastern Kentucky University 2019-2020 Undergraduate Catalog* (2019), the course description is the following: "Corequisite support for students concurrently enrolled in STA 215. Emphasis on prerequisite skills needed for statistics, such as real number sense and operations, equations, analyzing graphs, modeling, critical thinking, and use of statistical software" (p. 357).

The support course includes three major components: study skills, mathematics, and statistics. A Class-Embedded Consultant (CEC), an upper division or graduate student, is assigned to each class. The CEC attends classes, assists with activities, provides tutoring, etc. The primary course creators used a form of backward design to determine which mathematics skills should be included in course by considering the skills that would be needed for each statistical topic in Introduction to Statistical Reasoning. The support course includes required diagnostic assessments that cover essential mathematics skills. Students who score below 75% on a diagnostic quiz are required to meet with the CEC or other tutor to discuss the material on the quiz. Students who are required to take STA 215P may enroll in any section of STA 215 except mass lectures.

2.1 Spring 2019 Schedule

The schedule from the STA 215P syllabus for the spring semester of 2019 is given in Table 1. It provides an outline for both STA 215 and STA 215P for each week of the semester. Some sections of STA 215 meet two days a week for 75 minutes each, while some meet three days a week for 50 minutes each. The STA 215P classes meet twice a week for 50 minutes each day.

Table 1. Spring 2019 Schedule

Week	STA 215	STA 215P
1	Syllabus, introduction Chapter 1: Statistics: The Art and Science of Learning from Data Chapter 2: Exploring Data with Graphs and Numerical Summaries	Syllabus, introduction, time management, campus resources for students, introduction to Mathematics & Statistics Tutoring Center Growth Mindset session Study Smarter, Not Harder session
2	Martin Luther King, Jr. Day (Monday) Chapter 2 continued	Diagnostic Assessment 1 Math review material: proportions, decimals, percentages, place value, rounding, summations, exponents, square roots, mean, median, mode
3	Chapter 3: Association: Contingency, Correlation, and Regression	Activity: Using Your Hair to Understand Descriptive Statistics Preparing for Exams session Math Study Strategies session
4	Chapter 3 continued Chapter 4: Gathering Data	Diagnostic Assessment 2 Math review material: negative numbers, linear equations, slope, y-intercept, graphing lines Statistics review material: descriptive statistics, graphs, correlation, regression
5	Chapter 4 continued	Activity: Tipping Point Statistics review material: correlation, regression Activity: Random Rectangles
6	Chapter 4 continued Statistics and Data Integrity (departmental-developed module) Chapter 5: Probability in Our Daily Lives	Diagnostic Assessment 3 Critical reading strategies for statistics problems Math review material: fractions, probability
7	Chapter 6: Probability Distributions	Activity: Paper Airplanes Activity: Lottery activity
8	Chapter 7: Sampling Distributions	Diagnostic Assessment 4 Math review material: functions, function notation, area, percentiles, order of operations, evaluating expressions, solving equations Activity: Sampling Distribution Simulation
9	Spring Break	

10	Chapter 7 continued Chapter 8: Statistical Inference: Confidence Intervals	Diagnostic Assessment 5 Math review material: inequalities, intervals, more solving equations, formulas, more square roots, solving equations involving radicals Statistics review material: sampling, experiments, probability, normal distribution, sampling distributions
11	Chapter 8 continued	Activity: Confidence Interval Simulation Activity: Trivia Party
12	Chapter 8 continued Chapter 9: Statistical Inference: Significance Tests About Hypotheses	Diagnostic Assessment 6 Math review material: More square roots, more order of operations, more evaluating expressions, more rounding
13	Chapter 9 continued	Activity: Facial Prototyping Activity: Do You Have ESP?
14	Chapter 9 continued Chapter 10: Comparing Two Groups	Activity: Using Technology to Conduct Tests Statistics review material: Confidence intervals, significance tests about hypotheses, statistics/data integrity
15	Chapter 10 continued	Activity: Is Yawning Contagious? Comprehensive math review
16	Chapter 10 continued Chapter 11: Analyzing the Association Between Categorical Variables	Final Exam Preparation
17	Final Exam	

3. 2018-2019 STA 215 and STA 215P Data

Tables 2-5 summarize data for STA 215 and STA 215P in the 2018-2019 academic year. Note that "W" stands for "Withdrew," "S" stands for "Satisfactory," and "U" stands for "Unsatisfactory."

Table 2. 2018-2019 STA 215 Grade Distribution, $n = 1120$

	Grade	A	B	C	D	F	W
Term	**Fall 2018**	165 34.30%	142 29.52%	82 17.05%	33 6.86%	37 7.69%	22 4.57%
	Spring 2019	226 35.37%	162 25.35%	119 18.62%	39 6.10%	58 9.08%	35 5.48%
	Overall	391 34.91%	304 27.14%	201 17.95%	72 6.43%	95 8.48%	57 5.09%

Table 3. 2018-2019 STA 215P Grade Distribution, $n = 56$

	Grade	Satisfactory	Unsatisfactory	W
Term	**Fall 2018**	19 79.17%	2 8.33%	3 12.50%
	Spring 2019	21 65.63%	4 12.50%	7 21.88%
	Overall	40 71.43%	6 10.71%	10 17.86%

Table 4. Fall 2018 STA 215 Grade by STA 215P Grade, $n = 24$

	STA 215 Grade	A	B	C	D	F	W
STA 215P Grade	**S**	2 10.53%	8 42.11%	4 21.05%	1 5.26%	4 21.05%	0 0.00%
	U	0 0.00%	1 50.00%	0 0.00%	0 0.00%	1 50.00%	0 0.00%
	W	0 0.00%	1 33.33%	0 0.00%	0 0.00%	0 0.00%	2 66.67%

Table 5. Spring 2019 STA 215 Grade by STA 215P Grade, $n = 32$

	STA 215 Grade	A	B	C	D	F	W
STA 215P Grade	**S**	1 4.76%	5 23.81%	8 38.10%	3 14.29%	4 19.05%	0 0.00%
	U	0 0.00%	0 0.00%	0 0.00%	0 0.00%	4 100.00%	0 0.00%
	W	0 0.00%	0 0.00%	0 0.00%	0 0.00%	0 0.00%	7 100.00%

4. Student Feedback

A survey was administered to students in the department's support courses in Fall 2018; the STA 215P surveys were shared with the researcher. There were only four responses, but they included some useful comments. One of the questions was the following: "What strategies were the most helpful in learning the content? (P worksheets, group work, CEC appointments, reviews, etc.)" Group work and activities were each mentioned twice, and worksheets and reviews were each mentioned once as being the most helpful strategies. One student named the diagnostic tests in response to a question about what elements of the course could be improved, and one student named diagnostic tests in response to a question about what elements of the course could be omitted. One of the students suggested that students in STA 215P should be grouped according to section of STA 215 so they will be studying the same topics at the same time. (EKU does not have enough STA 215P students to do this, but the issue of varying paces in sections of STA 215 needs to be addressed.)

5. Instructor Feedback

Instructors provided informal feedback to the STA 215 and STA 215P coordinators via email and in-person discussions. Fall 2018 STA 215P instructors noted that they did not have enough time to do all of the activities given on the schedule. Instructors sometimes had to modify activities due to small class sizes, and occasionally instructors modified the schedule to spend more time on math skills based on students' needs. At times it appeared that students struggled more with directions for the activities than with the concept questions on the associated worksheets. Some students who were not required to take STA 215P registered for the course because they incorrectly assumed that it was required for all STA 215 students. The Spring 2019 STA 215P instructor indicated that the variability in instructor pace for the different sections of STA 215 created problems. The Summer 2019 online STA 215P instructor suggested that, at least for an eight-week online course, some of the required tasks may be perceived as busywork by students. The purpose of the support course is not always clear to students, and in some cases, it is not clear to instructors. It may be the case that instructors do not completely agree on the purpose.

6. Modifications

Between the Fall 2018 and Spring 2019 semesters, several activities were removed from the regular schedule. "Extra" activities were made available to instructors via the STA 215P Dropbox folder. In Fall 2019, STA 215 instructors will be asked to follow the schedule more closely. Faculty will also meet to discuss the possibility of having the course more tightly coordinated in general.

Acknowledgements

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