THE RELATIONSHIP BETWEEN PREREQUISITE COURSES PERFORMANCE AND ADVANCED COURSES PERFORMANCE IN AN UNDERGRADUATE PROGRAM

A Project

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Abstract

Prior knowledge plays an important role in learning and teaching. Many undergraduate-level courses in Chinese universities require students to take prerequisite courses. However, students are not required to pass the prerequisite courses to enroll in an advanced course. This research will analyze the relationship between prerequisite-course performance and advanced-course performance. An assumption is that students who did well in prerequisite courses will have better chances to success in a target advanced course. The correlational research will be used in this study. Samples are from an undergraduate program in the major of Educational Technology in a university in Shanghai, China. The independent variable is the GPA of prerequisite courses; the dependent variable is the target advanced course's grade. The result will provide evidences of the importance of prerequisite courses and its effect on students' performance in further studies.

Keywords: Academic Performance, Prerequisite Course, Advanced Course, Educational Technology, Undergraduate

Chapter 1

Introduction

Based on the historical academic records of the undergraduate program in the major of Educational Technology at Shanghai Normal University (SNU), there were 15%-20% students who received D's in advanced courses between 2003 and 2010. Students might fail to get a bachelor's degree because of lower GPA since they got a lot of D's in advanced courses (The lowest GPA to get a bachelor's degree is 2.0. If a student got a D, the student only gained 1 point credit for the course). By checking the prerequisite courses which were taken in the first two years of a 4-year undergraduate program, the researcher found that most students who got a B or higher in advanced courses have a GPA higher than 2.5 in prerequisite courses. On the other hand, a lot of students who have a GPA lower than 2 in prerequisite courses only got a C or lower grade in advanced courses. This research will focus on the relationship between prerequisite-course performance and advanced-course performance.

Statement of the Problem

Does an undergraduate student who got a higher GPA in prerequisite courses have a better chance of getting a higher grade in an advanced course in the major of Educational Technology in China?

Research Problem Description

The Department of Educational Technology (DET) at SNU tries to help undergraduate students know more about their academic status, especially for those students who have a higher chance of failing to get a bachelor's degree. The department wants to warn them as early as possible. If prerequisite courses' GPA could be a predictor of the advanced courses' grade, students will get the prediction of their future success. Most prerequisite courses will be

completed in the first two years, so students could get this information at the end of their sophomore year. Related studies in other disciplines in the United States indicated that the prerequisite courses' GPA could be an important predictor of following courses.

Delimitations of the Problem

The target population is the undergraduate students in the major of Educational Technology in China. This research is limited to China because its higher education system is different than other countries. The accessible population is the undergraduate students who graduated between 2004 and 2011 with a major in Educational Technology at Shanghai Normal University. All the students in the accessible population are a part of this research. The research will collect students' historical academic records from a management information system of the university. The research will use four advanced courses which were taught from 2003 to 2010. The research will focus on the relationship between the student's advanced course's score and his/her prerequisite courses' GPA. The research will also examine whether textbooks and instructors of each advanced course would affect the relationship between prerequisites' GPA and advanced course's score. However, this research will not account for different instructional methodology.

Undergraduate programs have a reference template and a development guideline for core-course design of each major from the Department of Higher Education of China. The course system of the undergraduate program in Educational Technology at Shanghai Normal University is designed under specific guidelines. Therefore, the result of this research will be able to be generalized to the undergraduate programs of Educational Technology at different universities in China, if the program's course system was designed according to the prescribed guidelines. Different disciplines may vary.

Limitations of the Problem

This research has only one university as accessible population. The samples are in preexisting groups rather than a randomized sample. Only the score of a nationwide unified entry examination will be used to measure student's overall capability and the entry score level is different each year. Therefore, the measurement of students' overall capability might not be accurate. Other conditions, like newly constructed computer labs and later version of software will not be considered in this research.

Research Assumptions

This research is being done under the assumption that prerequisite courses can improve students' readiness to take target advanced courses. Students who got a GPA of 2.5 or higher in prerequisite courses might have more chances to succeed in following courses, since prior knowledge is important in learning and instruction. Therefore, prerequisite courses' grades might be a predictor of an advanced course grade. If students have prerequisite courses' grades and the prediction of the target advanced course, they can adjust themselves better for further learning.

Research Questions

This research will examine the following questions:

1. Does a GPA of prerequisite courses have an impact on advanced course's grade?
2. Do different textbooks and instructors have an impact on the correlation of prerequisite courses' grades and advanced course's grade?

Hypotheses

This research will study the following hypotheses:

H_1: There would be a positive correlation between prerequisite courses' GPA and target advanced course's grade.

H_2: Different textbooks and instructors of a target advanced course would affect the correlation coefficient of prerequisites' GPA and the target advanced course's grade.

Variables. The independent variable in H_1 is the prerequisite courses' GPA. This variable is quantitative. The dependent variable in H_1 is the target advanced course's score. It is quantitative.

The independent variables in H_2 are the textbook used in the target advanced course and the instructor who teaches the course. They are categorical. The dependent variable in H_2 is the correlation of prerequisites' GPA and target advanced course's grade. It is quantitative.

Measures of Variables. This research will use inferential statistics to check the correlation coefficient in H_1. A ratio scale will be used to represent prerequisite courses' GPA (independent), ranging from 0 to 4. The target advanced course's standard score (dependent) will use a ratio scale. A standard *z*-score will be used in this research. Since different semesters had different instructors and their evaluations were dependent, the raw score is incomparable. The research will use a *t*-test for *r* to see whether a correlation coefficient calculated on sample data is significant.

For H_2, this research will use descriptive statistics. The textbook variable (independent variable 1) will be represented on a nominal scale. Digits (from 1) will represent the textbooks used in each semester. The instructor variable (independent variable 2) will be represented on a nominal scale. Alphabet (from A) will represent the instructors of each semester. A correlation coefficient (dependent) will be calculated for each semester. There will be 8 semesters' data in

this research, so this research will use descriptive statistics to find out the differences between the groups.

Justification/Need for the Research

Why It Is Important To Address the Problem? In Chinese universities, instructors do define prerequisite courses for advanced courses in their syllabi. However, students are not required to get a C or higher grade in the prerequisite courses to enroll in an advanced course. The reason is, in Chinese universities, the undergraduate program coordinator will design the course system for students, and students just need to keep studying in the system steps, from one course to another course. Those students who didn't do well in prerequisite courses were unaware of the situation until they lost the chance to get a bachelor's degree after four years of study. The result of this research can provide evidence of the importance of prerequisite courses. This evidence can let administrators of universities reconsider the advanced courses' enrollment requirements.

On the other hand, if the hypotheses are supported, the correlation coefficient which is found in a pair of prerequisite courses and an advanced course could be used to examine whether the prerequisite courses are appropriate for the target advanced course.

Contributions to Knowledge and Practice The results of this research can provide evidence of the importance of prerequisite courses. If the assumptions are true, the methods used in this research could be used in other programs to check whether the prerequisite courses defined for advanced courses are appropriate.

The result of this research also can contribute to the knowledge base of educational data (mining). Prerequisite courses grades might be a substantial predictor of students' performance in further studies.

Definition of Terms

The following terms are used throughout this research. The researcher has supplied both constitutive definitions and operational definitions.

Advanced course. An upper-level course has at least one prerequisite course which is defined by instructors. Commonly, an advanced course would be put in the third or the fourth year in a 4-year undergraduate program.

Prerequisite course. A lower-level course which is recommended to study before students enroll in a target advanced course. The instructors or the instructional designer of advanced course will define the prerequisite courses. Commonly, prerequisite courses would be completed in the first two years of a 4-year undergraduate program. A course may be both an advanced course and a prerequisite course if it is has prerequisite courses and can be defined as a prerequisite course of another advanced course.

Textbook. A book used in a course. Commonly, this book is a primary book used in course, and each course has only one textbook. Other books are reference books. The instructor will choose the textbook for his/her class.

Chapter 2

Review of Literature

Prerequisite courses are those that students must take before they enroll in target advanced courses. Prerequisite courses will improve the students' readiness to take the target advanced courses (Abou-Sayf, 2009). In Chinese universities, advanced courses do have prerequisite courses defined in the syllabus. However, passing the prerequisite courses is not a condition to enroll in advanced courses. Students who failed in prerequisite courses still could enroll in sequence courses. They underestimated the effects of prerequisite courses.

Some researchers assumed that prerequisites' performance was a predictor of advanced courses' performance (Christensen, Nance, & White, 2012; McMillan-Capehart & Adeyemi-Bello, 2008); some researchers presumed that prerequisites made students have more chance to succeed in advanced courses (Hoz, Bowman, & Kozminsky, 2001; Huang, O'Shaughnessy, & Wagner, 2005).

In a research article by Hoz, Bowman, and Kozminsky (2001), they describe an experiment that they conducted in earth sciences education. There were two problems in their research (Hoz et al., 2001). First, did the students gain new knowledge in the course Introduction to Geomorphology? If so, what are these aspects of new knowledge? Second, what is the pattern of the relations between the students' new knowledge in geomorphology and their prior knowledge in both geology and geomorphology? They randomly selected 13 freshmen from 50 students who enrolled in a one-semester course, Introduction to Geomorphology, with a prerequisite course, Introduction to Geology. They defined three types of knowledge to find out the effects of prior knowledge on different types of learning instead of using only one final grade. The result showed that prior knowledge has generally no effect, and some hampering effects, on

learning the new contents; and these effects are dimension-specific. The conclusion is conflicting with this study's hypothesis. However, the sample of the research had some flaws. First, all samples were from the same class, so the teaching style and learning materials may affect the result. Second, the number of students included in the sample was too small. It might affect the correlation significance.

In McMillan-Capehart and Adeyemi-Bello's (2008) article, they tried to "determine the appropriateness of Comparative Management as a prerequisite for Organizational behavior" (McMillan-Capehart & Adeyemi-Bello, 2008, p. 11). They predicted that the grade of the graduate prerequisite management course would positively relate to the grade of Organizational Behavior. They used a sample of 471 graduate students in a MBA program of a large southeastern university. They completed the Organizational Behavior courses during the fall 2004 to second summer session 2007 period. The independent variables were whether or not the student took the prerequisite course, the grade in the prerequisite course (A=4, B=3, C=2, and F=1), mode of instruction (online, campus), gender, and race. The result supported that "the grade received in Comparative Management was positively and significantly related to the grade earned in Organizational Behavior" (McMillan-Capehart & Adeyemi-Bello, 2008, p. 14). In this study, only one prerequisite course was involved as a predictor. There might be other courses affecting the result.

Abou-Sayf (2009) identified the challenges in assessment of the impact of prerequisite courses. He redefined the purpose of prerequisites: "one needs to be the more measurable one of improving the students' readiness to take the target course rather than increasing the likelihood of their success in the target course …" (Abou-Sayf, 2009, p. 18). He concluded that there are three domains of challenges: research design and methodology challenges, general statistical

challenges, and political challenges. In the domain of research design and methodology challenge, there were four aspects (Abou-Sayf, 2009). First, grades as the dependent variable. In statistics, raw grade is a poor dependent variable. Standard scores might be used for this purpose. The second one was uncontrollable nuisance variables, course-specific variables and student-specific variables. Course-specific variables included textbook changes, differences in course content, and different instructional strategies; student-specific variables included attendance, motivation, and cognitive strategies. The third one was the persistence effect. Students who did better in prerequisite courses tend to do better in the target course just because they were better students. The fourth one was generalizability. The study of prerequisites suffered from poor generalizable evidence, "not only because of poor research design but rather due to the very nature of the topic" (Abou-Sayf, 2009, p. 16). Abou-Sayf's study provided noticeable points in research design of prerequisites from variables and instruments.

Christensen, Nance, and White (2012) conducted a study on the relationship of undergraduate GPA and MBA GPA. (They used students' GPA of 8 undergraduate business prerequisites as the independent variable and their MBA GPA as the dependent variable.) One of the hypothesis was "Overall undergraduate GPA would be positively correlated with MBA GPA" (Christensen et al., 2012, p. 44); another hypothesis was "There would be a significant positive correlation between completion of undergraduate business prerequisite course in marketing, management, accounting, economics, finance, and statistics and final MBA GPA" (Christensen et al., 2012, p. 44). The used a sample of MBA students who graduated between 1999 and 2006. The result showed that both hypotheses were supported. In their study, there were 32% of the samples missing (n = 491). However, the authors didn't explain why there was such a large amount of missing data and whether it might affect the result.

In conclusion, the topic of the relationship between prerequisite courses performance and advanced courses performance was examined by researchers from different fields and has different results between the studies. Some results show that prerequisites had no effects, or even negative effects, on advanced courses (Hoz et al., 2001). Otherwise, some results show significant positive correlation between prerequisites performance and sequenced-course performance (Christensen et al., 2012; McMillan-Capehart & Adeyemi-Bello, 2008). Those conflicted results might be caused by the research design and subject domain. The research outcome was difficult to generalize, especially to the different nature of topics (Abou-Sayf, 2009). This study is focused on the undergraduate program in the major of Educational Technology in China. It will identify the relationship between the GPA of prerequisite courses and the grades of advanced courses. The results will not only help students know more about their situations, but also will help administrators and instructors make the right decisions.

Chapter 3

Research Design and Methodology

Introduction

This chapter explains the methods and procedures that will be used in this research. This research will focus on the relationship between prerequisite-course performance and advanced-course performance. In this study, the researcher will collect students' historical academic records from a database. Every student's GPA of prerequisite courses for each target advanced course will be calculated. These scores will be paired with the scores of advanced courses to produce a correlation coefficient.

Problem and Purposes Overview

Undergraduate students in Chinese universities are not required to pass or acquire specific grades in prerequisite courses to enroll in advanced courses. The problem is a lot of undergraduate students failed to pass or got a lower grade in advanced courses. Research has been done in different countries and disciplines. Some of the researchers concluded that there was a positive correlation between prerequisite course performance and advanced course performance; others suggested that it may depend on the type of knowledge. The purpose of this research is to attempt to test whether there is a positive relationship between prerequisite course performance and advanced course performance in an undergraduate program in China.

Research Questions

This research will examine the following questions:

1. Does the GPA of prerequisite courses have an impact on a target advanced course's grade?

2. Do different textbooks and instructors have an impact on the correlation of prerequisite course performance and advanced course performance?

Research Hypotheses

This research will study the following hypotheses:

H_1: There will be a positive correlation between prerequisite courses' GPA and a target advanced course's grade.

H_2: Different textbooks and instructors of a target advanced course will affect the correlation coefficient of prerequisites' GPA and the target advanced course's grade.

Research Methodology

This research will use the correlational research method for hypothesis 1, and it will investigate the possibility of the relationships between two variables (Fraenkel, Wallen, & Hyun, 2011, p. 331). This correlational research involves two variables, the GPA of prerequisite courses and the target advanced course's grade. For hypothesis 2, scores will be grouped according to which textbook is used and who instructs the course. A simple descriptive statistic method will be used to describe the mean, range, and standard deviation of grouped correlation coefficients.

Population and Sample

The target population of this research is the undergraduate students in the major of Educational Technology in China. The accessible population is the undergraduate students in the major of Educational Technology at SNU. As other universities, the DET created the undergraduate program of Educational Technology according to the prescribed guidelines from the Department of Higher Education of China. The program's course structures are similar in

other universities in China. They have similar prerequisite courses and advanced courses. Therefore, the accessible population accurately represents the target population.

The DET at SNU established the Bachelor's degree (undergraduate) program in the major of Educational Technology in 1992. Before 1992, it was a two-year college diploma program. There were 1,150 students who graduated from 1996 to 2012. This research will use the purposive sampling method. The sample will be the students who enrolled after the fall semester of 1999. The DET at SNU revises the program's course structure and adjusts the course content for 5% - 10% every academic year due to the rapid development of technology. However, there were more than 20% changes made in the fall semester of 1999. These changes included adding and removing courses besides content adjustment. Therefore, the students who enrolled after the fall semester of 1999 represent the current population. There were 768 students in the sample (as shown in table 1). "The minimum acceptable sample size for a correlational study is considered by most researchers is to be no less than 30" (Fraenkel et al., 2011, p. 338). A total of 768 samples in this research met the minimum requirement.

Table 1

Enrollment of students according to academic year

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
Count	30	120	78	79	80	75	73	78	79	76	768

Data Collection and Instrumentation

This research will collect data from existing records, so there is no instrumentation involved.

This research will choose at least four advanced courses and then identify their prerequisite courses according to the program guidelines and syllabus.

All students' academic records will be retrieved from the management information system of SNU. Each student's GPA of prerequisite courses will be calculated separately for every advanced course. Because students in different classes took different tests, the raw scores were not comparable. To make the data from different classes comparable, both raw GPA scores and raw scores of advanced courses will be converted to standard *z*-scores within each class. Both variables are ratio scales. Every student had four GPA scores for four target advanced scores (as shown in table 2).

Table 2

Data table for correlation coefficient calculation

Student ID	GPA of prerequisites	Grade of advanced course (AC)
9901	p_1	g_1
9901	p_2	g_2
9901	p_3	g_3
9901	p_4	g_4
9902	p_5	g_5
9902	p_6	g_6
9902	p_7	g_7
9902	p_8	g_8
…	…	…

Data Analysis

This research will calculate the correlation coefficient to test hypothesis 1. A Pearson correlation coefficient (r) (Field, 2009, p. 179) will be used to describe the relationship between prerequisite courses performance and advanced courses performance. The significance of the correlation coefficient and the coefficient of determination (R^2) will be reported along with r (Field, 2009, p. 179).

To test hypothesis 2, a simple descriptive statistic will be produced. Students will be grouped by different textbooks and instructors. An r of prerequisites' GPA and advanced courses score will be calculated for each group. This research will conduct a bar chart for each group's r, and the mean, mode, range, and standard deviation will be reported (Fraenkel et al., 2011, p. 190). The researcher will analyze the outliers, especially the groups that have a lower r value.

Summary

In this research, the target population is undergraduate students in the major of Educational Technology in China. The accessible population is undergraduate students in SNU (N = 1076), and the sample is the groups of students who enrolled between 1999 and 2008 (n = 768). The sampling method is purposive sampling. Data will be collected from an existing database. A correlation coefficient (r) will be reported with the significance of r and the coefficient of determination (R^2) for H_1. Mean, mode, range and standard deviation will be reported along with a bar chart for H_2.

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