Chapter 4
An Introduction to Path Analysis Modeling Using LISREL

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ABSTRACT

Over the past decades, there has been a wide range of empirical research in the e-learning literature. The use of multivariate statistical tools has been a staple of the research stream throughout the decade. Path analysis modeling is part of four related multivariate statistical models, including regression, path analysis, confirmatory factor analysis, and structural equation models. This chapter focuses on path analysis modeling for beginners using LISREL 8.70. Several topics covered in this chapter include foundational concepts, assumptions, and steps of path analysis modeling. The major steps in path analysis modeling explained in this chapter consist of specification, identification, estimation, testing, and modification of models.

INTRODUCTION

Tremendous advances in information technology and the changing demographic profile of the student population have allowed colleges and universities to offer Internet-based courses as a way to meet the ever-increasing demand for higher and continuing education. In the early e-learning systems developmental stage, the focus of research was on the non-empirical dimensions of e-learning systems. E-learning systems include learning management systems, course management systems, and virtual learning environments. There are a wide range of free software and/or open source learning management systems (e.g., eFront), and course management systems (e.g., Dokeos, ILIAS, Moodle, etc.). Many well-known virtual learning environments are available to facilitate the creation of virtual class rooms (e.g., Blackboard, WebCT, FirstClass, Desire2Learn,

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CyberExtension, It's Learning, WebTrain, etc.). Some universities have developed their own custom learning environments for creating and managing e-learning systems. Furthermore, they have spent heavily to constantly update their online instructional resources, computer labs, and library holdings. Now it is evident that the technology itself may not be an impediment anymore.

The distance learning system can be viewed as having several human/non-human entities interacting together via computer-based instructional systems to achieve the goals of education, including perceived learning outcomes and student satisfaction. During the past decade, the volume of research in online and blended business education has increased dramatically. The most common e-learning research streams across business disciplines were outcome comparison studies with classroom-based learning and studies examining potential predictors of course outcomes (Arbaugh et al., 2009). The *Dimensions and Antecedents of VLE Effectiveness* introduced by Piccoli, Ahmad, and Ives (2001) contributed to developing new empirical research models. User satisfaction is the overall measure of the student's perceived level of fulfillment in the online course. The review of e-learning empirical research indicates that there are numerous quantitative research methods that have been utilized. They include categorical data analysis using chi-square test, multivariate data analysis techniques including analysis of covariance (ANCOVA), General linear model multivariate analysis of covariance (MANCOVA), conjoint analysis, canonical correlation analysis, discriminant analysis, multiple regression analysis, path analysis, factor analysis (confirmatory vs. exploratory), structural equation modeling (SEM) using PLS graph and Smart PLS, LISREL, AMOS, and EQS. Moreover, qualitative research methods for e-learning empirical research have been applied to examine the effects of various factors or variables on the student satisfaction and learning outcomes. Qualitative research methods include action research, case study research, the grounded theory approach, ethnographic research, etc.

MAIN FOCUS

The use of multivariate statistical techniques has been a staple of the e-learning empirical research stream throughout the decade. This may reflect the fact that the field has drawn in some researchers who have been trained in such analytical techniques which are common in many business disciplines, and those scholars simply brought these techniques with them to design and analyze studies of online learning. Moreover, there is a growing number of studies that have used highly sophisticated statistical techniques such as structural equation models and hierarchal models in recent years (Arbaugh, Hwang, & Pollack, 2010).

This chapter focuses on covariance based path analysis modeling using LISREL 8.70. Structural equation modeling (SEM) is "a comprehensive statistical approach to testing hypotheses about relations among observed and latent variables."(Hoyle, 1995) SEM methodology is used to test four types of theoretical models: regression, path, confirmatory factor, and structural equation models. LISREL is capable of modeling all four models. All four models can be tested by following the five steps: specification, identification, parameter estimation, testing, and modification. To complement this chapter of path modeling, several other chapters are concerned with path modeling applications, an introduction to SEM using PLS graph, and SEM applications. The remainder of this chapter is organized by the following several sections.

- Foundational concepts – observed and latent variables, dependent and independent variables, and regression models
- Assumptions