Chapter 16
The Direct and Indirect Effects of Computer Uses on Student Success in Math

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ABSTRACT

To promote the academic success of middle school students, the authors examined the effects of computer uses on mathematics self-efficacy and mathematics performance of students, paying focused attention to immigrant students. They analysed the effects of computer use for schoolwork and gaming of middle school students applying a Structural Equation Modeling (SEM) to Trends in International Mathematics and Science Study (TIMSS) USA. The results showed that when students frequently used computer for schoolwork, they revealed high mathematics self-efficacy, which in turn led to high mathematics performance. On the other hand, the students that used computer for gaming frequently indicated low mathematics self-efficacy and mathematics performance. The authors' study results highlight the importance of guiding students to use computers properly, which is directly and indirectly associated with students' self-efficacy and performance in mathematics.

DOI: 10.4018/978-1-5225-3832-5.ch016

INTRODUCTION

A large amount of American youths' lives is devoted to computers and digital games. According to a national survey, American children and teens aged from 8 to 18 spent 2 hours and 43 minutes per a day using computers and playing digital games for recreational purposes (Kaiser Family Foundation, 2010). Contrastingly, American youths used computers only 16 minutes per day for schoolwork. This study was motivated by the imbalanced use of computer by teenagers and examined the disintegrated effects of computer use for schoolwork and gaming by teenagers, particularly 8th graders.

More importantly, we explored the differentiated effects of computer use for immigrant students as well as native-born students. Our main focus was on the immigrant students who are making exponential growth in the US and need more special attention to promote academic success. As noted in many studies (Aud et al., 2013; Kim, & Chang, 2010) immigrant students frequently report difficulties in adapting themselves to the US schools. They consistently display low academic performance from their early schooling and also show a large performance gap in later grades (Chang, & Kim, 2009).

While this study's main outcome was the mathematics performance of students, the role of self-efficacy as a mediating variable of the computer effect on mathematics performance was also explored. As many researchers reported in their studies (Fast et al., 2010; Yailagh, Lloyd, & Walsh, 2009), self-efficacy is known as a critical factor of academic performance of students. This relationship was delineated in our analytical model in which a path from the type of computer use by students was directing students' self-efficacy, and another path leading to students' school performance. The importance of research on students' mathematics performance and mathematics self-efficacy was supported by the following motivation: First, mathematics performance of the US students is comparatively low among the Organization for Economic Cooperation and Development (OECD) countries (Kelly et al., 2013). Second, the majority of immigrant students including English Language Learners (ELL) in the US show a seriously large performance gap in mathematics despite the false expectation for mathematics; which even immigrant students would easily catch up with native-born (native) students right after they overcome the difficulties in English language learning (Aud et al., 2013).

This study used nationally representative data from Trends in International Mathematics and Science Study (TIMSS) USA that was collected by the National Center for Education Statistics (NCES) to arrive at the study's goal of high generalizability. For a statistical analysis, we adopted a Structural Equation Modeling (SEM) that was suitable to explore the influence of two types of computer use on students' mathematics performance which was mediated by students' mathematics self-efficacy. As important covariates, we included parents' educational level and student gender in the model. Figure 1 presents the diagram of the study analytical model.

The following overarching research questions guided this study:

- Does computer use for schoolwork make direct effects on mathematics self-efficacy and mathematics performance of immigrant and native-born students as well as indirect effects on mathematics performance through mathematics self-efficacy?
- Does computer use for gaming make direct influences on mathematics self-efficacy and mathematics performance of immigrant and native-born students as well as indirect effects on mathematics performance through mathematics self-efficacy?