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Indentifying latent classes and testing their determinants in early adolescents' use of computers and Internet for learning

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ABSTRACT

The purpose of the present study was to identify latent classes resting on early adolescents' change trajectory patterns in using computers and the Internet for learning and to test the effects of gender, self-control, self-esteem, and game use in South Korea.
Latent growth mixture modeling (LGMM) was used to identify subpopulations in the Korea Youth Panel Survey (KYPS). Initial analyses revealed four latent classes: High Use Class, Increasing Class, Decreasing Class, and Low Use Class. Adding gender, self-control, self-esteem, and game use, we tested the effects of the independent variables on the latent classes using multinomial logistic analysis. Results from the second analyses indicated that gender, self-control, self-esteem, and game use were significant determinants of the latent classes.
Findings suggest the need to consider heterogeneity in studies of early adolescents' use of computers and the Internet for learning in order to better target involvement programs.

1. Introduction

Computer and Internet use among adolescents has become an indispensable activity in their daily lives. According to a National Center for Education Statistics (NCES) report, almost 90% of children and adolescents aged 5–17 in the U.S. use computers; almost 59% of them use the Internet (NCES, 2004). Similarly, 85% of Korean adolescents aged 13–18 spend approximately 1.5–2 h per day on the Internet (Jang, Hwang, & Choi, 2008). The wide availability of computers in schools is a critical reason for the broad use of computers and the Internet among adolescents. Ubiquitous technology environments allow adolescents to engage in a variety of activities online. The Pew Internet project reported that 37% of American youth aged 12–17 participated in video chats with others; 27% of that group recorded and uploaded a video to the Internet (Lenhart, 2012). Jang et al. (2008) surveyed 851 Korean adolescents aged 13–18 and identified and examined the most frequently used Internet activities: online games (38.1%), information search (36.9%) and chatting with peers (25%). It is unclear whether students' activities were related to learning because studies did not restrict Internet use to learning purposes only. However, based on online content generated by teens and types of popular online games, it could be argued that although some students are actively engaged in computer and Internet use, the primary reason is entertainment unrelated to learning. Thus, there is a significant need for research on early adolescents' use of the Internet and computers for learning over time.

One reason for the lack of research on this topic is that several related studies examined the impacts of technology on learning but did not consider changes in students over time due to computer and Internet use. Several studies (Clements, 1991; Elliott & Hall, 1997; Garderner, Simmons, & Simpson, 1992; Jang et al., 2008) applied an experimental design or cross-sectional approach in which variables were observed at a particular point in time. This approach helps researchers compare many different variables at the same time but does not identify changes in sample characteristics at both the group and individual levels.

Another reason is that previous studies (Heo, 2012; Kim, 2009; Kim & Kim, 2008; Park, 2011), even though they involved the collection of longitudinal data to examine changes in student attributes, simply reported a single average growth trajectory that estimated the entire population. In other words, the results did not examine whether groups of students demonstrated a similar trajectory of technology use.

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Sometimes average trajectory can differ by aspects of panel data or researchers. For example, one result from a study of 7th to 9th grade middle schools in Korea showed a declining trajectory in the long-term use of computers for learning (Kim, 2009), but another reported an increasing average trajectory from 8th to 11th grade (Park, 2011). Both longitudinal studies did not consider subgroups in their changing trajectory. For this reason we must consider not only longitudinal changes in attributes but also changes to subgroups, called the latent class.

Therefore, the purpose of the present study was to identify latent classes using computers and the Internet for learning, and to test the effects of gender, self-control, self-esteem, and game use on group membership among early adolescents in South Korea. A longitudinal national data set was analyzed using Latent Growth Mixture Modeling (LGMM), and multinomial regression. This study had two research questions:

(a) How many *latent classes* exist in the trajectory of computer and Internet use for learning, and what are the distinctive characteristics in each changing trajectory group?
(b) What variables among *gender, self-control, self-esteem* and *game use* affect class membership?

2. Theoretical framework

2.1. Using the computer and Internet for learning in South Korea

Using the computer for learning and education plays an important role in critical thinking and effective construction of new knowledge and information (Jonassen, Carr, & Yueh, 1998). For this reason, the government of the Republic of South Korea has paid particular attention to the use of the computer and Internet in learning. Since the establishment of the Educational Information Development Plan in 1996, the Korean government has provided a national service system to support K-12 education through utilization of technology in classrooms.

In part due to government efforts, Korea became one of the nations to gain the highest Information & Communication Technology (ICT) ratings among countries belonging to the Organization for Economic Cooperation and Development (OECD), according to the PISA 2003 database (Ministry of Education and Human Resources Development & KERIS, 2006). While the Korean government has been strongly interested in computer and Internet usage for learning purposes, significant past researches (Jackson, von Eye, Witt, Zhao, & Fitzgerald, 2011; Kim, 2009; McCreay, Enrich, & Lisanti, 2000; Subrahmanyam, Greenfield, Kraut, & Gross, 2001) have focused on computer use and its relation to behavioral variables such as achievement and addiction without clearly defining the purpose behind "using the computer."

Computer and Internet usage can yield various results depending on the purpose of the use; therefore, it is necessary to accurately define the subject of study beyond the ambiguous generalization of "using the computer and Internet." To invest in enhancing the use of the computer and Internet to promote education would require researchers to focus on analyzing data on students' computer and Internet usage for learning purposes.

One particular example of computer and Internet usage for learning in South Korea is EDUNET (http://www.edunet4u.net/intro.do). The site includes teacher lesson plans, teaching resources, and multimedia content resources for every unit in required subjects in elementary and secondary schools. The learning content is organized based on the national curriculum and difficulty levels (i.e., basic, understanding, and advanced). Another example developed by the government is the Educational Broadcasting System (EBS, http://www.ebs.co.kr/). The site promotes equal education by allowing every student to access the best learning materials regardless of their socioeconomic status or region. These sites have been developed for those using computers and the Internet for learning purposes. Kim's (2009) research separated the concepts of *learning purposes* and *entertainment purposes* with regard to computer use. In this study, we focused on the use of computers for "learning".

2.2. Latent classes of using the computer and Internet for learning

Children are easily affected by media; their use of media fluctuates during their early developmental periods (Villain, 2001; Young, 1996). For this reason researchers have been interested not only in a single-point period but also in a multi-point period when identifying media effects on children. Even the two central debates over the effectiveness of the media (Clark, 1994; Kozma, 1994; Kulik & Kulik, 1984) used experimental methods and meta-analysis, which were both limited to using only single-point period data (Li & Ma, 2010; Shin, Park, & Kim, 2005). To amend this past inadequacy, some recent research has utilized longitudinal data methods in the study of technology usage (Jackson et al., 2011; Kim, 2009; McCreary et al., 2000).

Some researchers have sought to determine average changes in trajectory with longitudinal data using latent growth modeling (LGM). It is possible to analyze not only an individual's average changes in trajectory but also individual differences in development changes over time (Meredith & Tisak, 1990; Muthén, 2001; Muthén & Asparouhov, 2006). With regard to using computers for learning, Kim (2009) studied students utilizing longitudinal data from 7th grade to 9th grade in middle schools in South Korea and found a declining trajectory in their long-term usage of computers for learning. Park (2011) also engaged in a longitudinal analysis of achievement, self-esteem, and computer use for adolescents. She reported an increasing average trajectory in computer use for learning, based on longitudinal data from 8th grade to 11th grade in middle schools in South Korea.

However, changes in students' trajectories may be explained through one average pattern change. Previous studies using latent growth modeling (Kim, 2009; Park, 2011) have sometimes identified an opposite average change in trajectory, with one increasing and the other decreasing, considering differences in the panel.

Therefore, latent classes should be considered because changes may be indicated both in data (e.g., gender) and in analyses. Classifying latent classes from the *change* in the use of the computer and the Internet for learning purposes provides us not only with an understanding of variations within the variable, but also a guide to effectively addressing the different needs of each type of group. Most studies have classified groups by gender or ethnicity, which are fixed variables that do not change over time. However, students' use of the computer and Internet for learning is a factor that constantly changes throughout the students' development. For this reason, it is necessary to identify subpopulations among different individual growth trajectories.