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Exploring the Relationships between Adolescents' Perceived Achievement Goals, ICT Use in Education, Academic Achievement, and Attitudes toward Learning*

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Perceived control and use of Information and Communication Technology (ICT) has long been known as important aspects of students' achievement. The purpose of this study was to explore the relationship between adolescents' perceived achievement goals, their Individual ICT use, ICT use for government-sponsored educational programs on television or the Internet, academic achievement and the attitude toward learning. Most previous research has employed cross-sectional data analysis using relatively small samples. For this purpose, this study used the datasets of the Seoul Education Longitudinal Study (SELS 2011) from Seoul Educational Research & Information Institute. We analyzed structural equation modeling (SEM) a nationally represented sample (4,346 eighth-grade students). The results of this study showed that students' perceived achievement goals had a positive relationship with their individual ICT use, and their use of ICT programs for government-sponsored educational programs on television or the Internet. Also, students' individual ICT use had a positive relationship with their achievement, but ICT use for government-sponsored educational programs on television or the Internet did not have a significant relationship with their achievement. That is, students' individual ICT use mediated the relationship between their perceived goals and academic achievement. In addition, results indicated that students' individual ICT use and ICT use for government-sponsored educational programs on television or the Internet had a positive relationship with their attitude toward learning. That is, both students' individual ICT use and ICT use for government-sponsored educational programs on television or the Internet mediated the relationship between their perceived goals and their attitude toward learning.

Keywords: ICT use in education, Perceived achievement goals, Achievement, Attitude toward learning

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Introduction

The emergence of innovative information and communication technologies (ICT) has changed teaching and learning methods, and made instructional media an important component of most education settings. Further, instructional media like PC have been used not just for teaching, but together with smart-pad, smart-phone and social media to increase student achievement, motivation, and interpersonal interaction. It has become essential, then, for teachers and students to enhance their ability to effectively utilize ICT for teaching and learning activities. Many countries, including those in the European Union (EU) and the Organization for Economic Co-operation and Development (OECD), now consider ICT use in education to be a key priority, and they have begun to integrate ICT into many curriculum development, teaching, and learning processes in their schools (Aristovnik, 2012; İşman, 2012; Wilhelm, 2004).

A number of studies have shown that ICT use in education can have a positive impact on student achievement (Chandra & Lloyd, 2008; Liu, 2004; Rainer, Laosethakul, & Astone, 2003; Underwood, 2004). However, the use of ICT in educational settings does not in itself guarantee these benefits. In fact, in most cases teachers need to be trained to have the knowledge, competencies, and resources required to meaningfully integrate technology into their teaching and learning activities (Papanastasiou, Zembylas, & Vrasidas, 2003; Vrasidas & McIsaac, 2001).

The effects of ICT on learning activities and outcomes, then, depend on how teachers can design their classes, learning content, instructional models, and curricular philosophies structurally (Liu et al., 2003). In addition, when instructional designers and teachers develop and implement ICT-based instruction that reduces temporal and spatial barriers between learners they tend to engage in more knowledge-sharing (Hendriks, 1999). Thus, research using large samples of students can help teachers and instructional designers develop more effective

ICT-based instruction by providing information on characteristic patterns of student ICT use and on optimal environments and structures for ICT use in education.

A holistic understanding of the complex systemic nature of ICT integration, that is, using diverse ICT together requires more exploration of the multidimensional relationships between individual, school, organizational, and government-related factors associated with ICT use and student achievement (Tang & Ang, 2002; Tondeur, Valcke, & Van Braak, 2008). Although some researchers have addressed students' use of ICT to access government-sponsored educational programs on the Internet or television (Aypay, 2010; Wittwer & Senkbeil, 2008), few have examined the relationship between students' ICT use government-sponsored education programs designed for ICT as well as their ICT use in the individual level. Though research largely has focused on the effect of the frequency of computer and Internet use on student achievement, some studies have examined ICT use in education and other determinants of student achievement (Dewey, Husted, & Kenny, 2000; Wittwer & Senkbeil, 2008). For example, self-efficacy and other psychological components of student motivation may play a significant role in students' on-task behavior and effective use of ICT in learning activities (Ziden, Ismail, Spian, & Kumutha, 2011). In other words, students' psychological factors can influence their learning activities process using ICT and attitude toward learning, and consequently, they can also have an effect on their learning outcomes such as student achievement. More research is needed to explore the relationships between psychological factors such as students' perception of achievement goal and the effectiveness of ICT use in education specifically.

In this study, then, we used data from a large sample of Korean adolescents to investigate the use of ICT in education at the individual level and at the level of government-sponsored instructional programming delivered through television or the Internet. In Korea, such instructional programming is broadcast by the Korean Educational Broadcast System (EBS), and EBS broadcasts diverse educational

contents for each class of elementary-, middle- and high school students in terms of some subject matters such as Mathematics and Language. Specifically, they have six channels such as EBS PLUS 1 for high school students and EBS PLUS 2 for elementary and middle school students. It provides diverse educational contents based on the Korean national curriculum for school education. Currently, they have developed and operated 'the EBS clip bank systems' where about five-minute clip-based educational broadcasting contents are being offered in order to use the contents in different media such as TV, Internet, and mobile devices (EBS, 2014). However, there are few active discussions which deal with the issues structurally about how government-sponsored educational programs on television or the Internet such as EBS educational programs influence student learning process or outcomes such as achievement and attitude considering individual student factors.

This study aims to contribute to the ongoing debate about the extent to which students' ICT use for educational purposes affects their academic achievement and attitudes toward learning by exploring the relationships between these variables as well as related psychological factors.

This study addressed the following research questions:

(1) What are the relationships between adolescents' perceived achievement goals, individual ICT use, academic achievement, and attitude toward learning?

(2) What are the relationships between adolescents' perceived achievement goals, ICT use for government-sponsored educational programs on television or the Internet, academic achievement, and attitudes toward learning?

Theoretical Background

Determinants of effective ICT use in education

Individual student factors related with ICT use

In order not to overestimate the impact of students' ICT use on their learning process or outcomes, one must consider the influence of other determinants of academic performance (Wittwer & Senkbeil, 2008). Individual factors like perceived self-efficacy, perceived usefulness of ICT and the level of ICT literacy as well as demographic characteristics like gender, race, and social-economic status (SES), may directly or indirectly influence diverse aspects of students' ICT use in education. Mac Callum, Jeffrey, and Kinshuk (2014) reported that ICT literacy and ICT anxiety can influence the adoption of mobile learning, and ICT anxiety can hinder the development of ICT literacy. In addition, Shih (2006) examined the effects of students' self-efficacy and computer competence on their individual satisfaction with computer use. The results of the study revealed that self-efficacy affects computer competence positively, and computer competence is a strong and positive antecedent of individual satisfaction with computer use.

In a study of gender differences in junior high school students' Internet self-efficacy and use of the Internet, Tsai and Tsai (2010) found that female students scored significantly higher than male students on the scale measuring online communicative self-efficacy. In addition, the results revealed gender differences in students' styles and purposes for using the Internet. Male students were more exploration-oriented than female students, while female students were more communication-oriented than male students. Volman, van Eck, Heemskerk, and Kuiper (2005) identified gender and ethnic differences in pupils' use of ICT at the primary or secondary education level. At the secondary level, for example, the ICT attitudes about their own ICT competence of females tended to be less positive than that of males, a finding consistent that of Kuhlemeier and Hemker (2007) who discovered that when using ICT for learning activities, female students estimated their ICT skills and competencies to be significantly lower than those of male students. In addition, Vekiri and Chronaki (2008) found that female students reported less perceived support for computer use from their parents and peers and

less positive computer self-efficacy and value beliefs than male students. Ziden et al. (2011) also reported that ICT use for primary school science lessons in Malaysia had a greater positive impact on male students than female students. Some studies have indicated a narrowing of gender differences, however, especially in elementary and secondary school students, due to the successful integration of user interfaces, user-friendly online communication tools, and cloud computing (McCarthy, 2000; Rainer et al., 2003; Schweingruber, Brandenburg, & Miller, 2001; Tsai & Lin, 2004; Tsai & Tsai, 2010; Volman et al., 2005).

Other studies point to the impacts of factors like ethnicity, majority/minority status, and socioeconomic status (SES) on student ICT use for educational purposes. Kuhlemeier and Hemker (2007) conducted a study of 13- to 15-year-old students in the lower grades of Dutch secondary education and found that those with a majority background had relatively better Internet skills and a more accessible home computer use than those in pre-vocational education, in their first year, and from a minority background. In addition, Vekiri and Chronaki (2008) reported that students from ethnic majority families perceived themselves to use ICT more skillfully than students from ethnic minority families. Also, Hakkarainen et al. (2000) examined Finnish elementary and high school students' skills and practices in using ICT. The results indicated three factors that best represented the students' relationships to ICT: 1) positive attitude towards ICT and inclination to use ICT as a tool of learning, 2) technical ICT skills and intensive use of multiple applications of ICT for recreational purposes, and 3) intensity of self-reported use of ICT at school. The results also showed that male students scored significantly higher than female students on scales associated with all three factors. The difference in students' socio-economic backgrounds also has been found to be associated with disparities in their ICT use in education (Gündüz, 2010). Vekiri (2010) reported that students from low-SES families in Greece had lower confidence in their ICT skills, that is, less positive self-efficacy beliefs about their ICT use, than students from high-SES families.

School factors related with ICT use

The effectiveness of ICT use for instruction in school settings may be influenced by both school and teacher characteristics. School factors like a teacher's skill with the use of ICT for instruction may increase student interest and effectiveness in their own use of ICT for academic tasks. Female teachers who are proficient in using ICT for their instructional activities, for example, have been shown to serve as role models for female students who are not entirely confident of their own ICT skills and avoidant of learning activities that employ ICT (Meelissen & Drent, 2008). Tondeur et al. (2008) reported significant positive relationships between school culture characteristics like openness to change and the availability of an ICT school policy plan, and ICT use as a learning tool. In addition, they found that constructivist teaching beliefs on the part of teachers were associated with the adoption of three types of computer use: 1) adoption of basic computer skills, 2) adoption of computers as a learning tool, and 3) adoption of the use of computers as an information tool. In addition, one structural school-teacher characteristic as well as a mixed factor combining gender, instructional methods, and the computer experiences of teachers has been associated with students' attitude toward ICT use. In a study by Meelissen and Drent (2008), two teacher-related factors, teacher-centered pedagogy and previous computer experience by female teachers, had a positive effect on the attitudes toward ICT use of female students' in the Netherlands.

Biagi and Loi (2013) noted that technological infrastructures, ICT teacher training policies, and computerization policies are potentially important factors that may moderate effective ICT use at the student- and school-levels. Using 2009 data from OECD's Program for International Student Assessment (PISA), Gümüş (2013) investigated factors affecting ICT use by Turkish students. Using hierarchical linear modeling (HLM), he examined the relationships between student- and school-level variables and students' ICT usage for school-related tasks. Student-level variables included ICT availability at home, occupational status of

parents, parental level of education, family wealth, and access to ICT at school, while school-level variables included school size, student-teacher ratio, availability of the Internet, extra-curricular activities, and quality of educational resources at school. The results of the study indicated that access to ICT at school (a student-level variable) and school size (a school-level variable) were found to be significant predictors of students' ICT usage for school-related tasks. Accordingly, Gümüş' recommended that schools facilitate students' ICT use by offering opportunities for them to engage in ICT-related tasks at school and their access to ICT at school. These findings also point to the close connection between school-level and student-level factors. For example, parents with relatively higher socio-economic resources can enroll their children in better ICT-equipped schools (Biagi & Loi, 2013).

Aristovnik (2012) investigated the impact of ICT use on educational performance in 27 European Union countries (EU-27) and selected OECD countries and found significant variation in the efficiency of ICT use in education across the great majority of EU and OECD countries. Based on educational outcomes, it appeared that students in the countries Finland, Norway, Belgium, and Korea had the most efficient use of ICT for educational purposes.

ICT use in education, student achievement, and attitude

Relationships between ICT use in education and student achievement

Many previous studies have shown a positive relationship between students' educational ICT use and their achievement (Attewell & Battle, 1999; Chandra & Lloyd, 2008; James, Lamb, Householder, & Bailey, 2000; Papanastasiou et al., 2003). Based on the U.S. PISA 2000 data, for example, Papanastasiou et al. (2003) found that after controlling for students' socio-economic status (SES), a positive relationship between the frequency of computer availability at home and in the library and their PISA Science literacy. Using an experimental design, Ziden et al.

(2011) also found that students' ICT use had a positive impact on the achievement of Malaysian primary school students' in science. A few studies, however, have shown different results in regard to the student achievement and ICT use. Using data from the 2006 PISA, Aypay (2010) examined the educational ICT use and academic achievement of Turkish students and found no significant relationship between the two ICT skills and academic achievement. Similarly, an analysis of 2003 PISA data for German students by Wittwer and Senkbeil (2008) revealed no significant relationship between access to computer use and performance in mathematics for the majority of those surveyed. For a small group of students in this study, however, their use of ICT in a group problem-solving activity was associated with improved academic achievement. Also, in a study in which mobile learning devices, wireless communication, and network technologies were integrated in a constructivist learning context, students engaged in more effective group collaboration, concentrating on the learning itself rather than on tedious exercises and improving their academic achievement (Liu et al., 2003). In addition, Papanastasiou (2002) analyzed 1995 data from the Third International Mathematics and Science Study (TIMSS) and found negative relationships between the frequency of ICT use in the classroom and student achievement in many countries, including Cyprus, Hong Kong, and the U.S.

Other studies have revealed both positive and negative relationships between ICT use in education and academic achievement. For example, Wenglinsky (1998) examined the relationship between different uses of educational technologies and mathematics achievement among 6,227 fourth-graders and 7,146 eighth-graders in the U.S. who had taken the 1996 National Assessment of Educational Progress (NAEP). The results of the study indicated positive relationships between teachers' professional development in technology and in the use of computers for teaching higher-order thinking skills, and students' academic achievement in mathematics for both 4th and 8th graders. However, the results also showed negative relationships between the use of computers to teach lower-order thinking skills and

students' academic achievement in mathematics for both 4th and 8th graders.

In addition, a previous study investigated the relationships between specific domains of students' ICT use and their learning outcomes. Biagi and Loi (2013) examined the relationships between students' ICT use for specific purposes and their academic achievement using PISA 2009 data from 23 European countries. The four specific purposes were: 1) gaming activities, 2) collaboration and communication activities, 3) information management and technical operations, and 4) creation of content and knowledge and problem-solving activities. Their results indicated that of the four purposes for ICT use, a positive relationship between PISA test scores and intensity of students' ICT use was found only for individual and collective gaming activities, both online and offline. In fact, the results showed a negative relationship between PISA test scores and intensity of students' ICT use for the purpose of creation of content and knowledge and problem solving activities. This negative relationship may be explained by the tendency of the PISA test to deal with skills and competencies which can be affected and assessed by traditional teaching and learning methods and processes (Biagi & Loi, 2013; Bocconi, Kampylis, & Punie, 2012).

Relationships between ICT use in education and student attitude toward learning

A few studies have considered the relationships between student characteristics, student ICT use in education, and attitudes toward learning. Meelissen and Drent (2008) examined the differential effects of non-school related factors and school-related factors on student computer attitudes using large-scale survey data from 4000 Dutch primary school students. The overall results indicated that most of the variance in female students' attitudes was due to non-school related individual factors. Further, the results showed that parental encouragement for computer use and self-efficacy in ICT use had a significantly positive effect on student attitudes toward computers and learning. In addition, some studies have

reported that psychological factors like self-efficacy, value beliefs and individual beliefs about computer abilities play a key role in predicting student intentions to enroll in optional ICT courses (Dickhäuser & Stiensmeier-Pelster, 2003; Vekiri, 2010). Compeau and Higgins (1999) identified two types of outcome expectations held by students: performance-related outcome expectations and personal outcome expectations. They found a positive relationship between both types of student expectations and their ICT use, which was also related to improved job performance.

Method

Participants

The data used in this study was a part of a larger longitudinal study, focusing on three variables: students' ICT use in education, academic achievement, and attitudes toward learning. In 2011, a total of 4,346 middle school students attending eighth grade in Seoul, Korea were recruited for participation in Seoul Educational Longitudinal Study (SELS 2011) developed by the Seoul Education Research & Information Institute which was operated by Seoul Metropolitan Office of Education. The participants ranged in age from 14 to 15 years with a mean of 14.25 years; 45.4 % were female and 54.6% were male.

Instruments

This study employed the data set of Seoul Educational Longitudinal Study (SELS 2011) offered from the Seoul Education Research & Information Institute in Seoul Metropolitan Office of Education. This study utilizes the data from a total of 4,346 students attending eighth grade of 74 middle schools in Seoul, Korea from

SELS 2011.

The students completed a survey consisting of 23 items with answers on a 5-point Likert-type scale, from "strongly disagree"=1 to "strongly agree"=5. The measured constructs that are examined in this study include four domains: 1) students' perceived achievement goals (6 items), 2) their Individual ICT use (10 items), 3) their ICT use for government-sponsored educational programs on television or the Internet (2 items), and 4) their attitude toward learning (5 items). In addition, the participants' achievement scores in math and language on the Seoul Educational Longitudinal Study (SELS 2011) were used as a measure of academic achievement. The specific information of the survey and student achievement is as follows.

Perceived achievement goals

The survey included six items measuring students' perceived achievement goals: "I have a distinct and specific goal which I want to achieve," "I know what to do in order to achieve my goal," "I make an effort in order to achieve my goal," "The academic work I do currently helps me achieve my future goal," "My teacher knows what my goal is, and thinks positively of it," and "If I achieved my goal, I would contribute to public welfare." For the six items of perceived achievement goals, Cronbach's alpha was .87.

Individual ICT use and ICT use for government-sponsored educational programs on television or the Internet

The survey included ten items concerning students' Individual ICT use, defined as how skilled students were skilled at using the computer for e-mail, word processing, and Internet for learning. For the ten items for students' Individual ICT use, Cronbach's alpha was .88. For the use of ICT for government-sponsored

educational programs, specifically by those offered through Korea's Educational Broadcasting System (EBS), a dummy code was created to assign weights of 0 or 1 for responses to the question, "Have you utilized any educational programs (EBS programs) offered by the Korean government?"

Academic achievement

The measure of academic achievement was derived from participants' achievement scores on the Seoul Educational Longitudinal Study (SELS 2011). The standardized test is composed of English 30-items and math 25-items and language 30-items (academic achievement in reading, writing, and mathematics). It uses a standard score scale based on a mean of 100 and standard deviation of 15 and has a median reliability of .95.

Attitude toward learning

The survey included five items measuring students' attitudes toward learning. The students were asked to answer each item on a 5-point Likert-type scale, from "strongly disagree"=1 and "strongly agree"=5: "I am fully engaged in my class for my learning," "I take part in my class positively and actively," "I do my assignments faithfully," "I review for my class," and "I prepare for my class." For these five items for students' attitude toward learning, Cronbach's alpha was .91.

Data analysis

This study employed a structural equation modeling (SEM) framework to examine the relationships between participants' perceived achievement goals, individual ICT use, ICT use for government-sponsored educational programs on television or the Internet, academic achievement, and attitude toward learning. In

addition, we used a method of random assignment of items to doublets about the latent variable perceived achievement and attitude toward learning (Bandalos & Finney, 2001, Kline, 2010). This study utilized AMOS 7.0 to test the overall fit of the model (Arbuckle, 2006). Because the chi-square fit index is highly sensitive to sample size, this study used the Root-Mean Square Error of Approximation (RMSEA) (Steiger, 1990; Steiger & Lind, 1980), Comparative Fit Index (CFI) (Hu & Bentler, 1999), Tucker-Lewis Index (TLI) (Tucker & Lewis, 1973), and Non-Normed Fit Index (NNFI) (Bentler, 1990). The Sobel test was also used to make conclusions about the statistical significance of individual mediators. Finally, a multi-group analysis was performed to examine whether the mediation model is moderated by government-sponsored educational programs on television or the Internet. Group differences in the path of latent variables can be estimated only if the variables are on the same scale in all groups. Thus, this study tested configural invariance, metric invariance, and scalar invariance across the multiple groups (Steenkamp & Baumgartner, 1998).

Result

Descriptive statistics and correlations between variables

This study explored the relationships between five constructs relevant to ICT and effective teaching and learning: 1) students' perceived achievement goals, 2) their individual ICT use, 3) their ICT use for government-sponsored learning programs on television or the Internet, 4) their academic achievement, and 5) their attitude toward learning. Table 1 shows descriptive statistics, reliability (Cronbach's α) and correlations for all the variables used in the study. The maximum likelihood estimation procedures may produce distorted results when the normality assumption is severely violated (Curran, West, & Finch, 1996) and thus the

normality of each variable was investigated in terms of its kurtosis and skewness. In Table 1, the results indicated that the normality assumption of all the variables was well met according to the guidelines of severe nonnormality (i.e., skewness> 2; kurtosis > 7) proposed by West, Finch, and Curran (1995). The means of the students' perceived achievement goals and their attitudes toward learning (Ms = 3.56 and 3.32, SDs = .76 and .78, respectively) were significantly greater than the mean of their Individual ICT use (M = 2.56, SD = .41). The values of the skewness and kurtosis for all latent variables were in the range of -1 to +1.

Table 1. Descriptive statistics and correlations between variables

Variable	Mean	SD	Skewness	Kurtosis	1	2	3	4	α
1. PAG	3.56	.76	-.28	.49					.870
2. ICT-IN	2.56	.41	-.30	-.35	.18**				-
3. ICT-WG	.22	.41	.37	.14	.07	.02			-
4. ACH	55.92	21.59	-.22	-.37	.14**	.08*	.04		-
5. ATL	3.32	.78	.03	.03	.42**	.16**	.08*	.28**	.912

Note. *p < .05, **p < .01; PAG: perceived achievement goals; ICT-IN: individual ICT use; ICT-WG: ICT use for government-sponsored educational programs on television or the Internet; ACH: academic achievement; ATL: attitude toward learning

Table 1 indicated that there were significant differences in the correlations between the variables. Students' perceived achievement goals were significantly related to their Individual ICT use (r =.18, p < .01), their academic achievement (r =.14, p < .01), and their attitude toward learning (r= .42, p < .01). In contrast, students' perceived achievement goals were not significantly related to their ICT use for government-sponsored learning programs on television or the Internet (r = .07, p > .05).

Further, students' attitudes toward learning were significantly and positively related to their Individual ICT use (r = .16, p < .01) and ICT use for government-sponsored learning programs on television or Internet (r = .08, p

< .05). Students' attitude toward learning was significantly related to their academic achievement (r = .28, p < .01) as well as to their use of ICT for government-sponsored learning programs on television or the Internet (r = .08, p < .05).

Structural equation modeling analysis

Tests of measurement models

This study employed structural equation modeling (SEM) to test whether the relationships between the variables were significant. In the first step of the analysis, missing values were estimated. All missing data were replaced using the expected maximization (EM) method. The frequencies of the missing values ranged from 217 (0.05%) to 489 (8.9%) per variable, which is considered acceptable (e.g., > 25%; Collins, Schafer, & Cam, 2001; Graham, 2003).

In the second step of the analysis, AMOS 7.0 was used for all measurement models in order to check out the factor structure and structural equation modeling. All reported structural equation models were estimated on the basis of the covariance matrices of the manifest variables using maximum likelihood estimation. Each factor was indicated by items and the errors of items were uncorrelated. However, the five factors were able to be correlated. The correlations between the five factors ranged from .47 to .67. These results mean that the indicators were good measures of the underlying constructs (Schreiber, Stage, King, Nora, & Barlow, 2006).

Structural equation model

The structural equation model was used to test our hypothesis about relationships among the variables.

Table 2. Results of hypothesized model fit

Model	x2	*df*	CFI	TLI	RMSEA
Measurement model	896.45	49	.971	.952	.034
Hypothesized model	1046.795	49	. 955	. 929	.068

Table 2 provides an overview of the hypothesized model. The results of the measurement model fit indices indicated that this model was acceptable (x2=896.45; CFI=.971; TLI=.952;RMSEA=.034); all factor loadings were statistically significant at $p < .01$. Table 2 shows the results for the hypothesized model after specifying hypothesized paths based on the measurement model. For latent variables, this study used the method of item parceling, randomly assigning items to doublets (Kline, 2010). The fit of this hypothesized model (CFI = .955, TLI = .929, RMSEA = .068) was acceptable because RMSEA values of .05 indicate a close fit, values in the vicinity of .08 indicate a fair fit (Browne & Cudeck, 1993). In Table 2, the results demonstrated that the hypothesized model satisfactorily fits the empirical data. All factor loadings were significant in the model, revealing that the measures of the five constructs were appropriate.

Table 3. Path parameter estimates of mediation effect research model

Path			β	β	SE	T
PAG	→	ICT-IN	.151	.029	.003	8.698**
ICT-IN	→	ATL	.030	.139	.075	1.855
PAG	→	ATL	.457	.408	.018	23.05**
PAG	→	ACH	.004	.072	.308	.233
ICT-IN	→	ACH	.184	16.421	1.401	11.719**
ATL	→	ACH	.284	5.409	.353	15.325**

Note. *p < .05, **p < .01; PAG: perceived achievement goals; ICT-IN: individual ICT use; ICT-WG: ICT use for government-sponsored educational programs on television or the Internet; ACH: academic achievement; ATL: attitude toward learning

Table 3 shows the results of the path parameter estimates in the research model. Students' perceived achievement goals had a direct effect on their individual ICT use, their ICT use for government-sponsored educational programs on television or the Internet, their academic achievement, and their attitude toward learning. Students' perceived achievement goals positively predicted their individual ICT use ($\beta = .151$, $p < .01$) and their attitude toward learning ($\beta = .457$, $p < .01$). Also, students' individual ICT use positively predicted their academic achievement ($\beta = .184$, $p < .01$). Students' attitude toward learning positively predicted their academic achievement ($\beta = .284$, $p < .01$). However, there were no significant relationships between students' perceived achievement goals and their academic achievement ($\beta = .004$, $p > .05$) and between their individual ICT use and their attitude toward learning ($\beta = .030$, $p > .01$).

This study also employed Sobel test suggested by Sobel (1982) to check out mediation effects of students' individual ICT use and their attitude toward learning from their perceived achievement goals to their academic achievement.

Table 4. The results of sobel test

Path	a	SEa	b	SEb	Z
PAG → ICT-IN → ACH	.029	.003	16.421	1.401	7.548**
PAG → ATL → ACH	.408	.018	5.409	.353	12.694**

Note. *p < .05, **p < .01

Table 4 shows that this research model was full mediation model. The results of Sobel's z test demonstrated that students' individual ICT use ($z = 7.548$, $p < .01$) and their attitude toward learning ($z = 12.694$, $p < .01$) had significant mediation effects on the relationship between their perceived achievement goals and their academic achievement. However, students' perceived academic goals did not significantly predict their academic achievement directly.

Moderating effect of government-sponsored educational programs on television or the Internet

Assessing model fit

This study used multi-group structural equation modeling analysis to test the effects of moderating variables. It conducted a multi-group analysis test of the full mediation model to determine whether the path coefficient for the hypothesized model were equal in two groups (i.e., 'government-sponsored educational programs on television or the Internet use' group and 'no use' group) (Figure 1).

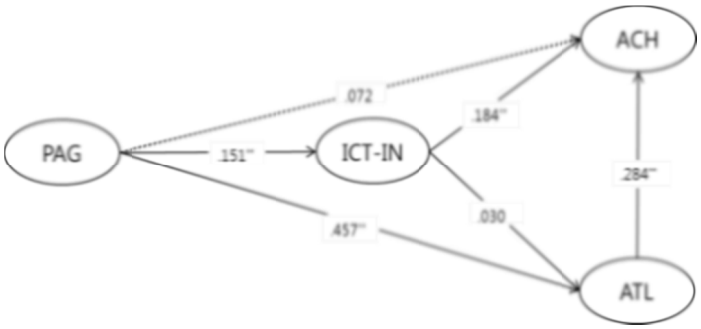

Figure 1. Structural diagram of the mediation model

As a prerequisite to testing for hypothesized model, it is customary to consider a model fit assessment that is estimated separately for each group of interest. According to the multi-group SEM analysis, models fit improved in terms of NNFI, TLI, and RMSEA confirming all metric invariance across in both groups. This model represents the model that best fits the data (e.g., NNFI range from .944 to .947, TLI ranges from .949 to .951, and RMSEA ranges from .046 to .051).

This study provided a relational pattern between the two groups ('government-sponsored educational programs on television or the Internet use' group and 'no use' group) (Figure. 2).

Table 5. The results of multi-groups analysis model fit

Model	x2	df	NNFI	TLI	RMSEA
Configural invariance(baseline model): Model 1	1160.558	98	.947	.951	.051
Full metric invariance: Model 2	1170.781	109	.947	.951	.048
Full metric and scalar invariance: Model 3	1219.68	121	.944	.950	.046
Full metric, factor variance invariance: Model 4	1233.862	125	.944	.949	.046

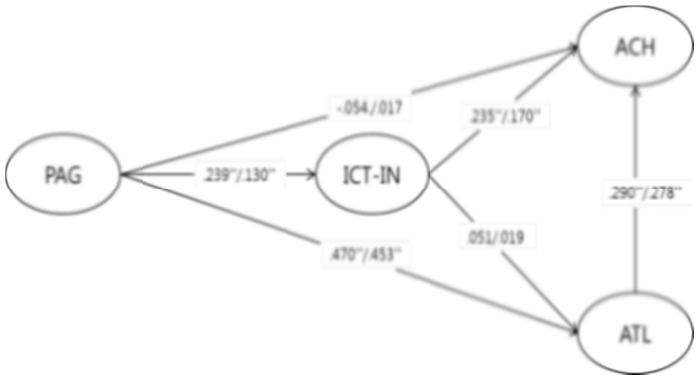

Figure 2. Structural diagram of the moderation model.

Note. 'Use' group in terms of ICT use for government-sponsored educational programs on television or the Internet (ICT-WG)/ 'no use' group for ICT-WG

The results revealed that there were significant differences in structural weights for 'use' vs. 'no use' participants. For students' ICT use for government-sponsored educational programs on television or the Internet, 'use' group was strongly predicted than 'no use' group.

Table 6 shows path parameter estimates of moderation effect research model. The results showed relatively strongly high path coefficients of students' ICT use for government-sponsored educational programs on television or the Internet between their perceived achievement goals and their individual ICT use (β = .239(.130), p < .01), and between their individual ICT use and their academic achievement (β = .235(.170), p < .01). However, there were no significant

relationships between students' perceived achievement goal and their academic achievement (β = -.054(.017), p > .01). In addition, there were no significant relationships between their individual ICT use and their attitude toward learning (β = .051(.019), p > .01).

Table 6. Path parameter estimates of moderation effect research model

Path			ICT-WG use				ICT-WG no use			
			β	β	SE	T	β	β	SE	T
PAG	→	ICT-IN	.239	.050	.008	6.214**	.130	.024	.004	6.591**
ICT-IN	→	ATL	.051	.227	.154	1.467	.019	.089	.088	1.013
PAG	→	ATL	.470	.440	.043	10.341**	.453	.401	.020	20.267**
PAG	→	ACH	-.054	-.967	.733	-1.32	.017	.278	.345	.806
ICT-IN	→	ACH	.235	20.003	2.949	6.783**	.170	15.488	1.631	9.495**
ATL	→	ACH	.290	5.581	.777	7.179**	.278	5.295	.402	13.171**

Note. *p < .05, **p < .01; PAG: perceived achievement goals; ICT-IN: individual ICT use; ICT-WG: ICT use for government-sponsored educational programs on television or the Internet; ACH: academic achievement; ATL: attitude toward learning

It is concluded that the relationship between students' perceived achievement goals and their individual ICT use, and between their individual ICT use and their academic achievement are strongly significant for 'use' group in terms of their ICT use for government-sponsored educational programs on television or the Internet.

Discussion

This study investigated the relationships between five factors related to ICT use in education among Korean adolescents: perceived achievement goals, Individual ICT use, ICT use for government-sponsored learning programs on television or

the Internet, academic achievement, and attitude toward learning. The analysis indirectly demonstrated effects by comparing the relationships between students' Individual ICT use and ICT use for government-sponsored learning programs and their academic achievement and attitude toward learning. The results showed no significant differences between the effect of students' Individual ICT use and the effect of ICT for government education programs on attitude toward learning. These results do not corroborate the findings of a previous study by Meelissen and Drent (2008), which showed a relationship between students' ICT use for education and their attitudes about computer. However, this discrepancy may be due to differences in test items and domains for assessing attitude, such as learning activities and computer use. Thus, further in-depth research should explore the relationships between students' psychological factors, their ICT use, and their attitudes toward diverse activities, such as social interactions, online learning, and computer use.

In addition, the results indicated significant differences in the effects of the two variables related to ICT use. ICT use for individual purposes was associated with greater academic achievement than ICT use for government-sponsored educational programs on television or the Internet. These findings are inconsistent with the results of some studies which found no significant effects of individual ICT use in education on academic achievement (Aypay, 2010; Wittwer & Senkbeil, 2008). However, the findings of this study support the results of many other studies that have found significant effects of ICT use in education on academic achievement (Attewell & Battle, 1999; Chandra & Lloyd, 2008; Papanastasiou et al., 2003; Ziden et al., 2011). The results suggest, then, that in order to facilitate positive student attitudes toward learning and academic achievement, teachers and instructional designers should recognize individual psychological characteristics such as perceived achievement goals and attitudes toward learning, and then design and implement appropriate instructional strategies. In addition, for teachers and instructional designers to know how students' perceived goals affect their attitudes

toward learning and academic achievement, they should recognize and consider the conditions of students' ICT use, that is, whether it occurs for individual ICT use or for government-sponsored educational programs on television or the Internet or in some other manner.

Among the limitations of this study is the use of only one psychological variable, students' perceived achievement goals to investigate the relationships between students' psychological characteristics, ICT use in education, academic achievement, and attitude toward learning. Some relevant predictors of characteristics of students and schools need to be considered in order to explain the relationship between these variables. Another limitation of this study is that it did not utilize more than one survey item to investigate ICT use for government- sponsored learning programs on television or the Internet. Finally, this study did not explore school-level and organizational-level variables as the determinants of ICT use and academic achievement. Thus, further studies using multi-level analyses are recommended in order to investigate interaction effects among the determinants of ICT use.

The results of this and previous studies suggest that researchers should focus on how to efficiently and effectively use ICT in education, rather than whether to use ICT in order to improve student achievement and engender positive attitudes toward learning (Papanastasiou et al., 2003; Vrasidas & Glass, 2002; Vrasidas & McIsaac, 2001; Weaver, 2000). Further research should explore how the specific types of ICT use in education, as well as other meaningful variables, are related to student achievement and attitudes. In addition, to develop a more comprehensive understanding of ICT use in education, further research must investigate other factors that may influence students' ICT use in education, such as motivation for learning, computer self-efficacy, and value beliefs. In this way, researchers can better develop theoretical frameworks and instructional models to facilitate the design of learning activities, and teachers and instructional designers can employ this knowledge to develop more meaningful and effective ICT-based instruction.

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