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INTERNATIONAL REVIEW

Different but similar: computer use patterns between young Korean males and females

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Abstract This study was developed to identify and describe new trends and gender differences in the use of computers and the Internet in South Korea. In this mixed-method study, both quantitative and qualitative techniques were used. Results indicated that both males and females used computers generally for four purposes: social networking, personal knowledge, formal learning, and entertainment. The study also found differences in preference between the sexes: Males liked playing multi-user online games, especially in internet cafés with friends, while females enjoyed social networking websites more. Although the patterns of computer use between males and females were ostensibly different, all participants used computers for fun and socializing. Therefore, more emphasis should be placed on understanding various uses and the implications of emerging differences. Also, consideration should be given to building learning environments that appeal to the computer preferences for both genders.

Keywords Gender digital divide · Gender differences in computer use · Social networking

Introduction

In the 1990s, the American Association of University Women (AAUW) (1998) noted that the advent of technology in education resulted in a discouraging new gap: a difference between the way girls and boys experienced computer activities in schools. This "gender divide" exists even among developed nations (Sciadas 2005). Generally, many educators feel that girls and young women do not develop the same experience with computers as

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boys and young men do, which often means that their attitudes are less positive about technology (Sanders 2005). Even though bridging the "digital divide" in the use of technology from a socioeconomic perspective has received considerable attention in recent years, another important digital divide—gender inequities in the use of technology—is still an under-researched area (United Nations Development Fund for Women [UNIFEM] 2005). This is an unfortunate literature lapse because the significance of gender equity in technology is grounded on the belief that computers can be tools for contributing to gender equality and women's empowerment leading to positive social change (Huyer and Sikoska 2003; UNIFEM 2005).

Considering the links between the digital divide and gender equity, it is critical to investigate the relationship between gender and technology in regions where gender discrimination is deeply embedded in the culture and where technology use is highly advanced. Korea might be considered one of those nations. Korean culture reflects a great deal of Confucian ideology and thus women are considered subordinate to men (Cho 2001; Oh 2000). Meanwhile, empirical data show that Korea is among the world's most technologically advanced and digitally connected countries (Business Services Industry, 2005; National Internet Development Agency of Korea [NIDA] 2008; Organisation for Economic Co-operation and Development [OECD] 2007a, b; West 2007).

Recent computer advances may have specific implications for women's use of technology. Web 2.0 trends, web applications that facilitate interactive information sharing, interoperability and collaboration on the web ("Web 2.0" 2010), raise the social functionality of the computer to a new level. The computer and the Internet have increased individuals' capacity for self-expression, self-understanding, and social interaction. Accordingly, it may now be particularly relevant to research gender differences and technology behavior. It may be also be important to focus on computer use among teenagers, who are more likely to use technology more intensively compared with other age groups (National Center for Educational Statistics [NCES] 2006; NIDA 2008).

In the study described below, we explored whether and how boys and girls in high school in Korea use computers and the Internet in a different way in terms of purposes and locations.

Literature review

Gender differences in computer use

Cooper (2006) noted that in relation to gender, "The digital divide is fundamentally a problem of computer anxiety whose roots are deep in socialization patterns of boys and girls and that interact with the stereotype of computers as toys for boys" (p. 320). It is possible that gender stereotypes in social environments can be used to narrow or exacerbate a digital divide. Cooper (2006), for instance, argues that the prevailing belief, that men dominate computers can constitute a kind of self-fulfilling prophecy further entrenching this stereotype. Expectations from parents, school, and society for boys and girls can affect their attitudes and behaviors with computers. Shashaani (1994) asserts that gender differences in attitudes about computers have their origin in the way that males and females are brought up. Volman et al. (2005) demonstrated girls' usage tendencies: Girls used computers less at home than boys. Programming and games in particular were unpopular among girls.

These discrepancies may reflect the fact that boys and girls are exposed to external expectations of behavior patterns. Shashaani (1994) reported that students' interest and confidence in using computers were significantly related to the perceptions of their parents' beliefs and encouragement. Moreover, she found that both mothers and fathers tended to agree with the statement that "the computer is more appropriate for males than for females" (p. 7). In Korean society, sex-biased perceptions are also prevalent, resulting in male-centric curricula and attitudes in school regarding technology use (Jung 2003).

Psychological constructs influence the use of computers. It is generally conceded that boys' attitudes and behaviors toward computers are more positive (Gürer and Camp 2002; Kadijevich 2000; Liao 2000; Sacks et al. 1993–1994; Shashaani and Khalili 2001; Siann et al. 1990). In addition, Shashaani (1993) and Li and Kirkup (2007) have reported that self-confidence matters: Girls had less interest in learning about and using computers and reported feeling less confident around computers, even though they showed that they were as competent as males in using the computer. Moreover, men were found to spend more time on computers (Land 1999) and women used them less frequently, which was associated with less practical computer knowledge and less computer self-efficacy (Koch et al. 2008; Vekiri and Chronaki 2008). These differences could contribute to the finding by others that females experience computer anxiety more than males (Todman 2000). In the same research, even though computer anxiety and the percentage of computer-phobic students between 1992 and 1998 decreased, the overall results revealed a widening gap between female and male students in terms of computer anxiety. Koch et al. (2008) noted that women attributed a failure in using computers more internally (to their own inability), and men more externally (to the faulty technical equipment).

Gender similarities in computer use

Interestingly, results from Bain and Rice's (2006) study are not consistent with past findings of stereotyped computer behaviors. They found no significant gender differences in attitudes, perceptions, and use of computers among sixth grade study participants, and they also found that females reported that they enjoyed working with computers and Palm Pilots. "[Female enjoyment of computers] may be enhanced by educators providing more opportunities for females to use computers and having computer use modeled by female educators" (p. 129). With the increased use of the Internet, differences in people's online skills and abilities have become increasingly important as more people have access to the Internet (Hargittai 2002). However, internet use, as a dichotomous classification (whether someone does or does not use the Internet) has received little attention. Some studies also suggest that, as the Internet evolves, computer access and literacy differences between males and females are not as much of an issue (Gunn et al. 2003; Sanders 2005). At the same time, in the US, it may be that "the increased connectivity of American households and American schools is producing different gender-based patterns of technology use than those reported in early studies" (Crocco et al. 2008, p. 23). As the Web 2.0 has developed, particular aspects of these differences between boys and girls seem to have changed. Communication and collaboration on the web through instant messaging and social networking websites are among the functions that might be leading this change.

Over time, research interest in gender equity has moved from addressing hardware access issues to investigating different types of uses between males and females. Aslanidou and Menexes (2008) and Nachmias et al. (2000) found that boys used computers more to play games. As social networking features have become popular on the web, computer use has changed in a more dramatic way. According to Lenhart and Madden (2005), girls ages

15–17 engaged in blogging more than boys. New types of computer use, such as online social networking environments and other communication-related tools, have increased girls' interest in technology (Crocco et al., 2008). Volman et al. (2005) suggested that boys and girls in secondary education experienced different affinities in technology use. Crocco et al. (2008) review of the literature identified studies in which female students surpassed male students in using some computer applications that emphasized collaboration and communication. Li (2006) supported this point: Females had a significantly higher frequency of collaborative instances using computer mediated communication (CMC) than males, which indicated females' online communication tended to be more collaboratively oriented. These different preferences between males and females can be partly captured by Gunn et al. (2003): "Educational games and challenges may be more appealing to a typically competitive male orientation while communicative and collaborative activities may appeal more to typical female traits" (p. 27).

Cultural and technological context in Korea

The "Joseon" Dynasty, begun in the end of the 14th century, encouraged the entrenchment of Confucian ideals in Korean society and Confucianism became entrenched, and informed the legal doctrine and social norms of the country. (Lee 2000; Lee and Lee 1999; Park 2006). In Confucianism, women had subordinate relationships with men and were forced to be obedient (Jeong 2004; Lee 2000). The domination of Confucianism lasted more than 600 years, during which women had little access to education and public life (Cho 2001; Oh 2000). Subsequently, gender inequality seemed to have diminished with the latest rapid development of economy in Korea. For example, the proportion of students who enrolled in college was 27.2% in 1980 and 83.3% in 2008. The percentage of women in this group grew from 24.1% in 1980 to 40.9% in 2008 (Education Statistics and Information 2009). However, it is still debatable whether women have gained corresponding access and power to economic activity. As of 1970, 73.8% of adult males and 38.2% of adult females were employed. The proportion changed slightly in 2007 (71.3 and 48.9%, respectively), but the wages for women were on average 66 percent of those for men (Min et al. 2008). According to the United Nations Development Programme (UNDP) (2007), Korea ranked 64th among 93 countries on the Gender Empowerment Measure and placed 108th among 130 countries in the Global Gender Gap Report investigated by the World Economic Forum (Hausmann et al. 2008). These results strongly indicate that Korea still reflects a great deal of Confucian ideology in society.

Korea has transformed itself from one of the world's poorest countries for decades after the Korean War in the 1950s to the world's 14th largest economy (International Monetary Fund [IMF] 2008). A critical aspect of this transformation was the development of Korea's dynamic technology environments. Among the OECD countries, Korea ranked first in households with broadband access (OECD 2007a) and was selected as one of the top five nations in historical broadband penetration rates (OECD 2007b). As of December 2007, the rate of households with internet access was 79.8%, and the rate of internet use among teens and individuals in their 20s was 99.8 and 99.3%, respectively (NIDA 2008). West (2007) announced that the Korean government earned a top spot among international e-government websites on the strength of its online services. As a result of these strengths, Korea is emerging as one of the global leaders in information and communication technology fields (Ahn 2009).

Unique trends in Korea in computer use

Elsewhere in the world, internet cafés are key sites for using the internet. In Turkey, for example, they have played a role as places for online social relationships; however, time spent at internet cafés was negatively related to the social involvement of internet café users (Koç 2007). In other words, the longer individuals spent in the cafes, the less they were socially involved with other café members. In Norwegian rural areas, internet cafés were techno-spaces: Some Norwegians went to play games and chat on computers while others went for social purposes (Lægran 2002). Youth in Greece, especially boys, particularly liked using the Internet in internet cafés for searching the web and downloading games. (Papastergiou and Solomonidou 2005). The internet café is particularly common in Korea. According to NIDA (2008), 39.6% of Korean teenagers use an internet café. Generally, the internet café, called "PC Bang" (a place for using personal computers in Korean), offers high-speed internet service and is regarded as the place for social activities among young people (Hwang et al. 2001).

Another distinctive feature of computer use in Korea is a popularized social networking website named "Cyworld," the Korean equivalent of "MySpace" or "Facebook"—popular social networking sites in the US ("List of social networking websites" 2010)—and similarly, Cyworld is a Korean web community site where users can update their blogs and invite friends. "Members cultivate on- and off-line relationships by forming buddy relationships with each other through a service called "minihompy" (pop-up homepage), which encompasses a photo gallery, message board, guestbook, friend list, and personal bulletin board" ("Cyworld" 2010). The number of monthly unique visitors to Cyworld was to 21.17 million as of June 2006, representing nearly half the nations' population of 49 million (Jacobs 2006). Some of the strongest features of Cyworld are its ability to build and manage one's own blog easily and to link to others online to use multimedia functions (Kim et al. 2004). Kim et al. (2006) note that females represent 53% of Cyworld users, which may indicate that females participate actively in online communities in ways that take advantage of these functions of collaboration.

Methods

Research questions

The goal of the study was to identify factors related to the types of computer and internet use and to explain the differences in purposes and locations of computer use between males and females. The following research questions guided this study:

- Can the use of computers by high school students in Korea be categorized in a coherent set of elements?
- Are there gender differences in the purposes of computer and internet use among the students?
- Are there gender differences in where young people use the computer?

The first research question explores the purposes of computer and internet use to determine if the purposes are grouped by specific factors. The second question investigates gender differences in these factors. The last question investigates gender differences in the use of computers and the Internet reflected in where Internet is used.

Participant selection

In order to reflect the proper distribution of participants in high school students in Korea, the study sample included students who attended schools of various types and had different academic performance levels. However, the participants for the study were basically collected on a convenience basis—access to the various schools—from four high schools in a metropolitan area in Korea. Internet access was not a concern because there is little difference among teenagers across residential areas in Korea: 99.9% of males and 99.7% of females had internet access (NIDA 2008). Therefore, the geographical residence of the participants was not a factor in selecting schools. For this study, 673 (males = 340 and females = 333) valid participants from the four high schools participated. Among the respondents, 10 students—five males and five females each—volunteered to participate in follow-up interviews.

Instruments

To address the research questions effectively, the study employed mainly a quantitative analysis of questionnaire data with some qualitative measures for capturing explanatory information. For the analyses, a survey questionnaire and an interview protocol were developed.

Questionnaire

The survey questionnaire was developed on the basis of both the literature and results from a pilot test, as well as on reviews by content experts and high school students. It contained four parts. The first part was designed to explore participants' general computer and internet use. Questions asked how frequently participants used computers and the Internet for various activities using a five-point Likert scale: "never," "little," "somewhat," "a lot," and "a great deal." The questions covered four factors of computer use: social networking, personal knowledge, formal learning, and entertainment. Each factor had five, four, four, and seven questions, respectively. The second part of the questionnaire used an open-ended question to collect data on participant computer and Internet activities that may not have been captured with the questions in the first part. The third part asked about the amount of time spent on computer and the internet use in various places, including school, home, internet cafés, a library, and a friend's or relative's home. The range of the five-point Likert-type scale for this section was "less than 30 min a day," "30 min–1 h a day," "1–1:30 h a day," "1:30–2 h a day," and "more than 2 h a day." The last part asked for the participants' gender.

Interview protocol

The qualitative data were gathered through semi-structured interviews. The interview protocol was also developed based on the literature review, the pilot test, and reviews by experts. The interview questions consisted of five parts: questions about background and demographics, general behavior and experience questions, specific behavior and experience, opinions/values/feelings, and a final wrap-up question. The background and demographic questions covered age, gender, grade, and computer competency. To understand the participants' patterns of computer usage, the researcher asked for the purposes of and the amount of time spent on using the computer and the Internet at school, home and other

places in the general behavior and experience questions section. In the specific behavior and experience questions, information about particular activities such as social networking, formal learning, and personal knowledge acquisition was ascertained. Personal opinions, values and feelings about gender differences were solicited in the fourth part of the questionnaire. The final question asked participants to share anything in general related to the topic. The semi-structured questions were used as a basic guide for the interviews; the researcher let the students answer the questions and elaborate. Follow-up questions were used for clarification only.

Data analysis

For quantitative data analysis, inferential statistics were used. To address the first research question, confirmatory factor analysis (CFA) was performed to examine factor structures for both male and female participants based on a hypothesized model. For research question two, multi-group CFA with tests for factorial invariance and non-invariant items were conducted. Lastly, multivariate analysis of variance (MANOVA) was used to address the third research question.

For the qualitative analysis, the interviewer transcribed all the information from the notes and audio recordings of the interviews and then analyzed the data for patterns which had substantive significance for the study. Another important factor to note regarding the interviews was that all the conversations were held in Korean and the interviewer, who was also Korean, transcribed the interviews and the notes in Korean. They were later translated into English.

Results

Confirmation of coherent constructs in computer use

Quantitative findings

Based on the literature review, pilot study, and feedback from content experts and high school students, the hypothesized model was built. The 20 observed variables, which are the items in the first part in the questionnaire, constitute four latent factors: social networking, personal knowledge, formal learning and entertainment. The latent factors are labeled F1–F4 and the observed variables are designated V1–V20. V1–V4 represent items related to social networking, V5–V9 personal knowledge, V10–V13 formal learning, and V14–V20 entertainment. Also, E1–E20 are consistent with their related observed variables. For example, the error term E1 is the residual associated with the measurement of V1 (Byrne 2006). Table 1 shows the structure of the hypothesized model.

CFA was conducted to set baseline models for both male and female participants with the hypothesized model. To assess the adequacy of the model, several fit indices were used such as the comparative fit index (CFI) and the root mean-square error of approximation (RMSEA). Also, the results of the Lagrange Multiplier (LM) Test were analyzed for each run in order to check any necessary parameters in the model. The LM Test is used to test hypotheses bearing on the statistical viability of specified restrictions in the model (Byrne 2006). Final models for both genders were chosen with substantive considerations taking into account the issue of parsimony. In the process of model evaluation, robust maximum likelihood method was used each time for all models in the study due to multivariate non-

Table 1 The overall structure of the inventory

Construct	Initial	Item
F1 (Social Networking)	V1	Use instant messaging (e.g., MSN)
	V2	Update my homepage or blog (e.g., Cyworld)
	V3	Visit friends' or people's blogs
	V4	Comment on others' postings on blogs
	V5	Use online chatting websites
F2 (Personal knowledge)	V6	Take online classes for personal knowledge (not related to school)
	V7	Use online communities for personal knowledge
	V8	Use email
	V9	Meet people in online communities
F3 (Formal learning)	V10	Take online classes for school
	V11	Use an online discussion board for school
	V12	Search for information for homework
	V13	Do homework using Office productivity tools (e.g., Word, PowerPoint, Excel)
F4 (Entertainment)	V14	Check for updated news/sports
	V15	Acquire information by surfing the web (e.g., use Wikipedia) (not related to school)
	V16	Buy items or goods online
	V17	Play stand-alone games (e.g., Minesweeper, Flash games)
	V18	Play multi-user games (e.g., StarCraft)
	V19	Watch movies or videos for fun
	V20	Listen to music

normality of the data (Byrne 2006). Accordingly, Satorra–Bentler (S–B) scaled χ^2, the robust CFI, the robust RMSEA were used.

In testing for the validity of the questionnaire for males, findings were consistent in revealing goodness-of-fit statistics for the initial model that were less than optimal for males (S–B$\chi^2(164) = 419.38$; CFI = 0.86; RMSEA = 0.07; 90% Confidence Interval (CI) of RMSEA = 0.06, 0.08). Therefore, a goodness-of-fit test with LM Test with robust statistics was examined. According to the Multivariate LM Test results, three parameters (E18, E1; E9, E5; E11, E10) representing error covariances exhibited high incremental univariate LM χ^2 value. Based on substantive backgrounds, the parameters were freely estimated for the respecification of the model and the post hoc analyses were conducted. The goodness-of-fit results for the respecified model revealed a fairly well-fitting model: The model-fit evaluation for males shows a value of 0.94 for CFI and 0.05 for RMSEA. Also, reliability estimates were calculated based on Cronbach's Alpha and Rho coefficient; Crobach's Alpha was 0.81 and Rho coefficient was 0.83 for the male model.

Similarly, initial testing of the hypothesized model for females did not yield an optimally good fit (S–B$\chi^2(164) = 445.66$; CFI = 0.84; RMSEA = 0.07; 90% CI = 0.06, 0.08). Review of the LM Test statistics revealed on cross-loading (F4→V3) and three error covariances (E9, E5; E11; E10; E18, E17) to be markedly misspecified. Although review of the LM Test statistics also suggested the addition of E15 and E12, these items were considered measuring different aspects, thereby arguing against its model specification.

Given that the cross-loading of item V3 on F4 (Entertainment) seemed reasonable, this parameter was added to the model. Analogously, because of the overlap of content between error covariances, the model was subsequently respecified and reestimated with the three error covariances included. The respecification revealed a reasonably good fit model. CFI was 0.91 and RMSEA indicated 0.06 with its range from 0.05 to 0.06, which supports the goodness of its model fit. Regarding reliability, Cronbach's Alpha was 0.82 and Rho coefficient was 0.83 for the female model.

Qualitative findings

In the qualitative findings, interviewees generally agreed with the factors created (see Table 1) for the study. When directly asked if the quantitative findings reflected their own perceptions of computer use, all the interviewees responded affirmatively. In further discussion, all of the interviewees in the study agreed that online social networking was one of their major reasons for using a computer. Moreover, every participant stated that most of his/her friends also used online social networking software and websites. Interviewees also confirmed that computers were used for building their own personal knowledge. Email was cited as an example of personal use for both sexes. Participants also discussed their use of computers to build formal knowledge in school situations. Using the computer for entertainment was one of the most popular activities among the participants. Male participants especially referred to online games frequently when asked about the entertainment factor, indicating that for this sample of males, gaming was a strong component of entertainment. In terms of gender, even though there were differences in the preference of some specific activities between males and females, all of the interviewees felt that the four general purposes captured the key categories for using computers and the Internet.

Gender differences in the purposes of computer use

Quantitative findings: testing for factorial invariance

First, configural invariance was conducted with no equality constraints imposed on the parameters. The fit indexes indicated reasonably adequate fit to the data with a CFI of 0.92 and RMSEA of 0.05, suggesting that the configural model adequately represented the data for both males and females. For the next step, the testing for measurement invariance was conducted. The multigroup model was somewhat deteriorated in model fit ($\Delta S–B\chi^2 = 37.28$, df = 18) to a level of significance ($p < 0.001$) suggesting that this restricted model was less tenable. This also indicated that at least one of the factor loadings is noninvariant, which meant equality constraints were not imposed on some of the factor loadings. Five constraints revealed the incremental univariate χ^2 values that were $p < 0.05$. The parameters that did not operate equivalently across male and female participants were four factor loadings (V3, F1; V4, F1; V13, F3 and V18, F4) and one commonly specified error covariance (E11, E10). Lastly, a test for invariance of the structural model was also conducted based on the condition of partial measurement invariance (Byrne et al. 1989). Comparison with the configural model yielded a nonsignificant difference in χ^2 values (Corrected $\Delta S–B\chi^2 = 17.15$, df = 17, $p > 0.05$) and the difference in CFI values were minimal (ΔRobust CFI = 0.01). Though the review of the univariate χ^2 incremental value revealed one with $p < 0.05$ (V12, F3), the $\Delta S–B\chi^2$ test yielded a difference value that was not significant. Therefore, it is concluded that structural relations among the four factors are invariant across the two groups of gender in this structural model.

Quantitative findings: testing for noninvariant items

The results of the testing for the invariance of measurement indicated that the four item contents were differentially interpreted by male and female participants. Provided with the findings of partial measurement invariance, diverse avenues of inquiry including testing for evidence of item bias and examination of response patterns, skewness, and kurtosis were used to identify possible reasons for the nonequivanlence in the items.

Regarding item bias, As van de Vijver and Leung (1997) proposed, an approach to the detection of item bias or differential item functioning (DIF) using two-way ANOVAs was employed to further explore the basis of the noninvariance of items. In order to apply the ANOVA procedure, each item is examined separately for evidence of bias, with the item score serving as the dependent variable, and gender and score levels serving as the independent variables. Sample sizes across these score levels ranged from 50 to 81 per cell. ANOVA results argued for bias related to the four noninvariant items identified. Items V3 ("Visit friends' or people's blogs"), V4 ("Comment on others' postings on blogs") and V13 ("Do homework using Office productivity tools") were biased with respect to the main effect of gender. Meanwhile, item V18 ("Play multi-user games") demonstrated a significant main effect of gender as well as a significant interaction effect. Using partial η^2 as the measure of effect size, the main effect of gender accounted for about 31% of the total variability in the score ($\eta p^2 = 0.31$). In reviewing results for evidence of bias pertinent to each item, the evidence of bias was focused on examining the extent to which the line connecting the item mean difference score, at each of the five score levels, yields a systematic pattern (i.e., its departure from zero follows a relatively consistent direction) (Byrne and Watkins 2003).

In relation to items V3 ("Visit friends' or people's blogs"), V4 ("Comment on others' postings on blogs") and V13 ("Do homework using Office productivity tools"), participants from female groups consistently have higher scores on the items. As Mellenbergh (1982) has called this pattern uniform bias, there were significant main effects of gender on the items. As noted in Fig. 1, the curves for the items are consistently below zero in these

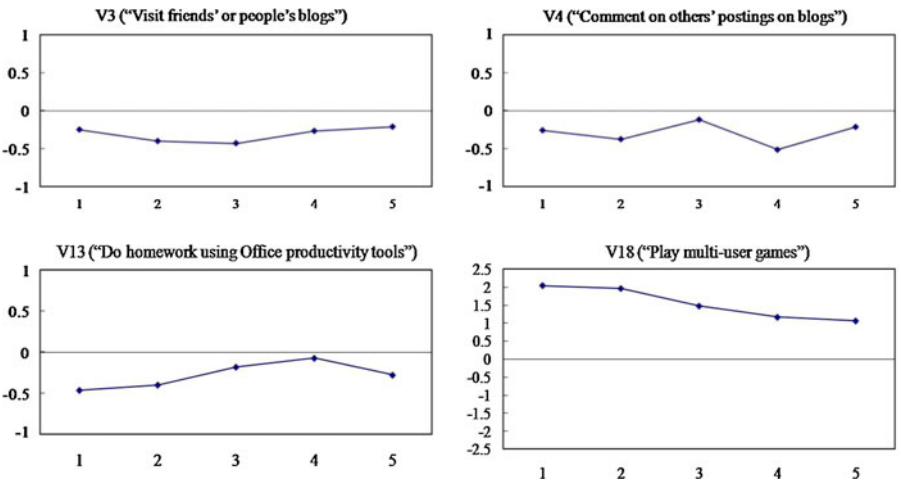

Fig. 1 Noninvariant items with score level and difference in means *Note*. *Horizontal axes* represent score level; *vertical axes* represent the difference value resulting from subtraction of the item mean score for females from the item mean score for males

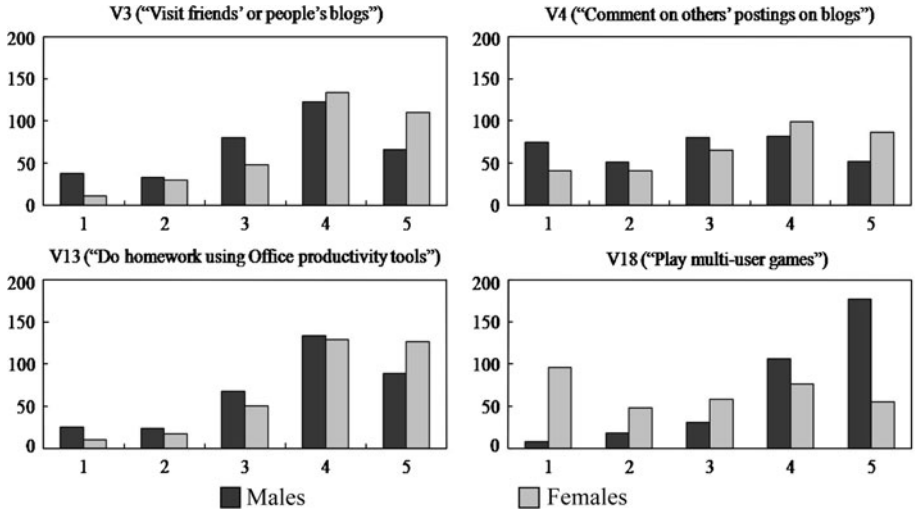

Fig. 2 Noninvariant items with response patterns *Note*. *Horizontal axes* represent item Likert-type scale points; *vertical axes* represent number of respondents

cases. Meanwhile, the significant interaction effect indicates that the difference between gender groups is not invariant across score levels (van de Vijver and Leung 1997), in which case it is labeled as nonuniform bias. As shown in Fig. 1 for item V18 ("Play multi-user games"), the curve connecting the gender differences in average scores departs systematically from zero. Basically, the male mean is significantly higher than that of females; differences in means widen as the score level decreases. This indicates that there are more differences among individuals in lower score levels.

For the analysis of response patterns, item scale-point frequencies as well as degrees of skewness and kurtosis were used to determine possible discrepant patterns of response and nonnormality (Byrne and Watkins 2003). A summary of the response patterns for each noninvariant item is presented in Fig. 2.

In reviewing these histograms, items V3, V4 and V18 were considered to suggest some degree of discrepancy between males and females in their pattern of response to the five-point items. Regarding item V3 ("Visit friends' or people's blogs"), a higher percentage of females than males (33 vs. 19.4%) opted for the 5-point response, "a great deal", whereas the reverse was true for the 1-point option, "never" (males = 11.2%; females = 3.3%). This finding suggests that whereas females would appear to enjoy social networking activities, males would appear to enjoy it less in this regard. Similar patterns were found in the item V4 ("Comment on others' postings on blogs"). A higher percentage of females (26.1%) opted for the 5-point response ("a great deal") than males did (15.3%). In addition, the reverse was true for the 1-point option, "never" (males = 22.1%; females = 12.3%). Turning to the graph related to item V18 ("Play multi-user games"), a different pattern was found. Scale-points related to 1-point and 5-point categories revealed a notable discrepancy. Whereas substantially more males than females (52.1 vs. 16.5%) chose the five-category response, "a great deal", the reverse was true for the one-category response, "never" (males = 2.4%; females = 28.8%).

Lastly, skewness and kurtosis for the testing of the invariance of measurement was reviewed. In Fig. 3, histograms related to the skewness and kurtosis of noninvariant items

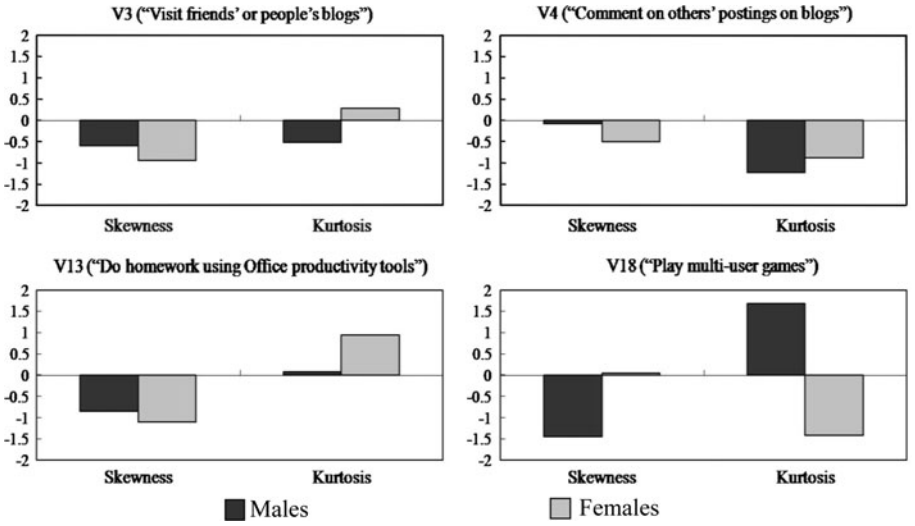

Fig. 3 Noninvariant items with skewness and kurtosis *Note*. *Horizontal axes* represent coefficient values of skewness and kurtosis, respectively; *vertical axes* represent values for skewness and kurtosis

are presented. Whereas kurtosis value associated with item V3 ("Visit friends' or people's blogs") for males was −0.53, it was 0.29 for females. In this case, the kurtosis value was higher for females than it was for males. Also, kurtosis values 1.69 for males and −1.42 for females in the item V18 ("Play multi-user games") suggest that males were more homogeneous in their responses to the item.

Following the review of item bias, the patterns of response and item score distributions, item V3 and item V18 are considered to be suggestive of substantial discrepancies between male and female participants. Specifically, as seen in the Fig. 2 for response patterns, 73.2% of females visit friends or people's blogs "a lot" or "a great deal" (55.6% for males). In regard to playing multi-user games, 83.3% of males chose "a lot" or "a great deal" categories in the Likert-style scale (39.3% for females). Although item V13 ("Do homework using Office productivity tools") was identified by the LM Test as being noninvariant across the two gender groups, results from the examination of response patterns, skewness and kurtosis suggested that this item might be weakly biased. Interview results were consistent with this argument: The interviewees did not feel that males and females used Office productivity tools differently.

Qualitative findings

The interview results were consistent with the findings from the quantitative analysis. Even though both male and female interviewees agreed with the classification of the four factors, they showed differences in the attitude and purposes of computer use. A female participant said:

> I think the boys' and girls' perception of the patterns of computer use will be similar. Also, there should be little difference in overall time on use between boys and girls. But the purposes must be different.

Males relatively had less interest in online social networking websites. However, females spent a lot of time on online social networking updating their own websites, visiting others' blogs, and leaving comments. All of the female interviewees liked to use Cyworld. Regarding this, a female noted:

> Sometimes, not all the time, but I think my daily life is kind of related to Cyworld. I take pictures to upload them on my "minihompy" and I feel like I should check my friends' Cyworld updates regularly.

Both males and females spent considerable time on the use of computers for entertainment. However, among entertainment activities, there were significant differences in playing multi-user online games in terms of gender. All of the male and female interviews said that male high school students tend to play multi-user online games more than females. A female said, "Boys are really into online games." Similarly, a male responded, "You can assume that nine out of ten boys play online games, or, at least are familiar with how to play online games." Another male participant commented:

> Sometimes I feel I need to reduce time on games, and indeed I am playing games less these days in order to prepare for College Entrance Exam. But, I do like enjoying multi-user online games with my friends.

Meanwhile, there was little difference in the description of activities related to personal knowledge and formal learning factors between males and females. In sum, in the qualitative data, the primary differences between males and females were that boys acknowledged spending a good deal of time on multi-user games and females discussed their extensive use of social networking.

Gender differences in the location of computer use

Quantitative findings

MANOVA was conducted with the independent gender variable having two levels (male and female) to examine the differences across the levels for the five dependent measures with the multivariate and univariate statistics test. Specifically, multivariate tests were conducted to examine the set of the dependent variables for differences between male and female groups. In addition, univariate tests on each location were performed, too. The results of multivariate and univariate tests are shown in Table 2.

Multivariate statistical testing results shows the four most commonly used measures. All of the four measures indicate that the set of the locations have a highly significant difference ($p < 0.001$) between male and females groups. Univariate statistical tests results show that two of the locations ("Internet café" and "A friend's or relative's home") are significant ($p < 0.001$ and $p < 0.05$, respectively). The power for the statistical tests of location "Internet café" was 1.0, indicating that the sample sizes and the effect size were sufficient to ensure that the significant differences would be detected if they existed beyond the differences due to sampling error (Hair et al. 2006).

Qualitative findings

Home was the most frequent place for the both sexes to use computers. This is consistent with the results from the quantitative analysis. However, an interesting distinction was found in the interviews: There were differences between the most frequent place and the

Table 2 Multivariate and univariate tests for group difference in locations

Multivariate tests							
Statistical test	Value	*F*	Hypothesis *df*	Error *df*	Sig.	Partial η^2	Observed power[a]
Pillai's trace	0.16	25.16	5	667	0.000	0.16	1.00
Wilks' lambda	0.84	25.16	5	667	0.000	0.16	1.00
Hotelling's trace	0.19	25.16	5	667	0.000	0.16	1.00
Roy's largest root	0.19	25.16	5	667	0.000	0.16	1.00

Univariate yests (between-subjects effects)						
Dependent variable	Type III sum of squares	*df*	Mean square	*F*	Sig.	Partial η^2	Observed power[a]
School	2.51	1	2.51	3.54	0.061	0.01	0.47
Home	3.81	1	3.81	2.15	0.143	0.00	0.31
Internet café	228.91	1	228.91	121.96	0.000	0.15	1.00
Library	0.00	1	0.00	.00	0.960	0.00	0.05
A friend's or relative's home	9.39	1	9.39	7.14	0.008	0.01	0.76

[a] Computed using alpha = 0.05

preferred place among males. Males used computers at home like most females, but this was mainly because they did not have enough time to go to internet cafés during weekdays. The most preferred place was the internet café. Four out of five male participants spent a lot of time in internet cafés with friends on weekends. Social activities and game playing were their main purposes for using internet cafés. A male participant said, "On weekends, I often stay about 5–6 h in internet cafés to meet friends and play games together." Thus, even though home was the dominant place among the five different places, time spent in the internet café dramatically increased on weekends among males. Compared to males, females did not go to internet cafés much, and there were little difference in the place of computer use between weekdays and weekends among girls. A female noted, "I prefer home because it's comfortable and relaxing to use computers at home." Regarding the other places such as school, a library, and a friend's or relative's home, interviewees showed little interest when asked. One participant stated, "At school, I am supposed to use computers only for learning in classes. So, I cannot use the computers as much as I want." Students were allowed to use computers only for the class under the control of teachers, and this possibly made participants less interested in computer use at school. Also, the participants rarely used computers either in a library or at a friend's or relative's home. Therefore, it did not seem meaningful to compare the differences in those places between males and females.

Discussion

The data revealed, first, that both males and females in this sample of Korean high school students used computers for some of the same purposes: social networking, personal knowledge acquisition, formal learning, and entertainment. Rather notable differences existed between males and females in their use of computers in online activities, however.

Males preferred game playing while females preferred social networking. These activities were closely related to the fact that boys and girls preferred different venues for using the computer: Girls preferred home because they felt it was comfortable and relaxing to use computers there. Boys, conversely, preferred internet cafés, where they could play games together with their friends.

In synthesizing the quantitative and qualitative findings, we found that girls and boys identified separate computer uses and venues, but the underlying socialization activities appeared to be similar, although they were gender specific. Boys reported going to internet cafés and also socializing by meeting friends and playing games together: Internet cafés were the place for males to gather and socialize. Meanwhile, girls reported creating and managing social relationships by updating their own sites and visiting others' social networking websites in a virtual world. Females believed that this kind of activity helped make friends and keep up friendships. These differences are partly grounded in the literature. Mulvaney (1994) suggests that the differences are rooted in the past, and that males and females are taught different linguistic practices. Women use communication as a mechanism for creating bonds, while men are expected to communicate primarily to exchange information (Borisoff and Merrill 1983). When a male participant in this study indicated that simply visiting a friend's blog without leaving a comment would be "enough … [to] get the information," such a comment might reflect a gender-differentiated understanding of why an individual goes to a blog. Also, Aukett et al. (1988) found that women emphasized talking, emotional sharing, and discussing personal problems with their same-sex friends, and men showed an emphasis on sharing activities and doing things with their men friends. Pilkington (1998) notes that different patterns in computer use seem to correspond to traditional patterns—that cooperation is for females and competition is for males. Accordingly, communication is a primary way to establish and maintain relationships with others for most women, while men often use communication to establish and define their personal status and ideas by asserting themselves and/or by challenging others (Wood 1994). In the study, males may enhance friendship as they unite against opponents or sometimes fight each other in multi-user online games. Females manage relationships with friends by visiting others' blogs and leaving warm and empathetic messages.

Caution should be taken in generalizing the quantitative findings because of limited sample size. Also, findings from the interviews represent the views of a small convenience sample. The interviewees participating in the study volunteered, making it more likely that they were interested in this topic and their responses did not necessarily represent the whole participants or population of the study. Therefore, a replication of these interviews with a larger sample size would be important. The population of the study was restricted to high school students in Korea, because of its unique environment. A strong high-speed internet broadband infrastructure means that there are few computer access issues in Korea. Moreover, an exceptionally popular social networking website among youth, Cyworld, and ubiquitous internet cafés make Korea's internet-use background distinct. Therefore, caution should be used when applying the research design and results to other countries.

Conclusion

Despite its limitations, the study contributes to our understanding of the purposes of computer and internet use among male and female high school students in Korea. These results can be useful in building better learning environments for educators and future researchers. First, it is important to understand and to address new types of digital divide

issues. In Korea and other high digital access counties, the issue may be less about inequitable access and more about the differences in the use of technologies. Therefore, more emphasis should be placed on understanding various uses and the implications of emerging differences. Also, consideration should be given to building learning environments that appeal to the computer preferences for both genders: in this study, both boys and girls used the Internet for fun and socializing. As technology continues to develop, it will be important to understand and build on the capabilities of new technologies to enrich digital learning environments for both genders.

Going forward, it will be important for researchers to continue to study similarities and differences in the use of technologies for males and females who, in high school, are at a very sensitive stage of their lives. If new digital divides are emerging, it will be important to address possible inequities and identify and address the factors that perpetuate the digital divide. Understanding the critical factors will enable educators to better design optimal environments for positive social development.

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