

# **The Effect of Internet Use on Information Literacy : A panel study with Japanese elementary school students**

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In this study with Japanese elementary school students as participants we examined if Internet use would improve “the skill to practically use information” (so-called “information literacy”). To estimate the causal relationship between the amount of Internet use and the skill to practically use information, a two-wave panel study was conducted, and the obtained data was analyzed by the structural equation model. As a result, a higher amount of Internet use caused higher degrees of improvement of the skill to practically use information as well as its components such as the ability to collect information, the ability to judge information, the ability to express information, and the ability to communicate information. Also, e-mail use and Web-site browsing played particularly important roles in improvement of the skill to practically use information. Similarly, Internet use for communicating with others notably contributed to improvement of the skill to practically use information.

## **Introduction**

### **Information literacy and Internet use**

It is believed necessary for individuals to acquire “information literacy” in order to survive in the advanced information society to come. Definition of the term “information literacy” differs with researchers, research institutions, and governments of different countries, but roughly speaking, there are definitions in broad and narrow senses. According to the narrow definition, the term information literacy mainly means the technique and ability to use computers (or the Internet). On the other hand, in a broad sense, this term represents the concept of the overall information processing ability necessary in problem solving activities. In other words, the term information literacy in a broad sense can be understood as the comprehensive information processing ability necessary in a series of information processing activities such as accessing necessary information, assessing the collected information, and communicating the collected information.

In Japan, the term “the skill to practically use information” is widely used as the equivalent concept to “information literacy” in a broad sense. This term was proposed by the Ministry of Education in 1998, and more specifically, it is defined as the “ability to voluntarily collect, judge, express, process, and create necessary information, and also the ability to communicate such information while taking the recipients’ status into consideration, and appropriate and effective use of means for conveying information depending on assignments or purposes.” Development of such ability is one of the goals of Japanese elementary, junior high, and senior high school education.

The importance of the skill to practically use information is believed to be its experiential as well as practical aspects, and is also believed to develop through the use of information as well as means for using information (especially information communication networks such as the Internet). Therefore, empirical studies have been conducted thus far with Japanese junior high school, senior high school, and university students in order to examine if daily use of the Internet actually

improved the skill to practically use information.

### **Empirical studies with junior high school, senior high school, and university students**

In the quasi experiment with junior high school students conducted by Naito, et al. (2003), students from schools that frequently used the Internet during classes showed greater improvement of the overall skill to practically use information than their counterparts from schools that did not use the Internet during classes. Among the components of the skill of practically use information, these students showed improvement particularly in their ability to “collect information”, “judge information”, “process information”, and “communicate information”. Also, Takahira, et al. (2003) conducted a panel study with junior high school students from the same area as selected for the study by Naito, et al. (2003) to examine the effect of the Internet use outside classes. The study result indicated that a higher amount of Internet use outside classes led to higher degrees of improvement of the ability to “collect information” and the ability to “communicate information”, two of the components of the skill to practically use information.

Next, as for the previous studies with senior high school students, Mouri, et al (2002) conducted a panel study to examine the effect of Internet use at school on the skill to practically use information. The study result indicated that Internet use at school had no effect on the skill to practically use information. At a senior high school that was emphasizing information education, however, a higher amount of Internet or computer software use resulted in higher degrees of improvement of the ability to “judge information”, which was one of the components of the skill to practically use information. Therefore, the effect of Internet use may become stronger if the Internet is used sufficiently during classes. In a different study, Takahira, et al. (2002) conducted a panel study with students from a commercial high school in which the students have a relatively high Internet skill. As a result, a larger amount of Internet use outside classes led to higher degrees of improvement of the ability to “judge information” and the ability to “express information”. At the same time, however, the study found that the students who indicated a larger amount of Internet use outside classes decrease the ability to “create information” and the ability to “collect information”.

As for the result of an empirical study with university students, according to the panel study conducted by Takahira, Ando, & Sakamoto (2002), increased use of the Internet led to improvement of the components of the skill to practically use information, namely, the ability to “collect information”, the ability to “express information”, the ability to “process information”, and the ability to “communicate information”. Meanwhile, a larger amount of Internet use led to decline in the ability to “create information”.

To summarize the results of the empirical studies conducted thus far as introduced above, Internet use by junior high school students contributed to improvement of the skill to practically use information; however, Internet use by senior high school and university students resulted in both positive effects and negative effects. The overall result, however, indicated that Internet use had more positive effects than negative effects on the skill to practically use information, and these positive effects were observed especially on the ability to “collect information (the ability to subjectively and sufficiently collect necessary information in accordance with purpose by using an appropriate method)”, the ability to “judge information (the ability to select necessary information from a large volume of information, judge its contents, and extract the most appropriate information)”, the ability to “express information (the ability to carefully examine the method for expressing information, organize information in an appropriate style, and express the information)”, and the ability to “communicate information (the ability to communicate information while being aware of the recipient's position or ability to process information)”.

### **The present study**

Based on the study results discussed above, in the present study, the effect of Internet use on the skill to practically use information was examined with elementary school students as participants. Although information education starts when children are elementary school students in Japan, there are only a few empirical studies that have examined the effect of Internet use on the children's skill to practically use information.

In this study, the effect of Internet use by tool as well as the effect of Internet use by purpose was examined. In most of the previous studies, for each tool (e.g. Web-site browsing, e-mail use), the effect of Internet use on the skill to practically use information was examined. Note, however, the term “Web-site browsing” may mean different things for different individuals; some may view Web sites for doing homework or studying, but others may view Web sites to check information related their favorite activities. Thus, not only Internet tools used but also reasons for using individual tools would become important information sources when considering effective improvement methods of the skill to practically use information.

In order to examine the effect of Internet use by purpose as described above, a two-wave panel study was conducted in this study. Specifically, various types of amount of Internet use as well as the skill to practically use information were measured at two different times, and causal relationships between variables were estimated. Usually, it is not possible to estimate causal relationships between variables if data is measured only once, but if the data is measured twice and the obtained data is analyzed by the structural equation model, it is possible to estimate the causal relationship between the amount of Internet use and the skill to practically use information (Finkel, 1995).

## Method

### Participants and Procedure

Surveys were conducted twice with the students from eight public elementary schools in Tokyo. The measures mentioned below were distributed twice with a three month interval, and the participants answered each time. Data obtained from 702 participants (352 males, 350 females) who participated in both surveys was analyzed.

### Measures

**Skill to practically use information (information literacy)** The “Scale of the Skill to Practically Use Information” by Takahira, et al. (2001) was used. We chose 48 items from this scale, and revised it for use with elementary school students. Conforming to the final report published by the Ministry of Education in 1998, this scale contained items regarding the skill to practically use information as well as its six kinds of components. Here, detailed description of each component is as follows: (1) ability to collect information: the ability to subjectively and sufficiently collect necessary information in accordance with purpose by using an appropriate method; (2) ability to judge information: the ability to select necessary information from a large volume of information, judge its contents, and extract the most appropriate information; (3) ability to express information: the ability to carefully examine the method for expressing information, organize information in an appropriate style, and express the information; (4) ability to process information: the ability to appropriately process the collected information and to extract and understand necessary information; (5) ability to create information: the ability to create information based on one's own ideas or opinions; and (6) ability to communicate information: the ability to communicate information while being aware of the recipient's position or ability to process information. In this study, the participants were asked to use a 4-point scale ranging from “Strongly disagree (point 1)” to “Strongly agree (point 4)” to answer the 48 questions above.

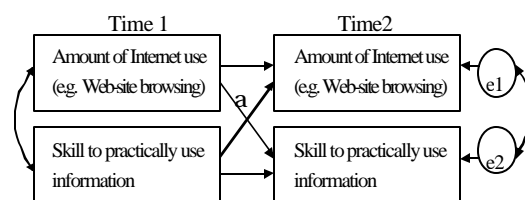
**Amount of Internet use by tool** For (1) e-mail use, (2) Web-site browsing (including BBS and email newsletter viewing), (3) Web-page making (including adjustment), (4) posting messages to BBS (including posting messages to a mailing list), (5) chat, and (6) on-line game, the participants were asked to use a 7-point scale ranging from “None (point 0)” to “More than 3 hours (point 6)” to indicate how much time they spent on using the Internet for each tool per week. The total score obtained by summing the points of (1) through (6) was treated as the total amount of Internet use by tool.

**Amount of Internet use by purpose** For (1) Internet use for school classes, (2) Internet use for doing homework or studying, (3) Internet use for checking things about hobbies or other favorite activities, (4) Internet use for communicating with family members or friends, and (5) Internet use for making new friends, the participants were asked to use a 7-point scale ranging from “None (point 0)” to “More than 3 hours (point 6)” to indicate how much time they spent on using the Internet for each purpose per week. The total score obtained by summing the points of (1) through (6) was treated as the total amount of Internet use by purpose.

## Result

### Analysis method

By using the structural equation model, the obtained data was analyzed in order to examine the causal relationships between the amount of Internet use and the skill to practically use information as well as its components (Finkel, 1995). The cross-lagged effect model was used for this analysis (Figure 1). In this model, if path “a” from the



**Figure 1** Cross-lagged effect model  
Note: “e1” and “e2” are errors.

amount of Internet use measured in the first survey (Time 1) to the skill to practically use information measured in the second survey (Time 2) had a positive effect, there would be a causal relationship in which a larger amount of the Internet use lead to improved skill to practically use information. Also, if path “a” had a significant negative effect, there would be a causal relationship in which a larger amount of the Internet use lead to decreased skill to practically use information.

#### **Effect of the amount of Internet use by tool**

The causal relationships between the amount of Internet use by tool and the skill to practically use information and its components (path “a”) were examined. As a result, the amount of Internet use by tool had positive effects on the overall skill to practically use information as well as its components: (1) ability to collect information, (2) ability to judge information, (3) ability to express information, and (6) ability to communicate information. On the other hand, there were no significant effects on (4) ability to process information and (5) ability to create information (Table 1).

***Effect on the skill to practically use information*** The overall skill to practically use information improved as the total amount of Internet use by tool was high. More specifically, a higher amount of e-mail use and Web-site browsing resulted in higher degree of improvement of the overall skill to practically use information.

***Effect on the ability to collect information*** A larger amount of total Internet use by tool resulted in higher ability to collect information. The same effects were observed for all the Internet tools studied except for posting messages to BBS. Among the Internet tools that showed positive effects, e-mail use and Web-site browsing noted somewhat stronger effects.

***Effect on the ability to judge information*** The total amount of Internet use by tool did not have any effects on the ability to judge information. A larger amount of e-mail use and Web-site browsing, however, resulted in higher ability to judge information.

***Effect on the ability to express information*** A larger amount of total Internet use by tool resulted in higher ability to express information. The same positive effects were observed for those who spent a lot of time on using e-mail and chat programs.

***Effect on the ability to communicate information*** The total amount of Internet use by tool did not have any effects on the ability to communicate information. A larger amount of e-mail use, however, caused higher ability to communicate information.

#### **Effect of the amount of Internet use by purpose**

The causal relationships between the amount of Internet use by purpose and the skill to practically use information and its components (path “a”) were examined. As a result, the amount of Internet use by purpose had positive effects on the overall skill to practically use information as well as its components: (1) ability to collect information, (2) ability to judge information, (3) ability to express information, and (6) ability to communicate information. On the other hand, there were no significant effects on (4) ability to process information and (5) ability to create information (Table 2).

***Effect on the skill to practically use information*** The overall skill to practically use information improved as the total amount of Internet use by purpose was high. More specifically, a larger amount of Internet use for communicating with others resulted in higher degree of improvement of the overall skill to practically use information.

***Effect on the ability to collect information*** A larger amount of total Internet use by purpose resulted in higher ability to collect information. The same effects were observed for all the purposes of Internet use studied except for the use for classes. Among the purposes of Internet use that showed positive effects, the use for doing homework or studying, the use for hobbies or other favorite activities, and communication with others noted somewhat stronger effects.

***Effect on the ability to judge information*** A larger amount of total Internet use by purpose resulted in higher ability to judge information. Such positive effect was observed only in Internet use for communicating with others.

***Effect on the ability to express information*** A larger amount of total Internet use by purpose resulted in higher ability to express information. Such positive effects were observed for those who spent a lot of time using the Internet to communicate with others or to make new friends.

**Table 1** Causal relationships between the amount of Internet use by tool and the skill to practically use information

Amount of Internet use by tool	Skill to practically use information						
	Overall	(1)Ability to collect information	(2)Abi lity to judge information	(3)Ability to express information	(4)Ability to process information	(5)Ability to create information	(6)Ability to communicate information
E-mail	.08*	.10*	.06*	.09*	-	-	.07*
Web-site browsing	.05*	.11*	.07*	-	-	-	-
Web-page making	-	.06*	-	-	-	-	-
Posting Messages to BBS	-	-	-	-	-	-	-
Chat	-	.07*	-	.08*	-	-	-
On-line game	-	.08*	-	-	-	-	-
Total (by tool)	.06*	.12*	-	.08*	-	-	-

Note: Values shown in this table are causal coefficient estimate values (standardized coefficients). \* $p < .05$ .  $N = 702$ .

**Table 2** Causal relationships between the amount of Internet use by purpose and the skill to practically use information

Amount of Internet use by purpose	Skill to practically use information						
	Overall	(1)Ability to collect information	(2)Ability to judge information	(3)Ability to express information	(4)Ability to process information	(5)Ability to create information	(6)Ability to communicat e information
Classes	-	-	-	-	-	-	-
Homework and study	-	.10*	-	-	-	-	-
Hobbies or for other favorite activitie s	-	.10*	-	-	-	-	-
Communication with others	.07*	.10*	.06*	.07*	-	-	.06*
Meeting new friends	-	.08*	-	.06*	-	-	-
Total (bv purpose)	.06*	.13*	.07*	.06*	-	-	-

Note: Values shown in this table are causal coefficient estimate values (standardized coefficients). \* $p < .05$ .  $N = 702$ .

**Effect on the ability to communicate information** The total amount of Internet use by purpose did not have any effects on the ability to communicate information. A large amount of Internet use for communicating with others, however, caused higher ability to communicate information.

## Discussion

### Effect of the amount of Internet use by tool

In this study, the effect of Internet use by Japanese elementary school students at school or at home on the skill to practically use information was examined. The overall result was that the participants who indicated a larger amount of total Internet use by tool showed more improvement in their overall skill to practically use information. Internet use had the effects of improving the overall skill to practically use information as well as some of its components, namely, the abilities to collect and express information.

However, the causal coefficient estimate values obtained in this study were not very large; therefore, the overall effect of the amount of Internet use by elementary school students outside classes on the skill to practically use information was not considered very strong. Since the volume of Internet use outside classes was small in this study, a floor effect may have been generated to prevent the detection of strong effects. According to Cooper (1989), however, the effect size of  $r = .10$  or larger in the fields of personality psychology, social psychology, or clinical psychology would not be considered small. This is because studies in these fields are in general susceptible to various uncontrollable exogenous variables. Since the study in this paper was conducted using the methodology employed in the study fields listed above, the effect size for ability to collect information would be considered a relatively robust result.

When close attention was paid to effect by each tool, e-mail use had the strongest effect in this study. Web-site browsing then indicated the second strongest effect. Similar effects were indicated in the previous studies with junior high school, senior high school, and university students (These studies indicated that Web-site browsing had the strongest effect and e-mail use had the second strongest effect on the skill to practically use information). Therefore, regardless of generation, it seems certain that Web-site browsing and e-mail use are particularly effective for improvement of the skill to practically use information.

### Effect of the amount of Internet use by purpose

In this study, the effect of the amount of Internet use by purpose was also investigated. The overall result was that the participants who indicated a larger amount of total Internet use by purpose showed more improvement in their overall skill to practically use information as well as its components: ability to collect information, ability to judge information, and ability to express information. This result was similar to that of the effect of the amount of Internet use by tool. Here, also, the effect size of  $r=1.0$  were observed for ability to collect information.

When close attention was paid to effect by each purpose, the strongest effect in this study was detected in Internet use for communicating with others. Meanwhile, Internet use for classes did not have any effect on the skill to practically use information. This result would imply that, in order to achieve comprehensive as well as extensive improvement of the skill to practically use information, use of the Internet only in classes would not be sufficient, and that use of the Internet must be promoted in activities that promote establishing interpersonal communications. We believe this study result has important implication when considering effective improvement methods of the skill to practically use information.

### Summary

Internet use has been rapidly spreading in Japan, and children now have increased opportunities to be exposed to the Internet at school or at home. In the study in this paper, the effect of Internet use at school or at home on the skill to practically use information was examined with elementary school students. The study result indicated that Internet use by elementary school students helped improvement of the overall skill to practically use information as well as its components: ability to collect information, ability to judge information, ability to express information, and ability to communicate information. Internet use had particularly strong effect on improvement of ability to collect information. As for the effect of Internet use by tool, e-mail use and Web-site browsing often promoted improvement of the skill to practically use information. As for the effect of Internet use by purpose, the study result indicated that Internet use for communicating with others also caused improvement of the overall skill to practically use information.

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