Impact of Internet Literacy, Internet Addiction Symptoms, and Internet Activities on Academic Performance

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Abstract

This study examines the interrelationships among Internet literacy, Internet addiction symptoms, Internet activities, and academic performance. Data were gathered from a probability sample of 718 children and adolescents, aged 9–19, in Hong Kong, using face-to-face interviews. Regression results show that adolescent Internet addicts tended to be male, in low-income families, and not confident in locating, browsing, and accessing information from multiple resources, but that they were technologically savvy and frequent users of social networking sites (SNS) and online games for leisure. Contrary to what was hypothesized, Internet literacy, especially in publishing and technology, increases—not decreases—the likelihood of someone getting addicted to the Internet. As expected, Internet activities, especially SNS and online games, were significantly and positively linked to Internet addiction as well as to all Internet addiction symptoms. This finding suggests that leisure-oriented Internet activities can be much more addictive than other applications such as communicating by e-mail or browsing webpages. Furthermore, the higher subjects scored on tool and social-structural literacy, the better their academic performance would be; however, technical literacy skills, such as publishing and technology literacy, were not significant predictors for academic performance. This indicates that adolescents who can locate, browse, and access different information resources and who are knowledgable about the context under which the information was created performed better both in overall grades and in academic competence.

Keywords

academic performance, adolescents and children, Internet activities, Internet addiction symptoms, Internet literacy

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Introduction

The skills to critically evaluate and to sort out information—often known as Internet literacy—can be regarded as the current form of literacy, in which processing information in a digital environment is equally important to, if not more important than, reading and writing of previous decades (Partnership for 21st Century Skills, 2003; Rivoltella 2008a, 2008b). However, in spite of the widely acknowledged merits of the Internet, especially its literacy skills, psychologists and educators have been aware of the negative impacts of its use, especially *overuse* and *misuse* which lead to physical and psychological problems (Bricolo, Gentile, Smelser, & Serpelloni, 2007; Hur, 2006). One of the most common problems is Internet addiction (Griffiths & Hunt, 1998; Huang & Leung, 2009; Shapira et al., 2003; Young, 1998a). The concept of "Internet addiction" has been proposed as an explanation for uncontrollable and harmful use of Internet technology (Byun et al., 2009; Griffiths, 1998; Leung, 2004, 2010; Young, 1998a, 1998b).

Although the use of the Internet by students is on the rise, so are concerns that for some students, heavier use of the Internet might interfere with academic achievement and traditional social interaction (Kubey, Lavin, & Barrows, 2001; Livingstone, 2002). Kubey, Lavin, and Barrows (2001) found a significant percentage of students in the academically impaired subgroup reported that their Internet use had kept them up late at night, and that they missed class due to Internet use. Today, new Internet applications like social networking sites (SNS) and online games are gaining popularity among students, and yet little is known about what impacts these new Internet activities have on school performance.

Previous studies have investigated Internet addiction among Chinese adolescents from various perspectives using different research questions and hypotheses (Cao & Su, 2007; Chak & Leung, 2004; Cheung & Wong, 2011; China Youth Internet Association [CYIA], 2010; Gong et al., 2009; Lam, Peng, Mai, & Jing, 2009; Li, Li & Xie, 2006; Yang & Tung, 2007). Other research has reported that Internet addiction is a "severe social problem that could threaten the nation's future" in China (Fallows, 2007; Jiang & Leung, 2011). However, most of these studies explored Internet addiction as a general phenomenon, especially from the perspective of antecedents, but largely ignored its effects on academic impairment.

This study goes beyond examining the level of addiction and tries to identify the symptoms of Internet addiction that adolescents experience and its impact on academic performance. Knowledge of these symptoms can help parents and educators detect and assess Internet addiction among adolescents in order to intervene appropriately at an early stage. Thus, the purpose of this exploratory study is to identify the interrelationships among Internet literacy, Internet addiction symptoms, Internet activities, and academic performance of adolescents.

Literature Review

Defining Internet Literacy

The Association of Colleges and Research Libraries (2010) defines information technology literacy skills (or simply Internet literacy) as those associated with an individual's use of computers, software applications, databases, and other technologies to achieve an academic, work-related or personal goal. To distinguish information literacy from one of its component skills, technology literacy (i.e., competence in using information technology), the association has redefined information literacy as "a set of abilities requiring individuals to recognize when information is needed and have the ability to locate, evaluate, manage, and use effectively the needed information" (Farmer & Henri, 2008, p. 4).

Dupuis (1997) indicates that information literacy must include knowledge and understanding of the "context" of information in today's society, information's composition and organization, as well

as its use in life-long learning. Others also think of Internet literacy as skills that go beyond locating and using information to the knowledge for interpreting and evaluating information (Banta & Mzumara, 2004; Livingstone, 2008; Livingstone, Bober, & Helsper, 2005; Murray, 2003). Shapiro and Hughes (1996) proposed and operationalized Internet literacy as a seven-dimensional construct: (1) "Tool literacy" refers to the ability to understand and use practical and conceptual information technology tools in respective professional life. (2) "Resource literacy" means the ability to understand the form, location, access methods, and formats of information resources. (3) "Social-structural literacy" reveals the understanding of how information is socially situated and produced. (4) "Research literacy" indicates the ability to understand and use relevant information technology tools for research. (5) "Publishing literacy" reflects the ability to format and publish research and ideas in textual and multimedia formats. (6) "Emergent technology literacy" refers to the awareness and the ability to adapt to, understand, evaluate, and make use of emerging information technology. (7) "Critical literacy" reveals the ability to critically evaluate the strengths and weaknesses, capabilities and limits, of information technologies (Farmer & Henri, 2008). As compared to previous studies (such as Livingstone et al., 2005) where information literacy or Internet literacy was articulated in three dimensions (access, understanding, and creation), this study adopted a similar but more encompassing conceptualization—a seven-dimension construct—by Shapiro and Hughes (1996).

Using this encompassing multidimensional definition of Internet literacy, this study explores whether different dimensions of Internet literacy are related to Internet addiction and academic performance.

Internet Addiction

Traditionally, the concept "addiction" was based on a medical model and was properly reserved for bodily and psychological dependence on a physical substance—and not a behavioral pattern. Recent research has argued that "addiction" should be widened to cover a broader range of behaviors (Lemon, 2002; Orford, 2001; Shaffer, 1996; Song, LaRose, Eastin, & Lin, 2004). As a subset of behavioral addiction, Griffiths (1996) proposed the concept of technological addiction, which is operationally defined as human–machine interaction and is nonchemical in nature. Despite the debate as to whether the excessive use of various technologies, such as Internet surfing, TV watching, and computer gaming, can be or should be called an "addiction," scholars have argued that excessive use of technology can be considered problematic (Griffiths, 1998; Griffiths & Hunt, 1998; Leung, 2008b; Shotton, 1989; Yellowlees & Marks, 2007).

Derived from criteria associated with pathological gambling in the *Diagnostic and Statistical Manual – Fourth Edition* (*DSM-IV*; American Psychiatric Association, 1994), Young (1998a) presented a definition for Internet-related disorders, called *Problematic Internet Use*. This definition requires that individuals meet five of eight criteria for Internet addiction to qualify as an addict. These include (1) preoccupation with the Internet, (2) need for a longer amount of time online, (3) repeated attempts to reduce Internet use, (4) withdrawal when reducing Internet use, (5) time management issues, (6) environmental distress (family, school, work, and friends), (7) deception around time spent online, and (8) mood modification through Internet use.

Young (1998a) characterized Internet addiction as staying online, for pleasure, largely in chat rooms, on an average of 38 hr or more per week, and concluded that Internet addiction can shatter families, relationships, and careers. Past studies examining Internet addiction have found a significantly higher use of synchronous communication Internet applications, like instant messaging (IM), by Internet dependent students compared to that of nondependent students. Chak and Leung (2004) indicated that people who are addicted to the Internet make intense and frequent use of it, especially for online communication via e-mail, I Seek You (ICQ), and online games. However, most of these studies conceptualized Internet addiction as a one-dimensional construct (Beard, 2005); little

research has been conducted on Internet addiction from a multidimensional symptomatic perspective (e.g., Leung, 2008a; Scherer & Bost, 1997). Therefore, this study asks:

Research Question 1: What Internet addiction symptoms can be identified among adolescents?

As indicated by Dunn (2002) that being Internet literate means that the individual has strong and critical views in the strengths, weaknesses, capabilities, and limits of information technologies, thus we propose:

Hypothesis 1: The more Internet literate adolescents perceive they are, the lower the likelihood they will be addicted to the Internet.

Academic Performance

The subject of whether academic performance and Internet use are related has long been the interest of some researchers. Scherer (1997) surveyed 531 students about their Internet use, using a checklist of 10 clinical symptoms to parallel the symptoms of substance abuse and dependency. Results indicated that 13% of the sample group reported Internet use had interfered with their academic work, professional performance, or social lives. In the same line of research, Barber (1997) also found that 86% of responding teachers from a survey believed that Internet usage by children does not improve performance; the teachers argued that the information that the students obtained was highly disorganized and unrelated to the school curriculum.

Similarly, Kubey et al. (2001) revealed that heavy Internet use for leisure was highly correlated with impaired academic performance, particularly with those using synchronous communication applications like chat rooms and Multiple User Dungeons (MUDs). The researchers argued that the unique social qualities of such applications represented a most significant utility for lonely individuals who can be with friends at any time; as a result, many users were kept up late at night and felt tired the next day, which in turn affected their academic performances. In a recent study, it was found that greater Internet use was associated with better reading skills especially for youth initially low in reading skills (Jackson, Eye, Witt, Zhao, & Fitzgerald, 2011). In contrast, however, Chen and Peng (2008) found that light Internet users had better relationships with administrative staff, better academic grades, and higher learning satisfaction than heavy users did; heavy Internet users were more likely to be depressed, physically ill, lonely, and introverted than nonheavy Internet users were. In studying IM, Huang and Leung (2009) found that both the level of IM use and level of IM addiction have significant and positive bivariate correlations with academic performance decrement among teenagers in China. When examining the relative influence of various predictors on academic performance decrement, stepwise regression showed that four IM addiction symptoms (namely, preoccupation by IM, loss of control, loss of relationship due to overuse, and escape) were the strongest predictors for academic performance decrement. Based on these literature, it is reasonable to believe that being Internet literate (especially in the tool, critical, and social-structural literacy) will have a positive impact on one's academic performance because, by definition, Internet literacy means being able to locate, retrieve, interpret, and evaluate the context under which information was created or produced. Such skill will facilitate the individuals with higher ability in solving academic problems. Thus, we hypothesize that:

Hypothesis 2: The more Internet literate adolescents perceive they are, the higher their academic performance will be.
Hypothesis 3: The more Internet addiction symptoms exhibited by adolescents, the lower will be their academic performance.

Internet Activities

Livingstone and Helsper (2010) argued that it is difficult to separate the highly correlated relationship between taking up opportunities and suffering from negative consequences from the overuse or misuse of the Internet. In fact, different Internet activities may bring different opportunities and negative consequences. This study limited its scope and examined the relationships between adolescents' academic performances and the amount of time spent on the Internet in general and the use of two favorite activities online for leisure in particular (e.g., interacting on SNS and online games). These are the two activities that children and adolescents often spend most of their time on, especially in the privacy of their own bedrooms. Thus, we posit the following and ask two research questions:

> *Hypothesis 4*: The more actively adolescents are engaged in Internet activities for leisure, the higher the likelihood the adolescents will be addicted.
> *Hypothesis 5*: The more actively adolescents are engaged in Internet activities for leisure, the poorer the adolescents' academic performance will be.
> *Research Question 2*: How can demographics, Internet literacy, and Internet activities predict overall Internet addiction and various addiction symptoms?
> *Research Question 3*: To what extent can demographics, Internet literacy, Internet addiction symptoms, Internet activities, and mass media predict academic performance?

Method

Sample and Sampling Procedure

Data were gathered from a probability sample of 718 children and adolescents aged 9–19, using a face-to-face, structured questionnaire interview during the months of December 2008 to February 2009. Respondents were eligible members of a randomly generated list of households from the Census and Statistics Department in Hong Kong. If there was more than one eligible respondent living in the household, the person who had had the most recent birthday was interviewed. Interviewers were trained university students. A total of 238 households were discarded when interviewers found them to be vacant, nonresidential, or ineligible, had no response after having visited more than three times, or were simply refused by the respondents. Of the 2,304 qualified households, 718 successfully completed the questionnaires, resulting in a 31.2% response rate.

The sample consisted of 44.4% males and 55.6% females. The mean age was 14.46 with 14.9% in the 9–11 age group, 73% in 12–17 age group, and 12.1% in 18–19 age group. This age distribution very closely resembled the data of the 2008 population census in Hong Kong. Of the 718 respondents, 15.3% were elementary school students, 38.6% were junior high students, 32.4% were high school students, and 17.3% were high school graduates. In terms of family income, the mean was at the income bracket of US$1,928–$2,571 a month with 10.4% were earning less than US$1,028 a month, and 9.3% more than US$5,141 a month.

Measures

Internet literacy. An inventory of 15 items was used to assess the five of the seven dimensions of Internet literacy as proposed by Shapiro and Hughes (1996). Resource and research literacy were excluded as they were less applicable for adolescents and children. Respondents were asked to answer the question, "How confident were you in performing the following tasks?" using a 5-point scale where "1" = *not very confident*, and "5" = *very confident*. Sample tasks included editing and formatting a document according to a set of editorial specifications; creating content in blogs, on YouTube, and on personal webpages for different audiences; and critically judging whether information on websites is authentic and accurate. Factor analysis of 13 tasks yielded a

five-factor Internet literacy structure, namely tool literacy, critical literacy, publishing literacy, emerging technology literacy, and social-structural literacy. Reliability αs were high and ranged from .77 to .84.

Internet addiction. The 20-item Internet Addiction Index (IAI) developed by Young (1998a) and additional items by Bianchi and Phillips (2005) were adapted to measure the level of Internet addiction in this study and to identify the addiction symptoms. A 5-point Likert-type scale was used in which "1" = *not at all*, "2" = *rarely*, "3" = *occasionally*, "4" = *often*, and "5" = *always*. The reliability for the scale as indicated by Cronbach's α was remarkably high at .90. A composite IAI was constructed with data ranged from 20 to 100.

Academic performance. Two variables were used to assess academic performance. First, each respondents was asked to report, on a 9-point scale in which "1"= 55 or lower, "2" = 56–60, "3"= 61–65, "4" = 66–70, "5" = 71–75, "6" = 76–80, "7" = 81–85, "8" = 86–90, and "9" = 91–100, his or her (a) standing in class, (b) the score on the most recent examination in Chinese, (c) in English, and (d) in mathematics. The four scores were summed and averaged to generate a combined score in overall grades with a mean equaling 4.43 ($SD = 2.07$) and a reliability α of .85. To offset the tendency to give socially desirable responses, a second variable, adopted from Hart (1982) and measuring cognitive or *academic competence*, was used. Using seven descriptions, subjects were asked to decide which kind of kid he or she was most like. A 4-point Likert-type scale was used for the child to decide whether the description was really true for him or her. Sample description items include finishes school work quickly; is just as smart as others; understands what is read; and likes school and doing well. Scores were summed and then averaged resulting in a mean of 2.77 ($SD = .5$) and a reliability α of .79.

Internet activities. Only Internet use overall and Internet use for leisure (i.e., SNS and online games) were chosen in the study as they are the most popular Internet activities for adolescents. Overall Internet use was measured by asking respondents "how much time (in minutes) did you spend on the Internet yesterday?" As for SNS-oriented activities, respondents were asked "how often do you use four separate popular SNS, namely, MSN, forums, Facebook, and blogs, using a 5-point scale with "1" = *never*, "2" = *seldom*, "3" = *sometimes*, "4" = *often*, and "5" = *very often*?" Cronbach's α for these 4 items was .81. Similarly, using the same scale, online games was measured using a single item asking "how often do you play online games?"

Demographics. Social demographic variables were included in the present study as control variables: gender (male = 1), age, education, monthly family income, and the frequent location for Internet access (in the bedroom with door closed, in the bedroom with door open, and in the living room).

Results

Internet Addiction Symptoms

The mean score for the 20-item IAI was 51.69 and *SD* equaled 11.31. As shown in Table 1, the principal components factor procedure yielded a five-factor Internet addiction symptoms structure and accounted for 62.61% of total variance. The first factor was *Preference for online*, reflecting that the addicts are more comfortable with computers than with people, more confident socializing online rather than offline, and felt they were being treated better and were safer relating to others in online relationships than face-to-face. *Loss of control* was the second factor. It included 4 items characterizing that adolescents felt the need to use the Internet more and more to achieve satisfaction; felt lost,

Table 1. Factor Analysis of Internet Addiction Symptoms

How Often Do You Experience the Following?	M	SD	Factors				
			1	2	3	4	5
Preference for Online							
1. More comfortable with computers than people	2.64	.95	.77				
2. More confident socializing online than offline	2.69	1.07	.77				
3. Being treated better in online relationships than in face-to-face	2.81	1.04	.68				
4. Feel safer relating to others online rather than face to face	2.65	1.06	.64				
5. Being treated better online than offline	2.95	1.09	.59				
Loss of Control							
6. I feel the need to use the Internet more and more to achieve satisfaction (2)	3.13	1.13		.76			
7. I feel lost, restless, depressed, and irritable if I cannot go online (4)	3.15	1.05		.75			
8. I have concealed the extent of my Internet use (7)	2.88	1.15		.74			
9. Preoccupied with Internet if I cannot connect for some time (1)*	2.70	1.01		.72			
Preoccupation							
10. Spent a good deal of time online	2.74	1.03			.82		
11. Go online for longer time than I intended (5)	1.97	.91			.80		
12. Lose track of time online	2.53	1.02			.73		
13. Tried to stop using Internet for long periods of time (3)	2.58	1.12			.51		
Negative Life Consequences							
14. Missed class or work because I was online	1.44	.73				.80	
15. Missed social event because of being online	1.97	.90				.72	
16. I feel worthless offline, but I am someone online	1.85	.82				.66	
17. Got in trouble in work/school b/c online (6)	2.33	1.08				.50	
Withdrawal							
18. Use Internet to talk with others when I feel isolated	2.75	.98					.87
19. Seek others online when I feel isolated	2.67	.95					.81
20. Go online to make myself feel better when I'm down (8)	3.01	.99					.60
Eigenvalues			6.52	2.23	1.55	1.19	1.05
Variance explained			32.57	11.13	7.75	5.93	5.23
Cronbach's α			.81	.74	.83	.69	.81

Note. Scale used: 1 = *Never* and 5 = *Very often*; Total variance: 62.61%; N = 718.
*The original *DSM* measure for pathological gambling was based on 8 items marked in parenthesis.

restless, depressed, and irritable if they could not go online; and had concealed the extent of their Internet use. *Preoccupation* was the third factor. It consisted of 4 items illustrating that adolescents spent a good deal of time online, went online for longer times than intended, and lost track of time online. The fourth factor, *Negative life consequences,* contained 4 items indicating that adolescents found that excessive use of the Internet had caused them trouble, such as by missing class, work, or social events, and that they felt worthless offline. The fifth factor was *Withdrawal,* reflecting that addicts used the Internet to talk with others when they felt isolated, lonely, and down.

As a whole, this study identified five Internet addiction symptoms which were conceptually consistent with the theoretical origins described in the diagnostic criteria of pathological gambling in

Table 2. Correlations Among Key Variables

	Internet Addiction Index (IAI)	Overall Grade	Academic Competence
Internet Literacy			
1. Tool literacy	−.01	.14***	.28***
2. Critical literacy	.06	.04	.17***
3. Publishing literacy	.11**	−.01	.15***
4. Emerging technology literacy	.15***	−.05	.10*
5. Social-structural literacy	−.04	.14***	.23***
Internet Addiction			
6. Internet Addiction Index (IAI)	—	−.26***	−.17***
Internet Addiction Symptoms			
7. Preference for online	—	−.18***	−.09*
8. Loss of control	—	−.23***	−.15***
9. Preoccupation	—	−.17***	−.12**
10. Productivity loss	—	−.25***	−.18***
11. Withdrawal	—	−.17***	−.04
Internet Activities			
12. Internet (yesterday)	.26***	−.21***	.10
13. SNS sites	.29***	−.22***	.00
14. Online games	.28***	−.10*	.02

Note. Figures are Spearman's ρ correlation coefficients.
***$p < .001$. ** $p < .01$. * $p < .05$; $N = 718$.

DSM-IV. The original *DSM* measure for pathological gambling was based on 8 items; however, this study employed 20. Reliability αs ranged from .69 to .83.

Hypotheses Testing

As shown in Table 2, publishing and emerging technology literacy are statistically significantly positively related to the composite IAI ($r = .13, p < .001$ and $r = .15, p < .001$, respectively), but the effect sizes were low. This indicates that, contrary to what was hypothesized, adolescents with great competence in publishing skills on the Internet and possessing knowledge in the latest Internet technology developments tended to exhibit a higher likelihood of becoming addicted to the Internet. Thus, Hypothesis 1 was rejected. Similarly, correlations between overall grade and tool literacy ($r = .11, p < .01$) and social-structural literacy ($r = .12, p < .01$) were significant. Likewise, correlations between all five dimensions of Internet literacy and academic competence were all also significant (r ranged from .09, $p < .05$ to .27, $p < .001$). Therefore, Hypothesis 2 was largely supported.

The results in Table 2 also revealed significant negative relationships between overall grade and the composite IAI ($r = −.27, p < .001$) and all dimensions of Internet addiction symptoms (r ranged from −.17, $p < .001$ to −.25, $p < .001$). Similarly, academic competence was also negatively and significantly linked to the composite IAI ($r = −.16, p < .001$) and, with the exception of withdrawal, to four out of the five dimensions of Internet literacy (r ranged from −.09, $p < .05$ to −.14, $p < .001$). Thus, Hypothesis 3 was largely supported.

As indicated in Table 2, the IAI was significantly correlated to overall time spent on the Internet yesterday ($r = .24, p < .001$), and time spent on SNS sites ($r = .29, p < .001$) and online games ($r = .28, p < .001$) for leisure. These results also confirmed Hypothesis 4, meaning that the more adolescents engaged in the Internet for general use and for leisure, the more likely they will be addicted.

Finally, results also showed that overall grade was significantly and negatively related to overall Internet use yesterday ($r = −.24, p < .001$) and Internet use for leisure such as SNS sites visited

Table 3. Regressing Internet Addiction on Demographics, Internet Literacy, and Internet Activities

	Internet Addiction Index (IAI)	Internet Addiction Symptoms				
		Preference for Online	Loss of Control	Preoccupation	Negative Life Consequences	Withdrawal
	β	β	β	β	β	β
Demographics						
Age	.01	.02	.04	.07	.27***	−.01
Gender (male = 1)	.15**	.14**	.07	.00	.16***	.09
Education	.03	−.03	.01	.05	−.28***	−.03
Household income	−.11*	−.06	−.07	−.02	−.04	−.10*
Where to go online (bedroom =1)	−.00	−.05	−.04	.11**	−.02	−.04
Internet Literacy						
Tool literacy	−.11*	−.06	−.02	.11**	−.19*	−.05
Critical literacy	.05	.09	.04	−.01	−.00	.01
Publishing literacy	−.02	.03	−.04	.10**	.05	.14*
Emerging technology literacy	.21***	.13*	.11**	−.03	.01	.09
Social-structural literacy	−.09	−.11*	−.10*	−.03	−.04	−.08
Internet Activities						
Internet (yesterday)	.08	.06	.07	.12**	.05	.02
SNS	.21***	.16**	.21***	.15**	.10*	.24***
Online games	.13*	.15**	.10*	.12**	.13***	.15**
R^2	.22	.16	.12	.10	.11	.17
Adjusted R^2	.19	.14	.11	.08	.09	.14

Note. SNS = social networking sites.
***p < .001. **p < .01. *p < .05; N = 718.

($r = -.24$, $p < .001$) and online games ($r = -.09$, $p < .05$). However, academic competence was significantly and positively linked to Internet use yesterday and had no relationship with Internet use for leisure. This indicates that for some adolescents, more Internet use yesterday may be a good thing if it is used for study and for doing homework rather than for escapism and diversion, such as through online games, or for a maladaptive use. Thus, Hypothesis 5 received only partial support.

Predicting Addiction Symptoms

In a model designed to investigate the best predictors for internet addiction symptomatology, the following variables were found to be statistically significant and thus included—all demographic variables, all Internet literacy except critical, and all Internet activity variables. In particular, adolescents who scored high in the IAI tended to be male, from a low-income family, savvy, and literate in emerging technologies, but illiterate in locating, browsing, and accessing information online (see Table 3). The highly addicted individuals tended to spend more time on SNS and online games *for leisure*. Similarly, those who exhibited strong symptoms in the areas of preference for online and loss of control tended also to be male, literate in emerging technology, but illiterate in social-structural meaning of information, and heavy users of SNS and online games for leisure. Individuals who often felt preoccupied or who lost track of time online tended to spend much time online in their

Table 4. Hierarchical Regression of Demographics, Internet Literacy, Addiction Symptoms, Internet Activities, and Mass Media Use on Academic Performance

	Academic Performance			
	Overall Grades		Academic Competence	
Predictors	β	ΔR^2	β	ΔR^2
Block 1: Demographics				
Age	−.52***		−.06	
Gender (male = 1)	.05		.04	
Education	.15*		−.06	
Household income	.07*		.06	
Where to go online (bedroom =1)	.04	.15	−.03	.00
Block 2: Internet literacy				
Tool literacy	.08*		.22***	
Critical literacy	−.00		.01	
Publishing literacy	.05		−.01	
Emerging technology literacy	−.03		−.02	
Social-structural literacy	.10*	.03	.09*	.08
Block 3: Addiction symptoms				
Preference for online	−.03		−.03	
Loss of control	−.04		−.06	
Preoccupation	−.04		−.15***	
Negative life consequences	−.14***		−.05	
Withdrawal	−.06	.04	.01	.02
Block 4: Internet activities				
Internet (yesterday)	−.11***		−.07	
SNS	−.01		−.02	
Online games	−.09*	.02	.06	.00
Block 5: Mass media use				
TV viewing	−.08*		−.03	
Book reading	.08*	.01	.09*	.01
R^2		.27		.12
Final adjusted R^2		.25		.11

Note. SNS = social networking sites.
***$p < .001$. **$p < .01$. *$p < .05$; N = 718.

own bedroom, were tool literate and publishing literate, and were heavy users of the Internet, as well as of SNS and games online for leisure. Furthermore, those who suffered most from the negative consequences due to Internet addiction tended to be older males, less educated, heavy SNS and game users, and often tool illiterate. Finally, adolescents from low-income households who often withdrew from their offline world to the online world when they felt isolated and down tended to be competent in online publishing and spent a lot of time on SNS sites and playing games for leisure. Variances explained ranged from 8% to 19%.

Predicting Academic Performance

To examine the extent to which demographics, Internet literacy, Internet addiction symptoms, Internet activities, and mass media use predict academic performance, a series of hierarchical regressions were run. Results in Table 4 show that adolescents who scored higher overall grades or who performed better in school tended to be those in senior classes with higher household incomes and high tool and social-structural literacy, who experienced little negative life consequences due to Internet

use, used the Internet, especially online games, infrequently, and seldom watched TV, but were frequent book readers. Demographic block explained most of the variance at 15%, followed by addiction symptoms (4%) and Internet literacy variables at 3%, Internet activities (2%), and mass media use (1%) for a total of 27%. As for individuals who were high achievers in academic competence, they tended to score high in Internet tool and social-structural literacy, seldom suffered from preoccupation with the Internet, and were well-read. These predictors explained 11% of the variance with information literacy variables being the most influential at 8%.

Conclusions and Discussions

Linking Internet Literacy and Internet Activities to Internet Addiction

In the bivariate analysis, it is interesting to note that, contrary to what was hypothesized, the IAI was significantly and positively correlated with publishing literacy and emerging technology literacy. This indicates that Internet literacy, especially in publishing and technology, increases—not decreases—the likelihood of someone becoming addicted to the Internet. Such results may be explained by the fact that producing Internet content (such as on SNS like Facebook, in blogs, and on YouTube) requires technological and publishing know-how and users may easily become absorbed in or be preoccupied by the sites. Furthermore, as a leisure activity, producing multimedia content is a fun thing for adolescents to do. As a consequence, the more publishing and technological skills adolescents have, the higher the likelihood they will be addicted.

Regression results in Table 3 further support this finding that being competent in online publishing is significantly linked to addiction symptoms, such as withdrawal and preoccupation. This echoes the notion that producing multimedia content is time-consuming and absorbing, and that the activity may be adolescents' favorite means to seek companionships when they feel isolated or down. The insignificant relationships between tool, critical, and social-structural literacy and IAI suggest that Internet literacy education is lacking in Hong Kong. Children and adolescents may be very familiar with the technological know-how in publishing user-generated multimedia content online, they have yet to be taught with the critical, evaluative, and interpretive skills that may play a deciding role in lowering the likelihood of being addicted. As expected, Internet activities, especially SNS and online games, were also significantly and positively linked to the IAI as well as to all Internet addiction symptoms (as indicated in the regression results in Table 3). This finding suggests that leisure-oriented Internet activities can be much more addictive than other applications such as communicating by e-mail or browsing webpages. This result supports that of past research that indicates people who are addicted to the Internet tend to be frequent users of IM via I Seek You (ICQ) and online games (Chak & Leung, 2004; Griffiths & Hunt, 1998; Young, 1997).

Regression analysis in Table 3 also shows that adolescent Internet addicts tended to be male, in low-income families, not confident in locating, browsing, and accessing information from multiple resources, but technologically savvy, and frequent users of SNS and online games. These results seem to be in line with previous studies that showed adolescents who liked to purposely seek pleasure, variety, and stimulation through the use of the Internet for leisure tended to be the most vulnerable (Floros, Fisoun, Siomos, and Floros, 2010).

More importantly, the study also found that emerging technology literacy (positive) and social-structural literacy (negative) were significant predictors of addiction symptoms, especially preference for online and loss of control, respectively. This finding indicates that the more savvy adolescents are with technology but the less knowledge and understanding they had of the context in which information was produced or situated, the more they will exhibit addiction symptoms, especially in preference for online over offline and easily losing control of the amount of time spent on the Internet. Despite their rich technological expertise, this lack of knowledge in the cultural and historical background in

the production of information may actually hinder their ability to critically evaluate the authenticity and usefulness of information, which may lead to their dislike of the offline world and to overuse of the Internet (Caplan, 2003; Johnson, 2008).

Furthermore, it is also important to note that addicts who have the luxury of going online in the privacy of their bedrooms tended to become much more easily preoccupied with the Internet and to spend longer time than intended. For parents, requiring adolescents to go online in the living room, a common space outside of the bedroom, may be a solution to avoid developing such addiction symptoms.

Linking Internet Literacy to Academic Performance

As hypothesized, the higher that subjects score on Internet literacy, the better their academic performance will be. In particular, adolescents who can locate, browse, and access different information resources and who are knowledgable about the context under which information were created performed better both in overall grades and in academic competence. Such a finding is interesting since, unlike technology and publishing literacy which requires hands-on technical skills, social-structural literacy involves critical thinking skills with historical perspective, philosophical depth, and analytic strength in order to understand the ethical, legal, and social–political dimensions of how the information was produced. Such literacy is much more demanding and requires functioning at a higher intellectual level.

It is also interesting to note that other technical literacy skills, such as publishing, tool, and technology literacy, were found not to be significant predictors for academic performance, suggesting that technical skills are less important in influencing academic performance. This is because such skills can be learned in a short time while social-structural literacy is accumulated over a much longer period.

The sizes of the effects from Internet literacy (3–8%) and addiction symptoms (2–4%) on academic performance were small, but were of equivalent or larger magnitudes to those found for other blocks of predictors, and were evident even after we controlled for socioeconomic status.

Linking Internet Addiction to Academic Performance

In line with our hypotheses, bivariate analyses show that the IAI and addiction symptom subscales were inversely related to both overall grades and academic competence. The multiple regression analyses also echoed these findings with the symptoms of negative life consequences and preoccupation with the Internet being two significant predictors for impaired academic performance. This suggests that when adolescents missed classes, avoided social events, and skipped school due to overuse of the Internet, it is a warning sign for parents and teachers to intervene or to mediate their Internet habits.

Linking Internet Activities to Academic Performance

Furthermore, the negative relationship between Internet activities and academic performance suggests the possibility that heavy online gaming and overall Internet use result in adolescents having poorer grades, though not impaired academic competence. This finding is in line with study of Kubey et al. (2001) that indicated that heavy Internet use for leisure was highly correlated with impaired academic performance, particularly for those using synchronous communication applications like chat rooms and MUDs.

Internet addiction, exacerbated today by both fixed devices such as desktop computers used at home and by mobile third-generation (3G) devices, remains almost exclusively something that is

associated with adolescents and young people. Beyond just knowing about the danger of Internet addiction, parents, educators, psychologists, social workers, and policy makers should be aware of the threats that Internet addiction might pose for adolescents, especially the fundamental threats of health risk. As with a range of other technologies, adolescents and young adults have indeed been avid adopters of the Internet. Because of its prevalence and availability, its portability of access via mobile 3G devices, and its intricate incorporation into the patterns of everyday life, the Internet has posed considerable challenges, in addition to being potentially addictive, to the course of disciplines for educating the future generation to be more Internet-literate.

Limitations of this Study and Suggestions for Future Research

There are several limitations in this study: First, although the findings are consistent with the predictions for Internet literacy and academic performance, they do not demonstrate a cause-and-effect relationship and the effect sizes were generally small. Use of quasi-experimental and longitudinal designs would improve the strength of the findings. Furthermore, it is important to note that future research should pay attention to the important moderating influences of the bidirectional nature of Internet literacy and academic performance. It is logical to speculate that much larger effects might have been apparent had we been able to control for how much parenting mediation was involved in adolescents' use of the Internet.

Second, while 13 Internet literacy items were applied in this study, the failure to include other items from a list of 15 gathered in the five dimensions in the literature (Shapiro & Hughes, 1996; Dunn, 2002) may be due to the social and cultural differences between Hong Kong and the West. Future research should consider items that are developed locally and are reflective of the characteristics of Internet users in their native culture. Studies could also include a focused cross-cultural design comparing the differences between cultures in relation to distinct characteristics of Internet literacy.

Third, accurate assessment of actual Internet use is difficult to determine because of underreporting of hours spent on the Internet, either because of denial or because of losing track of time while using. A more accurate diary-keeping method may be an alternative for future research.

Fourth, identifying Internet literacy clusters using exploratory factor analysis is admittedly a weakness. Future research should undergo more rigorous testing, such as using confirmatory factor analysis, with alternative solutions and interpretations to make predictions or to test the presence of a hypothesized structure in a different population.

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