



The indirect effects of online social entertainment and information seeking activities on reading literacy

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ABSTRACT

Research showed distinct effects of different online activities on reading literacy or learning outcomes; however, no explanation about this link was provided. The current study investigated the effects of two genres of online reading activities on reading literacy based on knowledge of metacognitive strategies in a mediation analysis. Participants were 87,735 fifteen-year-old students (49.8% girls) across 15 regions in the PISA 2009 dataset. We divided online reading activities into social entertainment and information-seeking activities and controlled for gender, socioeconomic status, and the availability of Information and Communication Technologies (ICT) at home and at school. The indirect effects of knowledge of metacognitive strategies helped to explain why social entertainment and information-seeking activities would predict reading literacy differently. More frequent information-seeking activities predicted better knowledge of metacognitive strategies, which in turn predicted better reading literacy, while more frequent social entertainment activities predicted poorer knowledge of metacognitive strategies, which in turn led to poorer reading literacy. Suggestions were made to guide students in engaging in more online information-seeking reading activities, and incorporate instruction of metacognitive strategies for both online and offline reading, thereby improving students' reading literacy in both printed and digital formats.

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1. Introduction

Since 2000, the Organisation of Economic and Cultural Development (OECD) has started their 3-year cycle of Programme for International Student Assessment (PISA) to evaluate the literacy development in reading, science, and mathematics for the fifteen-year-old adolescents in the participating countries and regions. The purpose of the PISA is to understand if students near the end of compulsory education in most countries are equipped with the ability to participate in the society. With the wide spread of information and communication technologies (ICT), people's lives are subject to change accordingly. Most noted is the integration of reading digital text into daily life. As a result of this difference, OECD started to include the assessment of reading electronic text as part of the evaluation of reading literacy in 2009. Digital texts are not just electronic versions of the printed texts, where readers can turn the pages and read one chapter after another in a linear fashion. In contrast, nonlinearity is the most distinguishable feature of digital text. According to OECD (2011), the new features of digital text include (1) dynamic windows and frames, (2) networking and hyperlinking, (3) multimedia and augmented reality, and (4) online discussion and social networking. When reading digital texts, people are not constrained to a window or frame; instead, they can select the page they wish to browse. The result is reading within a networked environment, or reading hypertexts, which is often related to sources of distraction and shallow reading (Birkerts, 2006; Liu, 2005; Miall & Dobson, 2006). Moreover, the popularity of social networking, such as Facebook, MSN, and MySpace, has drawn a great deal of attention to people of all ages. People may read blogs or maintain one of their own, chat online with friends, and connect with others on the social networking sites (SNSs). As was stated in OECD (2011), "[T]hese activities require a mastery of reading comprehension and written skills, even though the genres and forms of texts that are involved appear relatively new" (p. 35).

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1.1. Theoretical underpinning

The current study draws upon the theory of self-regulated learning to explore how knowledge of metacognitive reading strategies mediates the effects of online social-entertainment and information-seeking activities on reading literacy. Reading is a complex process of cognitive and metacognitive activities to activate prior knowledge, decode symbols, construct the macrostructure of the text, and monitor and coordinate each of the different steps (Anderson, 1984; Garner, 1987; Perfetti, 1985), regardless of forms of texts. Metacognition is the core element in self-regulation and can be categorized into a component of knowledge and a component of regulation (Pintrich & De Groot, 1990; Pintrich, Smith, Garcia, & McKeachie, 1993). Simply put, the knowledge component is the awareness of metacognitive strategies including how students know about their learning, strategy use, and when to use these strategies. The regulation component is how students plan, execute, monitor, fix up, and evaluate their learning (Coiro & Dobler, 2007; Schraw & Sperling Dennison, 1994). Comparing good readers to poor readers, studies showed that the metacognitive skill plays an important role in students' reading (Baker & Brown, 1984). Good readers employed more strategies than poor readers at each of before, during, and after reading stages; several of these strategies are metacognitive strategies, such as setting a reading goal before reading, elaborate to interpret the content of the text during reading, and evaluate and reconstruct the macrostructure of the text after reading (Lau, 2006).

Researchers found that metacognitive strategies such as goal setting, monitoring, and evaluating were found to be influential in reading both printed and electronic texts (Akyel & Erçetin, 2009; Coiro & Dobler, 2007; Winne, 1995). In order to read online electronic texts, people will need good navigation skills (Bilal, 2000), including basic skills such as the control strategies to access and leave the webpages as well as advanced metacognitive strategies such as predicting, monitoring, and synthesizing information across webpages (Tsai, Hsu, & Tsai, 2012; Tsai & Tsai, 2003). The significance of metacognitive strategies was shown to weigh more in reading electronic text, due to the complexity in constructing a self-directed intertext (Coiro & Dobler, 2007). By interviewing 12 sixth grade skilled readers and analysing their reading patterns, Coiro and Dobler (2007) found the metacognitive strategies used in reading printed text are similar to those used to read digital text; nevertheless, the mental model required to construct a self-directed intertext in the cyberspace is much more complex in reading digital text. Specifically, Coiro and Dobler (2007) observed that online skilled readers employed a lot of inferential reasoning strategies to predict the unseen pages and evaluate their online reading progress. In the study investigating the relationship of science information searching with implicit and explicit strategies, Tsai, Hsu et al. (2012) also revealed that the use of metacognitive strategies, particularly evaluation skills, is related with better search outcomes.

Delving into these new features of digital reading, people will find that they are engaged in two distinct categories of online reading activities, namely social networking and entertainment activities and information-seeking activities. Research has shown that information-seeking behaviour (e.g., project-based learning activities to gather information online) resulted in favourable learning performance (ChanLin, 2008) while social entertainment activities such as instant messaging increased the time needed to carry out reading assignments (Bowman, Levine, Waite, & Gendron, 2010; Fox, Rosen, & Crawford, 2009) and were related to poorer reading comprehension and lower GPA (Fox et al., 2009; Jacobsen & Forste, 2011). However, in the literature, there is no explanation for the mechanism that mediates the relationship between the two types of online reading activities and reading literacy as well as academic performance. Moreover, the positive correlation between metacognitive strategies and reading literacy is evident in several studies (Dole, Duffy, Roehler, & Pearson, 1991; Duffy et al., 1987; Jacobs & Paris, 1987; Lau, 2006; Lau & Chan, 2003). Nevertheless, sparse research exists studying the link between online reading activities and metacognitive strategies. As the reading of both printed and electronic texts become one of people's daily habits, the relationship among different online reading activities, knowledge of metacognitive strategies, and reading literacy form the basis for the current study.

1.2. Research hypotheses

The current study intended to explore the effects of social entertainment reading activities and information seeking activities on the performance of reading literacy, as demonstrated by the mediating effect of knowledge of metacognitive strategies. The mediation model was conceptualised in Fig. 1. Recognising that the mediator of metacognitive strategies and reading literacy may be affected by individual differences in socioeconomic resources and gender. We controlled students' socioeconomic status, gender, availability of ICT at home and at school for knowledge of metacognitive strategies and reading literacy in the mediation analysis. First, we posited that better knowledge of metacognitive strategies will predict better reading literacy owing to its positive effect on students' reading or learning outcome in the printed (Dole et al., 1991; Duffy et al., 1987; Jacobs & Paris, 1987; Lau, 2006; Lau & Chan, 2003) and electronic (Coiro & Dobler, 2007; Tsai, Hsu et al., 2012) conditions. Also, we posited that more frequent social entertainment reading activities will predict poorer reading literacy, as demonstrated by Bowman et al. (2010) and Fox et al. (2009) where interruption by online social activities during a reading task increased the amount of time needed to complete the task and may even lead to poor academic performance (Fox et al., 2009; Jacobsen & Forste, 2011). As for the effect of information-seeking activities on reading literacy, we posited that more frequent information-seeking reading activities will predict better reading literacy as in the case of using wiki to promote collaborative writing (Wheeler & Wheeler, 2009) as well as the positive association of the intent to seek information online with in-depth reading and amount of online news consumption (You, Lee, Lee, & Kang, 2012).

Moreover, based on the known relationship of different online activities and reading literacy with knowledge of metacognitive strategies, we hypothesized that knowledge of metacognitive strategies mediate the relationship between social entertainment reading activities and reading literacy; the negative effect of social reading activities on reading literacy results from the negative effect of social reading activities on knowledge of metacognitive strategies. Likewise, we hypothesized that knowledge of metacognitive strategies mediate the relationship between information-seeking reading activities and reading literacy; the positive effect of information-seeking reading activities on reading literacy results from the positive effect of information-seeking reading activities on knowledge of metacognitive strategies. All of the above hypotheses were adjusted for students' socioeconomic status, gender, and availability of ICT at home and at school. Hypotheses for the current study were summarized as follows.

Hypothesis 1. More social entertainment reading activities will predict poorer reading literacy.

Hypothesis 2. More information-seeking reading activities will predict better reading literacy.

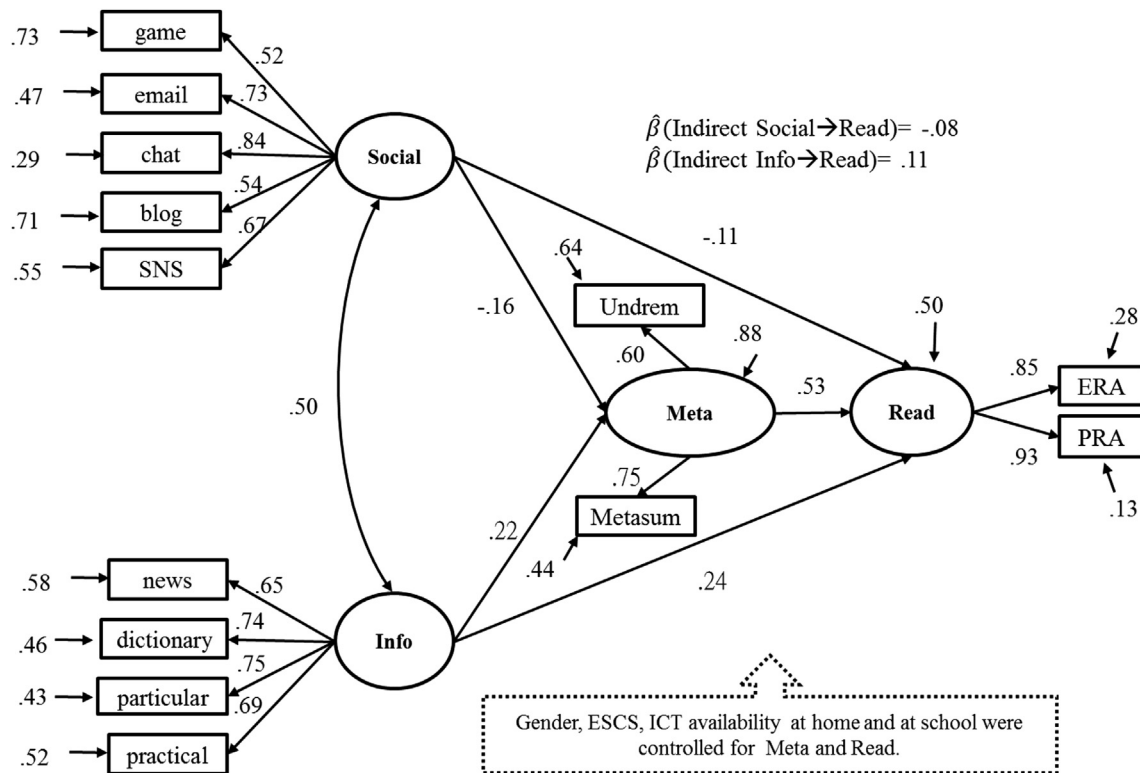


Fig. 1. Illustration of the mediation model with standardised coefficient estimates (RMSEA = .072, SRMR = .075). Social = Social networking and entertaining reading. Game = Online collaborative games. Email = Email use. Chat = Online chats. Blog = Maintain a blog. SNS = Social networking sites. Info = Information-seeking reading activities. News = Online news. Dictionary = Online dictionary. Practical = Search for practical information. Particular = Search for particular topic. Meta = Knowledge of metacognitive strategies. Read = Reading literacy. ERA = Electronic reading assessment. PRA = Printed reading assessment. Metasum = Metacognitive strategy: Index of summarising. Undrem = Metacognitive strategy: Index of understanding and remembering. Gender, ESCS, ICT availability at home and at school were controlled for knowledge of metacognitive strategies and reading literacy.

Hypothesis 3. Better knowledge of metacognitive strategies will predict better reading literacy.

Hypothesis 4. Social entertainment reading activities will have a negative effect on reading literacy through the mediation of knowledge of metacognitive strategies.

Hypothesis 5. Information-seeking reading activities will have a positive effect on reading literacy through the mediation of knowledge of metacognitive strategies.

Due to a scant literature simultaneously included the reading of printed and electronic text in their analysis, the current study used the component of knowledge of metacognitive strategies in the PISA 2009 dataset as the measure for metacognition to investigate its relationship with different types of online reading activities and reading literacy. In 2009, reading is the primary domain of assessment in PISA. The variables measured in PISA 2009 include the frequencies of both social entertainment reading activities and information-seeking activities, the knowledge of metacognitive strategies, and other demographic information; thus, the data were appropriate for use in this study. Social entertainment reading activities included playing collaborative online games, reading email, chatting online (e.g., MSN), maintaining a personal website or blog, and joining discussion forums or virtual communities (e.g., MySpace or Facebook) on social networking sites (SNS). Information-seeking activities consisted of reading online news, consulting an online dictionary or Wikipedia, and searching for a particular topic or practical information using search engines. Correlations between each specific online reading activity, knowledge of metacognitive strategies, and reading literacy measured in both the printed and electronic forms were exhibited in Table 1.

In the following section, a brief discussion of each activity is provided.

1.3. Social entertainment activities

1.3.1. Blogging

Researchers are interested in why and how people read or maintain blogs. Fullwood, Sheehan, and Nicholls (2009) performed a content analysis of MySpace blogs and concluded that blogs were written in the form of diaries and used as emotional or self-expressive outlets, not unlike other forms of blogging. Moreover, younger bloggers (between ages 18 and 29) preferred writing blogs using semiformal language styles, while older bloggers (over 30) used semiformal and formal language styles equally often. In terms of the purposes of maintaining blogs, using exploratory factor analysis with data collected from a sample of 299 ethnically diverse participants (ages 18–70), Hollenbaugh (2011) found that helping and informing, social connection, passing time, exhibitionism, archiving and organising, professionalism, and feedback seeking significantly accounted for people's decisions to keep blogs. In particular, she found that older adults are more likely to use blogs for helping and informing, while younger adults tend to use them for passing time. In addition, women are more likely to use blogs for

Table 1
Means, standard deviations, and correlations for all observed variables.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Collaborative games	–															
2. Read email	.21	–														
3. Chat online	.27	.56	–													
4. Maintain a blog	.11	.29	.31	–												
5. Social network sites	.20	.29	.40	.27	–											
6. Online news	.18	.22	.24	.12	.21	–										
7. Online dictionary	.12	.24	.20	.08	.15	.43	–									
8. Particular topic	.15	.22	.16	.10	.15	.40	.56	–								
9. Practical information	.15	.24	.20	.15	.22	.38	.42	.49	–							
10. Metasum	–.12	.04	.00	–.05	–.02	.05	.14	.09	.08	–						
11. Undrem	–.13	.04	–.02	–.03	–.05	.03	.11	.08	.07	.46	–					
12. ESCS	.03	.19	.14	.03	.11	.12	.19	.15	.16	.17	.15	–				
13. ICTHOME	.20	.32	.32	.16	.19	.16	.14	.14	.17	.03	.03	.41	–			
14. ICTSCHOOL	.07	.15	.13	.03	.11	.03	.07	.07	.06	–.00	–.02	.13	.25	–		
15. ERA	–.07	.08	.01	–.02	.07	.11	.21	.16	.16	.40	.34	.38	.15	.04	–	
16. PRA	–.14	.05	–.04	–.08	.02	.10	.23	.16	.15	.46	.39	.37	.09	.13	.84	–
Means	1.99	2.83	3.10	1.95	2.31	3.22	3.19	3.54	3.12	.01	.03	.09	.09	.14	501.63	500.33
SD	1.15	1.10	1.17	1.18	1.28	1.15	.99	.93	.99	1.00	1.00	.92	.97	.99	97.28	96.24

Note. Metasum = Metacognitive strategy: Index of summarising. Undrem = Metacognitive strategy: Index of understanding and remembering. ICTHOME = ICT availability at home. ICTSCHOOL = ICT availability at school. ERA = Electronic reading assessment. PRA = Printed reading assessment. All correlations are statistically significant at alpha = .05 except Chat online and ICTSCHOOL with Metasum.

archiving and organising, whereas men are more likely to use them for professional purposes. Instead of focussing on the motives for maintaining blogs, Baker and Moore (2011) collected data from 182 bloggers aged 18 to 64 to analyse their blogging styles. Four styles were extracted: therapeutic blogging for affective exchange, substitution of blogging for face-to-face communication, blogging to connect with others, and self-censoring for purposes of self-presentation while blogging.

1.3.2. Collaborative online gaming

Playing collaborative online games is associated with negative outcomes in psychological well-being and academic achievement. For example, in a sample of 170 male junior high school students in Taiwan, Ko, Yen, Chen, Chen, and Yen (2005) found that older age, lower self-esteem, and lower daily life satisfaction levels predicted higher levels of online game addiction. The same result, however, was not found in a corresponding female sample. In terms of academic achievement, Jacobsen and Forste (2011) found the greater video or online game usage predicted lower GPAs. Despite the negative association of online games with life outcomes, researchers (e.g., Childress & Braswell, 2006) provided examples of cooperative learning occurring through collaborative online game playing and suggested that the interaction and increased realism, combined with innovative teaching methods, could form a new way of teaching and learning by addressing critical thinking and problem-solving skills.

1.3.3. Chatting online

Research on the relationship between chatting online, such as instant messaging (IMing), and reading comprehension and academic achievement abounds. Most of these studies centre on the effects of multitasking on students' reading and academic performance. A common scenario is reading or studying while IMing; Fox et al. (2009) found that students who read while IMing took longer to complete the reading task than those who read without the distraction, even though the reading comprehension scores did not differ significantly. The same result was replicated by Bowman et al. (2010). Nevertheless, in an additional analysis on self-reported IM usage, Fox et al. (2009) revealed that students who reported spending more time IMing had lower GPAs and lower reading comprehension scores. The findings were not surprising, because greater frequencies of IMing are positively related to higher levels of distractibility (Levine, Waite, & Bowman, 2007) and greater procrastination of schoolwork (Junco & Cotten, 2011).

1.3.4. Use of social networking sites (SNSs)

Use of SNSs has shown negative associations with academic achievement. Jacobsen and Forste (2011) examined the effects of media use on social and academic outcomes in a sample of 1026 university students. Their results showed that students spent 52 min, on average, per day using SNSs (mostly Facebook) and that the use of SNSs negatively predicted student GPAs and positively predicted face-to-face social interaction (Jacobsen & Forste, 2011). Recognising that over a billion people are connected through SNSs such as Facebook, Cheung, Chiu, and Lee (2011) used a structural equation model to explore why students use Facebook. They discovered that people use Facebook for rapid communication with friends; thus, social presence is the key factor explaining the use of Facebook (Cheung et al., 2011). Madge, Meek, Wellens, and Hooley (2009) also found Facebook are used mainly for socialising. Nevertheless, Selwyn (2009) analyse Facebook walls of an education-related interaction and discovered that Facebook serves as a platform beyond socialising and has the functions of sharing university experiences, exchange practical information, exchange of academic information, display of supplication and/or disengagement, and exchange of humour or nonsense. The prevalence of Facebook also prompted researchers to investigate how Facebook could be used for educational purposes. Specifically, Mazman and Usluel (2010) revealed that 50% of the variance in using Facebook for educational purposes (i.e., Factor 1 included communication, collaboration, and resource sharing) can be accounted for when placing Facebook use (Factor 2) indirectly and user purpose directly (Factor 3) in a structural equation model. Among the eight indicators that form the two explanatory factors (Factor 2 & Factor 3), usefulness had the greatest impact on adoption, and social relations impacted purpose the most.

1.3.5. Reading email

Email has been widely used as an extension of instructional media because it is easily accessible, cost effective, and promotes student–student and student–instructor interactions in a natural context. Studies show that reading and writing emails have positive links to student outcomes (Doherty & Mayer, 2011; Yu & Yu, 2002). For example, in Doherty and Mayer's study (2011), emails were exchanged among students and the teaching team in the Positive Links between Universities and Schools (PLUS) Project, which took place as a 2-h lab session for 8 weeks; emails were sent either as broadcast messages or individualised messages. The results were improved teacher–student relationships, along with enhanced critical literacy, among a group of Australian indigenous middle school students. In addition, email has been widely used for educational purposes, such as in paired international “key pal” relationships for reading and writing instruction in ESL classrooms (Mahfouz, 2010; Vinagre, 2005). However, unless specially designed for learning purpose, email use is primarily for everyday social connection and interaction.

1.4. Information-seeking activities

1.4.1. Online dictionaries

People's cognitive loads are subject to limited space in working memory (Sweller, 2010; Sweller, Van Merriënboer, & Paas, 1998). Consulting an online dictionary or encyclopaedia, such as Wikipedia[®], and reducing the cognitive load caused by extraneous disturbances from unfamiliar vocabulary, can be seen as a scaffolding strategy used to ease cognitive demands and provide the support needed to understand a text. In Liu and Lin's study (2011), vocabulary improvement was the highest among those who used the pop-up dictionary in the electronic condition, compared to the type-in or paper-format dictionaries. However, another study found reading comprehension did not differ in the electronic and paper-format dictionary conditions despite that students in the electronic condition approached dictionaries more often than their counterparts (Grimshaw, Dungworth, McKnight, & Morris, 2007).

1.4.2. Reading online news

Tewksbury and Althaus (2000) compared the readers of printed and online versions of newspapers and found that the topics covered in online newspapers were broader than those in the printed versions because of the lack of space limitations. Readers of online versions can find related news topics and extend their reading through hyperlinks. You et al. (2012) further examined the relationship of the amount of online news consumption with reading motivation and behaviour; the authors found the motivation to seek information positively predicted people's in-depth reading behaviour, which in turn predicted the amount of online newspaper reading measured in terms of total time used and number of pages visited. Nevertheless, researchers in the Netherlands (D'Haenens, Jankowski, & Heuvelman, 2004) revealed that news consumption was dependent upon the news categories, reader gender, and reader interest. For example, national news was more freely recalled, regardless of print or online format. Female readers recalled significantly more national news stories than men from both print and online newspapers.

1.4.3. Searching for particular topics or practical information

Searching online for a particular topic or for practical information involves a sequence of decision making and use of metacognitive processes, which requires comprehension, integration, reflection, and evaluation of the text. As Willson (2000) noted, information seeking is “the purposive seeking for information as a consequence of a need to satisfy some goal” (p. 49). Individual information-seeking behaviour proliferated by the prevalence of ICT (Bilal, 2000). In the post-secondary education setting, Tsai, Liang, Hou, and Tsai (2012) found college students had better information search strategies in searching for practical information than for study purpose. Particularly, male students may have the disorientation problems when searching for practical information while female students had better control strategies and information evaluative strategies in searching practical information.

Review of literature demonstrated the diverse nature of social entertainment reading activities and information-seeking activities. In the following section, we reported our method in investigating the mediating effect of knowledge of metacognitive strategies between different online reading activities and reading literacy in the hypothesized model.

2. Method

2.1. Sample

Participants were drawn from the PISA 2009 dataset. PISA 2009 data were obtained using a two-stage stratified sampling scheme. In the first stage, schools were selected with probabilities proportionate to their sizes, measured by the number of 15-year-old students within the schools, from a sampling frame of a comprehensive national list of schools. At least 15 schools were chosen for each country. In the second stage, a random sample of 35 students was selected from each of the participating schools.

Nineteen countries and regions participated in the PISA 2009 Electronic Reading Assessment (ERA). Only OECD countries with available ICT familiarity components were used in the current study. The remaining countries and regions included in this study were Australia, Austria, Belgium, Chile, Denmark, Hungary, Iceland, Ireland, Japan, Korea, New Zealand, Norway, Poland, Spain, and Sweden. The resulting sample consisted of 87,735 students, with nearly equal proportions of boys (50.2%) and girls (49.8%).

2.2. Materials and instruments

Two questionnaires were required for all countries and economies. Students completed a 30-min questionnaire to provide information about themselves and their households. School principals or administrators answered a 20-min questionnaire about their schools. An international option was the questionnaire of ICT familiarity components which assess students' attitude towards ICT as well as availability of ICT at home and at school and use of ICT facilities for different purposes at home and at school.

2.2.1. Printed reading assessment (PRA) and electronic reading assessment (ERA)

In 2009, the PISA reading framework started to include ERA besides the original PRA. The PISA reading literacy is assessed in terms of text format, reading process, and situations. Text format contains continuous texts and non-continuous texts. Continuous texts are organised hierarchically (sentences, paragraphs, sections, chapters, and so on). Examples of non-continuous texts include lists, tables, graphs, diagrams, advertisements, and schedules. Reading process evaluates students' ability in information accessing and retrieving, integrating and interpreting, as well as reflecting and evaluating on different situations that are defined as specific uses for constructing the text, such as a personal letter, a public announcement, or a textbook. The current study used the combined scale reading score to evaluate overall reading literacy. In the current sample, the average score for PRA was 500, with a standard deviation of 96.

ERA is not just the electronic version of PRA. ERA simulates the online reading environment that requires students to access and locate desired information, integrate information from multiple webpages, and reflect and evaluate the webpage content. Students received different sets of tasks drawn from a pool of 29 digital reading tasks, which were organised into three 20-min clusters. Each student was administered two of the clusters (in sum, a 40-min test) for the ERA. Before the test, there was a 10-min section consisting of orientation and practice questions. The scores on the ERAs and PRAs were equated with the means of the countries or regions so that the results could be compared. The average score in the current sample was 501, with a standard deviation of 97. Due to the high correlation between PRA and ERA, we used PRA and ERA as indicators to construct a latent factor for reading literacy using confirmatory factor analysis (CFA) in the overall mediation model (shown in Fig. 1). The standardised factor loadings were .85 for ERA and .93 for PRA.

2.2.2. Engagement in online reading activities

Nine items from the student and ICT familiarity component questionnaires formed two genres of online reading activities using CFA. The responses were coded in terms of frequency of engagement in each activity. All factor loadings were statistically significant. The magnitude of the standardised coefficient ranged from .52 to .84. The social entertainment reading activities consisted of collaborative online gaming, reading email, chatting online, blogging, and use of SNSs ($\alpha = .67$). The information-seeking reading activities consisted of reading online news, using online dictionary, searching for practical information, and searching for a particular topic ($\alpha = .76$).

2.2.3. Knowledge of metacognitive strategies

Two indices of metacognitive strategy variables were included in the PISA 2009 dataset. One is the index of summarising (Metasum), and the other is the index of understanding and remembering (Undrem). Each index contains several strategies. Students rated each strategy according to its usefulness. Scoring of the index was based on the extent to which the students' ratings agreed with expert ratings. Higher values on the indices represented greater perceptions of the strategy use. Sample items for the index of summarising include "I write a summary; then, I check that each paragraph is covered in the summary because the content of each paragraph should be included," and "I read through the text, underlining the most important sentences, and then I write them in my own words as a summary." Sample items for the index of Undrem are "I concentrate on the parts of the text that are easy to understand" and "I summarise the text in my own words." We used Metasum and Undrem as indicators for the latent construct of knowledge of metacognitive strategies ($\alpha = .63$). The standardised factor loadings were .60 for Undrem and .75 for Metasum (shown in Fig. 1).

2.2.4. Controlled variables

The analysis and interpretation of the results controlled for respondents' socioeconomic statuses (ESCS), genders, and ICT resource availabilities, both at home and at school.

2.3. Data analysis

The mediation analysis (MacKinnon, 2008) was performed using Mplus 6.11 (Muthén & Muthén, 2010). We conducted the Sobel test (1982) to investigate the indirect effects of social entertainment and information seeking reading activities on reading literacy through knowledge of metacognitive strategies (Krull & MacKinnon, 1999, 2001). We followed the data analysis procedure suggested in OECD (2009), using replicate weights and plausible values to prevent biased population parameter estimates and to approximate each individual's true score and ability while still preserving the two-stage stratified sampling scheme. Although the model fit chi-square test and related model fit indices are not available with analyses employing replicate weights, we used RMSEA (Root Mean Square Error of Approximation, Steiger, 1998) and SRMR (Standardised Root Mean Square Residual) to evaluate the appropriateness of the hypothesized model along with variance explained and standardised regression coefficients to show practical significance of the mediator. The variance explained statistic, or R^2 , is an effect size measure for the overall mediation model (Fairchild, MacKinnon, Taborga, & Taylor, 2009) to evaluate the proportion of variance in the overall model with or without the mediator and to avoid a spurious effect due to large sample size. In addition, we also used the standardised coefficient as an effect size measure for the indirect effects. According to Kenny (2012), the magnitude of .01, .09, and .25 for standardised coefficients of indirect effects corresponded to small, medium, and large effect because indirect effects are calculated as the product of two r s (effects or standardised coefficients). The R^2 change of reading literacy and BIC change (Raftery, 1995) of model with/without mediator (i.e., knowledge of metacognitive strategies) are provided as the statistical evidence to support our proposed mediation model.

3. Results

Table 1 presented the means, SDs, and correlations among the observed variables. All study variables were statistically significantly correlated with one another except chat online and availability of ICT at school with index of summarising. The mediation analysis showed an adequate model fit (RMSEA = .072, SRMR = .075), based on commonly used criteria (Hu & Bentler, 1998). We reported both the standardised and unstandardised path coefficients in Table 2 and interpreted the analysis result in terms of standardised coefficients, so that the coefficients can be compared on the same metric.

Table 2
Standardised and unstandardised coefficients in the mediation model.

Paths	$\hat{\beta}$	\hat{b}	SE	<i>p</i>
Controlled variables				
ESCS → Meta	.210	.175	.007	<.01
Male → Meta	-.211	-.313	.013	<.01
ICTHOME → Meta	-.011	-.008	.007	.21
ICTSCH → Meta	-.005	-.004	.006	.58
ESCS → Read	.262	25.813	.702	<.01
Male → Read	-.065	-11.412	1.386	<.01
ICTHOME → Read	-.034	-3.009	.589	<.01
ICTSCH → Read	.013	1.060	.579	.07
Direct effects				
Social → Meta	-.156	-.193	.013	<.01
Information → Meta	.216	.198	.008	<.01
Social → Read	-.109	26.311	.914	<.01
Information → Read	.242	-16.018	1.388	<.01
Meta → Read	.528	62.362	1.193	<.01
Indirect effects				
Social → Meta → Read	-.082	-12.056	.818	<.01
Information → Meta → Read	.114	12.363	.534	<.01

Note. $\hat{\beta}$ denotes the standardised coefficient estimates; \hat{b} denotes the unstandardised coefficient estimates. The indirect effects are calculated using Sobel test with delta SE.

3.1. The controlled variable

Table 2 presented the standardised and unstandardised coefficients for the controlled variables. Gender and ESCS were associated with metacognitive strategies and reading literacy. Girls reported better metacognitive strategies ($\beta = -.211, p < .01$) and also higher reading literacy than the boys ($\beta = -.065, p < .01$). Students with higher socioeconomic statuses reported better knowledge of metacognitive strategies ($\beta = .210, p < .01$) and demonstrated higher reading literacy ($\beta = .262, p < .01$). ICT availability at home had a negative impact on reading literacy ($\beta = -.034, p < .01$) but was not related with knowledge of metacognitive strategies ($\beta = -.011, p = .21$). ICT availability at school had no effect on knowledge of metacognitive strategies ($\beta = -.005, p = .58$) as well as reading literacy ($\beta = .013, p = .07$).

3.2. The mediation model

3.2.1. Direct effects

The social entertainment factor negatively predicted knowledge of metacognitive strategies ($\beta = -.156, p < .01$) and reading literacy ($\beta = -.109, p < .01$), while the information seeking factor positively predicted knowledge of metacognitive strategies ($\beta = .216, p < .01$) and reading literacy ($\beta = .242, p < .01$). Knowledge of metacognitive strategies also had positive direct effects on reading literacy ($\beta = .528, p < .01$); for every one SD increase in knowledge of metacognitive strategies, reading literacy increased .528 SDs holding other variables constant.

3.2.2. Indirect effects

Of interest to us were the mediating effects of the perceived usefulness of metacognitive strategies on reading literacy, in relation to the two genres of online reading activities. As hypothesized social entertainment reading activities had a negative indirect effect on reading literacy ($\beta = -.082, p < .01$) while information-seeking reading activities had a positive indirect effect on reading literacy ($\beta = .114, p < .01$). The magnitude of the two significant indirect effects corresponded to a medium effect size according to Kenny (2012). The variance explained, or R^2 , on reading literacy was 26% without knowledge of metacognitive strategies as mediator in the overall model. The variance explained on reading literacy was 50% (i.e., increased by 24%) when knowledge of metacognitive strategies was included as mediator in the overall model. The BIC change was 16,089 (larger than 10), which indicated the mediation model was much better than the one without hypothesized indirect effects.

4. Discussion

Many studies have examined the relationships between students' online reading activities and their reading comprehension abilities (Bowman et al., 2010; Fox et al., 2009; Grimshaw et al., 2007; Lee & Wu, 2012). However, those studies failed to explain the mechanisms that lead to the differences in reading, and oftentimes the reading assessment occurs only in a printed format. The current study divided online reading activities into social entertainment and information seeking activities and controlled for students' genders, socioeconomic statuses, and ICT availability, both at home and at school to explore the effects of different online reading activities on reading literacy and the mediating role of knowledge of metacognitive strategies. All research hypotheses were supported by the study results. The current study found that knowledge of metacognitive strategies helps to explain why information seeking and social entertainment reading activities can lead to different outcomes, as demonstrated by reading literacy scores. When people more frequently engage in information seeking reading activities, they obtain a more positive perception of the usefulness of metacognitive strategies, in turn leading to better reading scores. On the other hand, when more often engaged in social entertainment activities, individuals develop poorer perceptions of the usefulness of metacognitive strategies, which in turn lead to poorer reading literacy.

By dividing online reading activities into different genres, we obtained a clearer picture how different genres of activities impact the knowledge of metacognitive strategies and reading literacy differently, adjusting for the influence of gender, SES, and ICT resource at home

and school. When engaged in information seeking activities, students set a goal regarding the target information, they may consciously or unconsciously monitor the paths of their searches, evaluate the relevance of the information found, integrate that information, and predict and decide what to click next. The active self-regulatory and evaluative processes foster positive perceived usefulness of their metacognitive strategies. But why will this process lead to the increase of knowledge of metacognitive strategies? The possible reason may be because the more students are engaged in information-seeking activities, the more they will be aware of the metacognitive strategies that are useful to construct a self-directed intertext on the Internet efficiently and effectively. Students may then re-apply those useful strategies whenever they perform information-seeking activities online. By so doing, students' knowledge of metacognitive strategies may become better, which in turn further enhance their reading literacy. In contrast, when engaged in social entertainment activities, students usually "wander" about on the web or browse social networking sites without a specific purpose, or perhaps simply to pass time. The necessity in knowledge of metacognitive strategies might be reduced when students are engaged in unstructured social entertainment activities.

Metacognitive strategies are key components of successful reading. Our findings are consistent with prior studies (Boulware-Gooden, Carreker, Thornhill, & Joshi, 2007; Spörer, Brunstein, & Kieschke, 2009) in that better knowledge of metacognitive strategies predicted better performance on reading assessments. The study by Tsai, Hsu et al. (2012) also suggested metacognitive strategies better predicted students' cognitive outcome than other explicit strategies, such as numbers of pages visited, keywords entered, or depth of webpage explored, in an online search context. Kuhn (2000) noted that "Enhancing (a) metacognitive awareness of what one believes and how one knows and (b) metastrategic control in application of the strategies that process new information is an important developmental and educational goal" (p. 178). Besides the basic skills in accessing and retrieving reading information, educators and classroom teachers could apply greater effort towards instruction on strategies of monitoring, evaluating, and integrating not only in offline reading but online reading environments in order to foster effective strategies during the reading process.

As for the controlled variables, we found that students' genders and ESCSs were associated with their reading literacy scores and metacognitive strategies. Students of higher socioeconomic status had better learning outcomes (Luu & Freeman, 2011; Wang, 1993) and better metacognitive strategies (Wang, 1993; Yilmaz-Tüzün & Topçu, 2009). Consistent with prior research (Chiu & McBride-Chang, 2006; Guiso, Monte, Sapienza, & Zingales, 2008), girls outperformed boys in reading. Our findings also reconfirmed the availability of ICT at home has a negative direct association with reading literacy while ICT availability at school has no effect on reading literacy with different samples (Lee & Wu, 2012). To ensure students are reading or learning online, the availability of ICT at home or school should accompany appropriate guidance to encourage students engaging in more information-seeking activities, so as to facilitate metacognitive skills, and then enhance reading literacy.

5. Conclusion

This study sought an explanation as to why different genres of online reading activities have distinct effects on reading literacy, using a general trend analysis of high quality large-scale data. We found that knowledge of metacognitive strategies mediated the effects of different genres of online reading activities on reading literacy, with theoretical support and both practical and statistical significance. We also controlled the effect of gender, socioeconomic status, and ICT availability at home and at school in this study and found gender and socioeconomic status had a differential impact on knowledge of metacognitive strategies and reading literacy.

The importance of reading cannot be emphasized more. Reading literacy is the stepping stone to acquiring knowledge, participating in the society, and understanding the world. Although students' gender and socioeconomic backgrounds cannot be changed or manipulated, the study implies that practitioners, educators, and stakeholders in education can guide students to engage in more online information-seeking reading activities, improve and incorporate instruction of metacognitive strategies for both online and offline reading, and enhance students' knowledge of metacognitive strategies, thereby improving students' reading literacy in both printed and digital formats. However, the study should be interpreted in light of limitations. The direct effect of different genres of online activities on reading literacy were statistically significantly along with the indirect effect, indicating that knowledge of metacognitive strategies partially mediated the relationship between different types of online activities and reading literacy. As students are taking more time engaging in online reading activities, finding other factors for successful and meaningful reading warrants future research so that students can be provided with adequate interventions or support and guidance to facilitate their reading.

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