採 2009 PISA 資料，探索社交性與訊息搜尋性線上閱讀活動對紙本文本與電子文本閱讀素養的影響：以學習策略為中介

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摘要

隨著科技與網路的普及，學生的閱讀型態改變，電子文本的閱讀幾乎成了學生生活的一部份。因此，學生的電子文本閱讀素養也越來越受到重視。為了更進一步了解影響學生紙本與電子文本閱讀素養之因素，本研究提出一中介模型，探究學生對後設認知策略有效性的覺察、自陳學習策略的使用情形以及導航技巧，是否中介其在訊息搜尋性與社交性的線上閱讀活動投入程度與紙本和電子文本閱讀素養間的關係。此外，中介變相間的淨相關也納入分析，冀對本研究之研究問題提供更多訊息。

本研究之樣本來自 2009 年的國際學生評量計畫 (Programme for International Student Assessment ,PISA) 所建立之跨國大型資料庫，選取參與電子文本施測的 19 個國家或地區(韓國、日本、澳洲、香港、紐西蘭、澳門、愛爾蘭、冰島、瑞典、挪威、比利時、丹麥、法國、西班牙、波蘭、匈牙利、奧地利、智利與哥倫比亞) ，15 歲的學生樣本共 34104 位，其中女生有 17087 位，男生則為 17017 位。

研究結果顯示，透過學生對後設認知策略有效性的覺察和學生的導航技巧，訊息搜尋性的線上閱讀活動對學生的紙本與電子文本有正向影響;反之，社交性線上閱讀活動的影響為負向或沒有影響。至於學生自陳之學習策略使用情形，在模型中則扮演抑制變項的角色，若將它納入模型中，則可增加整體模型的解釋變異量，且可促進後設認知有效性的覺察對兩種閱讀素養的影響。換言之，教師與家長應鼓勵學生多透入於訊息搜尋性的線上閱讀活動，並引導其彈性運用學生的後設認知策略、學習策略，以及導航策略，以進一步促進其在紙本與電子文本上的閱讀表現。

關鍵字： PISA(國際學生評量計畫)、訊息搜尋性線上閱讀、社交性線上閱讀、紙本閱讀素養、電子文本閱讀素養、後設認知策略、學習策略、導航技巧

The Mediation Effects of Strategies on Online Information-Seeking and Social Reading Activities to Printed and Digital PISA Reading Literacy

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ABSTRACT

With the prevalence of Information and Communications Technologies (ICT) and Internet, electronic reading media have become an important reading resource and students' electronic reading literacy have received more and more emphasis. In this study, a mediation model was proposed to investigate the effects of information-seeking and social online reading engagement on printed and electronic reading literacies, via students' perceived usefulness of metacognitive strategies, self-report learning strategies use and navigation skills. Moreover, the partial correlations among mediators were also discussed.

In order to verify the mediation model, The Programme for International Student Assessment (PISA) 2009 data was used and the samples were 34104 fifteen years old students from 19 countries and areas (17087 females and 17017 males from Korea, Japan, Australia, Hong Kong-China, New Zealand, Macao-China, Ireland, Iceland, Sweden, Norway, Belgium, Denmark, France, Spain, Poland, Hungary, Austria, Chile, and Colombia). The results showed that, through perceived usefulness of metacognitive strategies and navigation skills, the information-seeking reading engagement had positive effects on students' printed and electronic literacies, whereas the social reading engagement had negative or weak effects on outcomes. As for students' self-report learning strategies use, it played a role as a suppressor. It could enhance the overall multiple r^2 of outcomes and increased the effect of students' metacognitive strategies on printed and electronic reading literacies with its inclusion in the model.

In sum, this study concluded that students' information-seeking engagement, metacognitive strategies, learning strategies and navigation skills use were helpful for students' printed and electronic reading literacies. Students' should be encouraged to engaged in information-seeking reading activities, and teachers should teach and guide students to use cognitive and metacognitive reading strategies in educational settings.

Keyword: The Programme for International Student Assessment (PISA), printed reading literacy, electronic reading literacy, information-seeking reading activities, social reading activities, metacognitive strategies, learning strategies, navigation skills

誌 謝

我認為，我這輩子最正確的決定，應該就是念了交大。進到交大後，雖是短短的兩年，但我卻是帶著滿滿的收穫離開！

在這兩年中，我最感謝的是我的論文指導教授-俊育老師，老師認為，學生被允許犯學習上的錯誤，但應該要多問多學，避免再次犯錯，因此，在學習的過程中，即使我問了很笨的問題，俊育老師總是能以最大的包容與耐心來指導我，其深入淺出的講解統計概念，不但澄清我的統計迷思，也增強了我的統計自我效能，讓我的統計突飛猛進，這真的是我意料之外的收穫！此外，元萱老師也給予我相當大的幫助與支持，在我論文撰寫期間，俊育老師和元萱老師不厭其煩地修改我奇怪的英文文法，指導我論文撰寫技巧，在我學習感到挫敗與沮喪時，與我分享他們的經驗，並鼓勵我，給我正增強，讓我撰寫論文的過程中，學習的快樂大於痛苦，他們真的是最棒的 advisors，我對他們的感謝，已超出我拙劣的文字表達能力可描述的程度！

在學習上，我也要感謝珊如老師和奕蘭老師，兩位老師常常帶領學生們深入探究心理學的領域，並要我們在學習別人的經驗時，仍保有自己的獨立思考與批判，這些，都為我們日後的獨立學習與論文撰寫打下堅固的基礎；而在論文指導上，我也要感謝我的兩位口試委員，獻元老師與珊如老師，兩位老師給我許多具體詳盡的建議，澄清了我論文撰寫上的一些盲點，也使我的論文更加完整。

在統計的學習上，除了老師們，我也要感謝幾位的學長姐們，妤貞學姊、肇盛學長、慧慈學姊、祈延學長和志鴻學長，真的非常感謝他們在統計上給我的建議、澄清與幫助，使我在學習統計的過程中， 減少了許多困惑與痛苦，讓我覺得原來學習統計與討論統計其實是一件快樂的事！

當然，在我這段快樂的研究所學習旅程中，還要感恩的，是我那一群很棒的朋友與學弟妹。羽恬、馨沂、晨寧、韻茹、欣純、凱昱和建宏的陪伴與包容，使我研究生生涯總是充滿笑聲，並得補充正向積極的能量，以面對下一次的困難與挑戰，姿螢總是很有義氣的要我寫自己的論文，把工作留給她，讓我感到窩心；秦嘉、孟婷、正哲與馨方的關心，也讓我在寫論文時備感溫暖，

最後，感謝我的父母與姊妹們與弟弟，總是以開放的態度面對我所有的抉擇，即使，在別人眼中，當時年近三十的我應該努力找工作，而非全職念書，但他們的無條件鼓勵與支持，讓我這兩年來得以全力衝刺學習，並在最後獲得豐收的果實！

彭雅君　謹誌

民國一０一年七月

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Chapter 1 **Introduction**

Reading is the heart of learning and the source of wisdom. By reading, you can satisfy your curiosity to the world and accumulate the experience of ancestors without limitation of space and time. Thus, students' reading performance was regarded as basic, but an important index of the students' abilities and the efficacy of education system. With the emerging of Information and Communications Technologies (ICT), the notion of literacy toady has been expanded to "learn, comprehend, and interact with technology in a meaningful way." (Pianfetti, 2001). The educational researchers, teachers and the educational authorities of many countries had done lots of efforts to find out the crucial factors which affected students' reading performances and established reading promoting policies to improve students' reading performances. However, most of the studies and policies focused on the effect of outer factors, such as the school/home reading resources, ICT availability or the quantity of books to be read, but ignored the effects of cognition-related factors and digital reading skill, such as metacognitive strategies, elaboration strategies, and navigation skill on students' reading abilities.

In the current study, we assumed that, through the processes of cognitive and metacognitive strategies use, students' online reading engagements impact students' printed and electronic reading literacies significantly. Thus, a mediation model was proposed to depict the indirect effects of two types of online reading activities (i.e. information seeking and social reading activities) on students' printed and digital reading literacies, with self-report cognitive strategies use, perceived usefulness of metacognitive strategies and navigation skills as mediators. Selected 2009 PISA data was used to investigate the relationships mentioned above. Regarding to the research

motivation, the purpose of the research and the framework of research were introduced in the following sections.

1.1. Research Motivation

Reading is critical to students, because it is the basis of learning. According to Chall's (1995) model of reading development, the reading development could be divided into six stages. The first three stages described the phase of "learning to read", which meant that students learned and developed their ability of how to read. At this phase, students learned the alphabet, the construct of sounds, word recognition, words reading, spelling, and other basic reading skills to prepare for the next phase. The next phase called "reading to learn" comprised last three stages. At this phase, students had to make use of the reading skills to absorb new knowledge, connected with their prior knowledge, develop the abilities of information and critical thinking, as well as other advanced reading strategies. As students learned how to read and knew how to read for learning, they would start to fetch the interested reading materials and wouldn't solely depend on the materials provided by knowledge givers. They could read by themselves and read for themselves. By means of the reading, students could read a lot of learning materials from different areas to broaden their horizons, or read a lot of materials from a specialized domain to improve the depth of learning and thinking. In other words, students' growing reading abilities gain themselves the power and the autonomy to build and rule their own world of knowledge.

Because of the essential status of reading, some cross-national large assessments, such as the Progress in International Reading Literacy Study (PIRLS) and the Programme for International Student Assessment (PISA) attracted more and more attention. Based on the results of these international assessments, the participating

countries could gain a better understanding of their students' reading performance, as well as check the efficacy of their educational system. Therefore, an increasing number of countries participated in these assessments gradually, and Taiwan had no exception. Taiwan joined in PIRLS since 2006 and participated in PISA in 2006, 2009, and 2012. In terms of 2006 PIRLS, Taiwan was ranked the twenty second of forty-five participating countries, and in 2009 PISA, Taiwan students' average reading performances were ranked twenty third among sixty-five participants. The results of these international assessments really shocked our education authority and also confused the educational researchers and teachers. We valued "Reading" highly, and since 2001, a series of policies were executed to promote students' reading abilities. For example, the national program of children's reading promotion proposed starting from 2001, focused on the construction of better reading environment, and the increase of higher reading engagement. Bounded reading resources and the instruction of reading ability were provided for the students. Moreover, in 2004, the Ministry of Education proposed the "Focus 300-the program of elementary school students' reading promotion" to further improve the reading environments of 300 focusing schools which were lack of cultural and social resources. As the result, teachers followed these policies, they bought a lot of books, asked students to read a lot of books, assigned reading report as homework and rewarded the students who read a large number of books.

However, the results of PIRLS and PISA assessment told us that what we have done for several years seemed to be insufficient. We put lots of efforts to improve the outer states of reading, but lack of interest in examining the inner states of reading and the process of reading. In recent years, considerable concern has been arisen over the effects of reading process and the use of reading strategies on reading performances

(Akyel & Erçetin, 2009; Bråten & Strømsø, 2011; Chiu, Chow, & Mcbride-Chang, 2007; Jairam & Kiewra, 2010; Koch, 2001; Lau & Chan, 2003; OECD, 2010; Souvignier & Mokhlesgerami, 2006; Swalander & Taube, 2007; Vidal-Abarca, Mañá, & Gil, 2010). The practice of learning strategies has been shown to improve students' reading performance and helped students learning effectively(Jairam & Kiewra, 2010; Vidal-Abarca et al., 2010; Zimmerman, 1990, 1995, 2002, 2008). Furthermore, the metacognitive strategies were used to monitor and regulate the whole reading and leaning process(Vidal-Abarca et al., 2010; Zimmerman, 1990, 1995, 2002, 2008). By means of these cognitive and metacognitive strategies, students could read and learn autonomously and effectively.

Thus, in this study, we didn't pay attention to the outer crucial factors to students' reading performance of how many books they read, but the inner factors of what skill they used in reading instead. Thus, we addressed the inner effects of three learning strategies (memorization, elaboration, and control strategies) and two metacognitive strategies (perceived usefulness of summarization, understanding and memorization strategies) on students' reading literacies.

In addition, with the convenience of technology and the universal use of Internet access, the Information and Communication Technologies (ICTs), such as Facebook, Wikipedia, MSN and blogs, were carried out to be a new kind of reading engagement. Digital/electronic text which was used in the online reading activities had become a new reading material. These online reading activities have been part of our lives and even been used as the platforms for teaching. Students' reading style and reading habits have changed. Instead of reading printed books, students spend more and more time on chatting online, reading online and searching the information they need with online searching engines. The online reading activities and resources expand the

definition of “reading literacy” from “reading and writing” to “reading, writing, learning and interacting with technology in a meaningful way.”(Pianfetti, 2001) The reading researchers also pay close attention to the new reading literacy. Some studies showed that students’ reading outcomes could be improved, when the knowledge providers use chat room, MSN, wiki or searching engine as platforms for teaching. However, did the ICTs (especially the social online reading activities) still positively affect students’ reading performance, as these ICTs were not used for teaching? This is an important issue that parents and teachers concern about as well. And there were some research showed that heavy internet engagement (especially spending time in chat room, online games, Bulletin Board Systems (BBS) and e-mail) had negative effects on students’ academic performance (Chou, Condron, & Belland, 2005; Chou & Hsiao, 2000; Kubey, Lavin, & Barrows, 2001; Lin & Tsai, 2002; Lin & Tsai, 1999). Therefore, I supposed that the nature and types of the online activities were one of the important factors which influence students’ reading performances. As a result, I divided the online reading activities into social and information seeking online reading activities and investigated the effects of these two types of online reading activities on students’ reading skills and reading literacy.

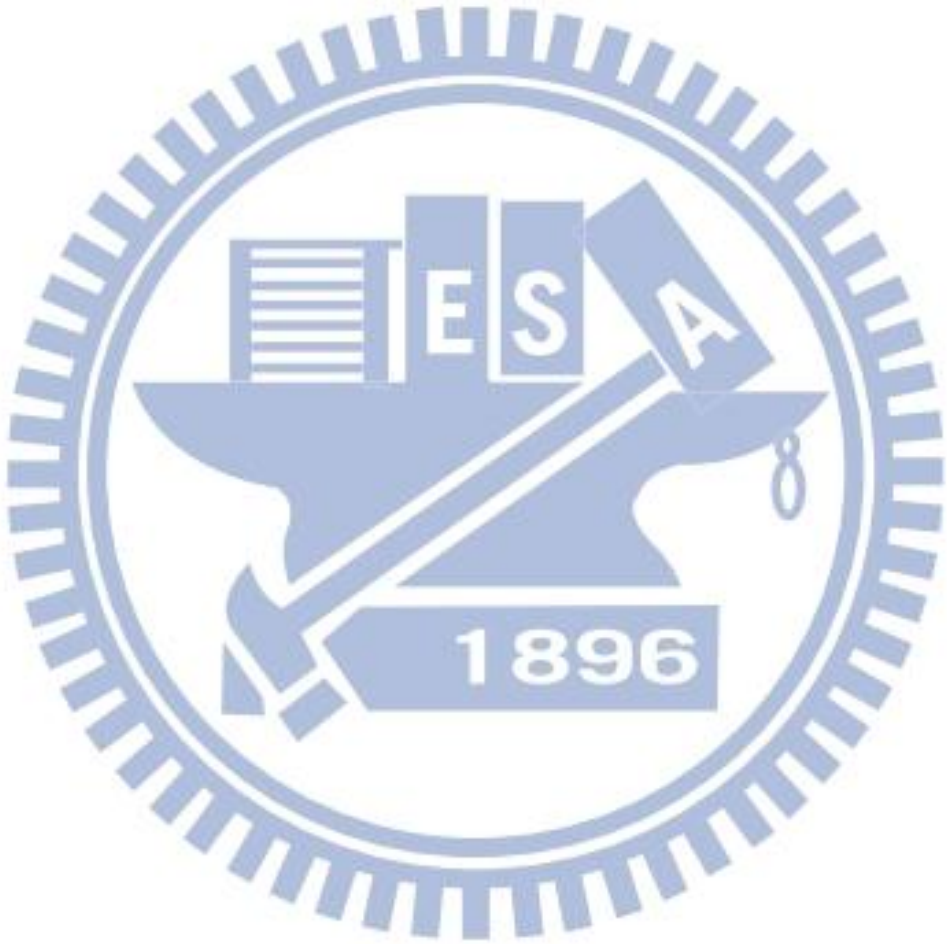
In addition, owing to nonlinear characteristic of digital text (e.g. hypertext), besides the reading strategies mentioned previously, the critical new reading strategies, navigation strategies, should receive more emphasis. Because in the digital reading environment, readers had to know where they were and how to get the meaningful information they needed when surfing the website, so that they required navigation strategies along with the metacognitive skills to direct their reading journey to get good comprehension and monitor their process of online reading.

Taiwan will join the digital reading assessments in the session of PISA 2012 assessment. The results of the mediation models based on the PISA 2009 data of nineteen countries and economics may provide some new ideas and guidelines to advance our students' reading ability and performance. Therefore, we investigate how the relationships between the engagement of two types of online reading activities (social online reading activities and information seeking online reading activities) and two types of reading literacies (printed reading and digital reading) were mediated by the inner crucial factors, that is, cognitive strategies, metacognitive strategies and navigation strategies.

1.2. Purpose of the research

The purpose of the research was to examine the relationships among the frequencies of two online reading activities (social online reading activities and information seeking online activities), reading and learning strategies (cognitive and metacognitive strategies), navigation skills and two reading literacies performance outcomes. A structural equation model (SEM) was proposed to identify the mediation effect of cognitive strategies, metacognitive strategies and navigation strategies. In addition, we used PISA 2009 data to verify the mediation model to see whether the model could be used cross countries and cultures. The framework of this study was shown in Figure 1.1. According to the research about reading, students' economic, social and culture status (ESCS) and gender have great effects on reading outcomes. In the study, I focused on the effects of cognition-related factors and students' online reading engagement on reading performance, thus, the effects of gender and ESCS on mediators and dependent variables have to be controlled. So that we hypothesized that, while controlling for the effect of gender and SES, the information seeking reading

engagement would improve navigation strategies and parts of reading strategies, and students' reading and navigation abilities could then affect students' printed and digital reading performances. Systematic literature reviews were organized in Chapter Two, and the detailed research hypotheses and research methods would be addressed in Chapter Three.



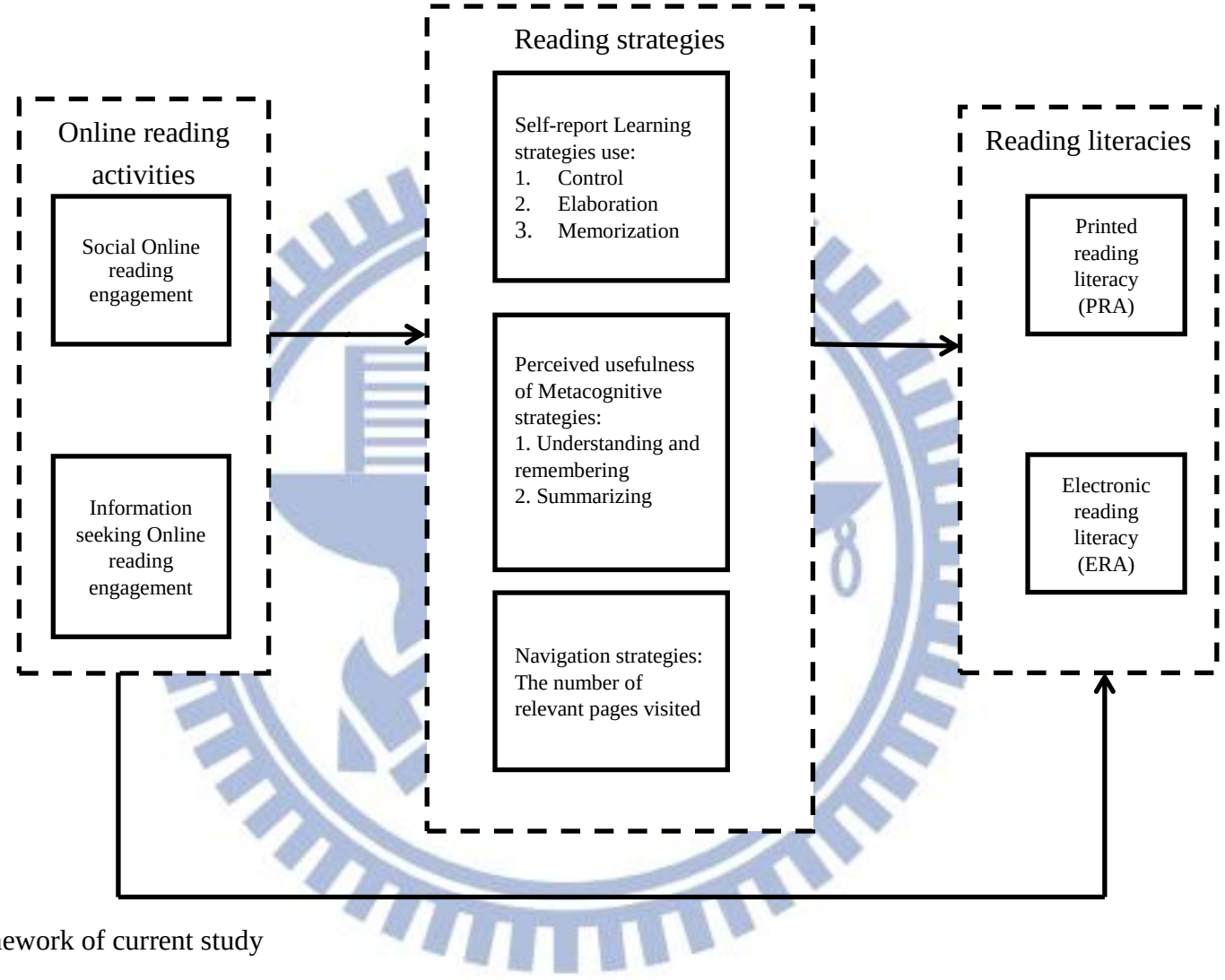


Figure 1.1 The framework of current study

Note. The effects of gender (male) and ESCS on mediators and outcome variables were controlled.

Chapter 2 **Literature Review**

According to PISA's survey of reading literacy, we could find that on average, most students' performance on digital reading assessment was consistent with their printed reading assessment. However, there were countries that showed a disparity in the two forms of reading assessments. For example, in Korea, Australia, New Zealand, Sweden, Iceland and Macao-China, students' overall digital reading performances were better than their printed reading performances, but students in Poland, Hungary, Chile, Austria, Denmark, Hong-Kong China and Colombia showed the opposite results(OECD, 2011b). The above-mentioned fact revealed that there existed similarities and differences between digital reading and printed reading assessment. In sum, these two forms of assessments had a high correlation between each other, but the pattern of difference in the overall performance differed among participating countries. In the current study, we will investigate the relationship between the printed and digital reading assessment as well as the factors that influence the difference in students' reading literacies.

2.1. The electronic and printed reading assessment

The traditional definition of literacy was the ability to read and write. However, with the development of Information and Communications Technologies (ICT), the notion of literacy toady has expanded to "learn, comprehend, and interact with technology in a meaningful way "(Pianfetti, 2001). In other words, the new reading (e.g., digital text) format gave a new meaning to the reading literacy so that reading literacy can be assessed using computer-based reading materials as well as paper-based materials. Throughout this thesis, we will call the computer-based reading assessment the electronic reading assessment (ERA) and the paper-based reading assessment the printed reading assessment (PRA). An introduction of the two forms of assessment for reading literacy is depicted in the following.

Reading in the traditional sense was the reading of printed texts that were presented on paper. The printed texts consist of print and two-dimensional graphics (Coiro, 2003). Most of the time, the information in printed texts was presented in a linear way so that the readers can easily follow the flow of the thought of the writer.

On the other hand, the drawback of the printed text was that readers had little choice to actively select and comprehend the information they need in a self-directed order. As for the printed reading skills learning, the reading instruction paradigm offered a holistic set of reading strategies for learners to comprehend the printed texts more effectively. Specific reading strategies are the metacognitive strategies or learning strategies, such as summarizing, controlling, memorizing, and so on(Coiro, 2003; Salmeron & Garcia, 2011).

As the age of multimedia arrives, reading had expanded to read materials that are developed and presented by computer-based technologies. The format of electronic reading or e-reading consists of a range of symbols, multiple media, virtual reality environments, hyperlinks and so on (Coiro, 2003). Digital text or more specifically hypertext is most characteristic of e-reading. The presentation of information was designed in a nonlinear fashion. Readers could navigate through the nodes in a different order based on the construction of their mental cognition of the text. In order to comprehend the texts effectively, the readers have to know how to make good use of textual reading strategies, as well as the basic and advanced navigation strategies, such as evaluating of information from different pages, predicting the content of unseen webpages, or choosing the links coherently (Coiro, 2003; Naumann, Richter, Christmann, & Groeben, 2008; Salmeron & Garcia, 2011).

Reading of electronic texts inherited some characteristics from printed texts such as structure of text (Coiro & Dobler, 2007); meanwhile, they also had their unique features, such as “dynamic windows and frames, networking and hyperlinking, multimedia and augmented reality, and online discussion and social network which couldn’t be found in printed texts” (OECD, 2011a, p. 34). Consequently, reading digital text was not isomornphic with printed text as we thought (Leu et al., 2007). The similarities and difference between printed texts and digital texts are described as follows.

In terms of the similarities between printed texts and digital reading texts, studies showed that some skills, strategies or dispositions could be used in both printed and online reading. For example, Coiro and Dobler (2007) adopted qualitative methods to investigate the reading strategies among sixth-grade skilled readers in the digital environment. The results showed that prior knowledge resources, reasoning strategies and self-regulated reading processes helped proficient readers understand

what they read and these strategies were also useful during traditional printed reading comprehension. Similarly, Leu and his colleagues (2007) reported that questions identification, information searching, analyzing, synthesizing and communicating were strategies that readers required for printed texts and hypertext alike.
However, it was also found that hypertext was distinctly different from printed text in terms of reading process, the way of text construction, and some particular new reading strategies and skills. Leu and his colleagues (2007) found that the nature of hypertext was different from printed reading and its reading comprehension required additional strategies. There were four main distinctions of hypertext from printed text including (1) self-directed texts constructing, (2) information seeking skills, (3) information synthesizing, and (4) cooperation and interaction. Hypertext reading was a process of self-directed text construction, and readers had to know how to choose the appropriate webpages through links to get the information they needed from the digital text. In hypertext environment, readers used search engine to locate information, whereas the index or catalogs were used to search for information during the printed reading comprehension. After confirming the purpose of reading, the readers had to decide what information they needed, what webpages to visit, which links to choose, and the order of text construction as they read. In the online reading environment, readers not only read but also write to communicate or respond to others' work. People read information provided by other people and at the same time write to respond or ask for more information. The interactive process would help readers get more information and deeper understanding about the topic as well as the abilities to evaluate and judge the reliability of information critically(Coiro, 2003; Coiro & Dobler, 2007; Leu et al., 2007, 2011).

2.2. The online reading activities, reading skills and reading literacies

With the progress of technology and prevalence of the Internet, the reading modes had been expanded. What we called Information and Communication Technologies (ICTs), such as blog, Wiki, MSN, online news, chat rooms, search engines and Facebook, provided readers a collaborative and interactive learning environment to share their opinions with each other, discuss an issue deeply, and search for information effectively. Furthermore, the process of cooperation and interaction enhanced readers' abilities in reading skills, learning strategies, thinking

styles as well as their digital reading performance(Coiro, 2003; Coiro & Dobler, 2007; Lee & Wu, 2012; Leu et al., 2007; Lin, Hope Cheong, Kim, & Jung, 2010; Tan, Ng, & Saw, 2010). For instance, McCreary, Ehrich and Lisanti (2001) pointed out that online chat rooms fostered students' collaborative learning performance. Tan et al. (2010) also argued that Wiki, email, blog and other online resources offered an interactive environment to improve students' reading and listening abilities. Additionally, O'Shea et al.(2007) suggested that the usage of Wiki could facilitate students' critical thinking and advanced learning strategies, such as evaluation, analysis, and integration. Moreover, Lee and Wu's (2012) analysis of PISA data showed that, besides the direct positive relation between students' attitude toward ICT and PISA reading literacy, the engagement in online reading activities serves as a positive mediator between ICT resources and reading literacy despite the negative relationship between availability of ICT at home and reading literacy. Their study, however, did not distinguish online activities that are used for information seeking or for social interaction.

Different kinds of online reading activities could foster different reading strategies and have different influence on people's reading in the printed and digital environment. However, few studies focused on this issue. In addition, the studies about social reading activities, such as online chatting, were often designed to provide an online teaching platform to boost students' abilities of discussing and thinking. As a result, the researchers often concluded that chat rooms were beneficial to students' learning (McCreary et al., 2001; Tan et al., 2010). Nevertheless, will the general social reading activities (not used for teaching purpose) still play a positive and significant role on the reading performance? There were some studies showing that heavy online activities engagement may influence students' academic performance negatively (Chou et al., 2005; Chou & Hsiao, 2000; Kubey et al., 2001; Lin & Tsai, 2002; Lin & Tsai, 1999). Lin and Tsai (2002) investigated Taiwanese high school students' internet usage and the related problems which heavy Internet use leaded to. The results showed that students who spent a lot of time on chat room, BBS, or other social online activities perceived their school performances were negatively impacted by their heavy internet use. Kubey et al (2001) also found out that students' heavy engagements in online activities were associated with their failure in academic performance. And most studies contributed students' failure in school performance

that the students spent too much on the internet to manage their daily time, and even miss their class or disregarded their studies. Nevertheless, we assumed the nature and online reading activities students engaged in was another reason which leaded to students' academic difficulties. Therefore, we assume that social online reading activities may not be able to enhance students' academic or reading performances.

As a consequence, in the current study, we divided online reading activities into online social activities and information seeking activities to further investigate the two online reading activities and their relationship with ERA and PRA. We also explored possible factors that mediate the relationship between online activities and ERA/PRA performances. Specifically, we examined how learning strategies, metacognitive strategies, and online navigation skills affected PRA and ERA outcome.

2.3. Learning strategies, metacognitive strategies and reading literacies

2.3.1. Self-regulated learning and reading

Recently, students are expected to learn autonomously and effectively, so that self-regulated learning has been high regarded. According to Pintrich's(2005) analysis and integration, most of the self-regulation theories contained the following assumptions. Firstly, learners were self-oriented and active. Secondly, in the process of learning, self-monitor strategies, control strategies and regulation skills would be used flexibly. Thirdly, before learners start to learn, they would set the goals and use all kinds of learning strategies to approach the goals. If they failed to reach the goals, they would adjust their learning process. Lastly, through self-regulation, the relationships between contextual characteristics and learners' learning outcomes could be explained more. Therefore, there are more and more studies explore the effects of self-regulated learning on students' learning and reading outcomes.

Based on self-regulated learning theory, students' academic performance would be influenced by their dynamic self-regulated processes involving metacognition, motivation and behavior(Zimmerman, 1995, 1995, 2002, 2008). Zimmerman (1990) suggested that learners' use of learning strategies and metacognitive strategies could optimize self-regulated processes and in turn improve learning outcome. Pintrich and De Groot (1990) argued that besides motivational factors, cognitive and metacognitive strategies use had significant impacts on students' academic

performance. Some empirical studies also supported their perspective (Lee, Lim, & Grabowski, 2010; Souvignier & Mokhlesgerami, 2006). In fact, more and more studies showed that learning strategies and metacognitive strategies were critical not only to people's learning, but also their printed and digital reading comprehension (Akyel & Erçetin, 2009; Jairam & Kiewra, 2010; OECD, 2010a; Souvignier & Mokhlesgerami, 2006; Swalander & Taube, 2007; Vidal-Abarca et al., 2010). For instance, Vidal-Abarca, Mañá and Gil (2010) reported that compared with less skilled readers, skilled readers performed well in monitoring their comprehension of questions and information seeking when they faced task-oriented reading situation. Jairam and Kiewra (2010) also noted that the SOAR strategies (select, organize, associate and regulate) improved students' learning and reading in the computer-based environment.

In the following sections, we will address the effects of self-regulation strategies (such as control strategies, elaboration strategies, metacognitive strategies) on people' reading performances.

2.3.2. Learning strategies and reading literacies

In terms of learning strategies, PISA (2010a) focused on the strategies of memorization, elaboration, control strategies and the relationship among the three strategies and reading literacies.

Memorization strategies were basic and universal strategies in learning. The memorization strategies are most noticeable in rote learning or learning by repetition so as to store the information in mind (OECD, 2010a). Some researchers regarded memorization as a superficial strategy (Bråten & Strømsø, 2011; Chiu et al., 2007). Memorization may work at the beginning of reading task for basic learning of facts, but as students depend heavily on these strategies, they would be overtaxed by the increasing information (Chandler & Sweller, 1991; Sweller, 2010). That's because memorization strategies, in brief, were limited to students' capacities of short-term memory, without the elaboration of information, students couldn't keep everything in mind. In addition, sometimes what students memorized was not so important as they considered, and may worsened students' reading and learning outcome. Nevertheless, use of memorization strategies was still part of the learning process and played a crucial and sufficient role in the beginning of learning and reading so that we will include it in our study.

Elaboration strategies were strategies that connect individual's prior knowledge with current learning and reading situation. In other words, effective elaboration strategies fostered a student's transfer of learning and help him/her to be a lifelong learner(OECD, 2010a) . Students are encouraged to develop the abilities of elaborating, because the effects of elaboration on learning and reading had been supported by empirical studies (Bråten & Strømsø, 2011).

Control strategies were also an essential part to learning and reading (OECD, 2010a; Vidal-Abarca et al., 2010; Zimmerman, 1990, 2002). Readers used these strategies to monitor reading purpose, process, and results, and then try to regulate their reading flexibly when they found they failed to achieve the goal. Therefore, control strategies were the core of the whole reading and learning procedure and affected students' reading performance in depth (Vidal-Abarca et al., 2010).

2.3.3. Metacognition strategies and reading literacies

Another internal psychological processe which influences readers' reading comprehension was metacognitive strategies. Metacognition, which Flavell (1993) called "cognition about cognition", involved awareness of one's thinking ,as well as regulation and evaluation of one's cognitive activities(Flavell, 2000; Zimmerman, 2002). They played important roles on self-regulation learning. Result from empirical studies indicated that proficient readers tend to metacognition strategies appropriately (Chiu et al., 2007; Koch, 2001; Lau & Chan, 2003; Vidal-Abarca et al., 2010). According to Lau and Chan's (2003)study, good readers monitored and evaluated their reading processed, and regulated their reading methods to achievement their reading purpose. Additionally, several studies (e.g.Akyel & Erçetin, 2009; Stadtler & Bromme, 2007) showed the importance of metacognition in the digital reading environment.

2.4. Navigation and reading literacies

Due to the nonlinearity nature in hypertext, readers had more freedom in information accessing and integrating. Nevertheless, navigation strategies were demanded to help readers construct a proper reading order to obtain, organize, and integrate the information effectively(Shapiro & Niederhauser, 2004).

Navigational behaviors could be simply divided into basic ICT skills and advanced navigation strategies. ***The basic ICT skills*** involves readers' use of the navigation tools and features embedded in the hypertext, such as the "back" and "forward" links to decide their reading direction, the use of overview to show the relationship between the nodes, the use of search engine to find the key information they need and so on
(Chen, Fan, & Macredie, 2006; Madrid, Van Oostendorp, & Melguizo, 2009; Van Oo stendorp & Juvina, 2007). The results of Madrid, Van Oostendorp, and Melguizo's experiment (2009) showed that navigation suggestions could lower readers' cognitive load and help them move around the pages in a coherent way. Additionally, the degree of navigational support is dependent upon the level of prior knowledge (Chen et al., 2006).Experts with rich prior knowledge needed the navigational tools to help them find the specific the information. Thus, they preferred Index tools or search tools to get the information quickly. By contrast, the novices with poor prior knowledge preferred the guided tours, maps and menu tools to show the structure of the hypertext to prevent them from getting lost in the digital environment. ***The advanced navigation strategies,*** in brief, referred to the strategies that helped readers traverse around the nodes in the digital texts to get the information they need (OECD, 2011a). The process of advanced navigation involved mental activities, such as self-control, self-monitor and self-evaluation, which fostered readers' abilities of accessing, integrating, and evaluating of information from different pages, predicting the content of unseen webpages , as well as correctly deciding which links should be chosen (Naumann et al., 2008; OECD, 2011a; Salmeron & Garcia, 2011). Research on the effects of navigation strategies on reading can be divided into three categories: (a) investigating the pattern of navigational path to classify the navigational types (Bousbia, Rebaï, Labat, & Balla, 2010; Lawless & Brown, 1997); (b)investigating the criteria of links selection and the reading order (Salmeron, Canas, Kintsch, & Fajardo, 2005; L. Salmerón, Kintsch, & Caãs, 2006); (c) proposing models to explore the relationship between navigation strategies and other factors which influenced on reading (Naumann et al., 2008; Salmeron & Garcia, 2011).

Lawless and her colleagues' research (1997; 2003) followed the first tendency. They collected and analyzed the past research about navigation and concluded that according to readers' paths of navigation, the readers could be divided into three

groups: knowledge seeker, feature explorers and apathetic user. Knowledge seekers followed the coherent strategies to access and integrated the information of the hypertext to achieve the reading goals. The feature explorers spent a lot of time on the special features that attracted them, such as video clips, instead of getting the meaningful information from the hypertext. The apathetic users were unmotivated readers.

The second tendency focused on the criteria the readers used to form their navigational paths. Salmerón and his colleagues (2005; 2006) reported that, on the basis of construction-integration model (C-I model), reading comprehension was affected by readers' prior knowledge and the coherence of text representation construction. If the low –knowledge readers chose the links based on the text coherence strategies, they could get better grades in reading. However, if the low knowledge readers construct the reading orders according to their interest (interest strategies), their reading performance could not be promoted. In contrast, the high knowledge readers benefited from low-coherence reading order. The researchers argued that the coherence strategies could support the low-knowledge reader to integrate the information from different pages and construct a mental representation of the whole text to help them get good comprehension.

With regard to the last tendency, according to Salmerón's (2011) model, navigation strategies (the cohesion of navigational path) mediated the relationship between reading skills and reading performance. Naumann's (2008) model showed that navigational behavior (number of relevant pages visited) mediated the relationship between learning strategies training and learning outcome. In addition, the mediation model would be moderated by the reading skills and working memory capacity.

In sum, based on the literature review, we may conclude that use of navigation strategies can foster low prior knowledge learners to access and integrate the information in a useful way and get the whole picture of the hypertext. The correct use of navigational tools and features not only decreased readers' cognitive load (Chandler & Sweller, 1991; Madrid et al., 2009; Sweller, Van Merrienboer, & Paas, 1998; Zumbach & Mohraz, 2008), but also avoided loss of orientation. As a consequence, we assumed that effective use of navigation strategies could positively predict students' reading literacy in the digital environment.

In the current study, we concentrated on the advanced navigation strategies, because they could be regarded as readers' cognitive representation and affected readers' reading and learning outcome in depth.

2.5. Gender, ESCS and reading literacies

From the past studies, we found that gender and students' economic, social and culture status (ESCS) were very important factors that influenced students' reading performances. Most of the research showed that girls outperformed boys in reading (Chiu & McBride-Chang, 2006; Coles & Hall, 2002; Logan & Johnston, 2009; McKenna, Kear, & Ellsworth, 1995; Smith, Smith, Gilmore, & Jameson, 2012), while few research reported that there was no significant difference between girls and boys' reading performance(Hogrebe, Nist, & Newman, 1985). In terms of students' economic, social and culture status (ESCS), researchers found that students with more economic, social and cultural capital performed better in reading literacies(Chiu & Chow, 2010; Chiu & McBride-Chang, 2006). Chiu & Chow (2010) discussed the relationship among culture, motivation as well as reading achievement and concluded that cultural capital (cultural possession and communication) positively predicted students' motivation and reading scores. Due to the critical effect of gender and reader's economic, social and culture status on reading literacy, we included them as control variables in our study.

Chapter 3 **Method**

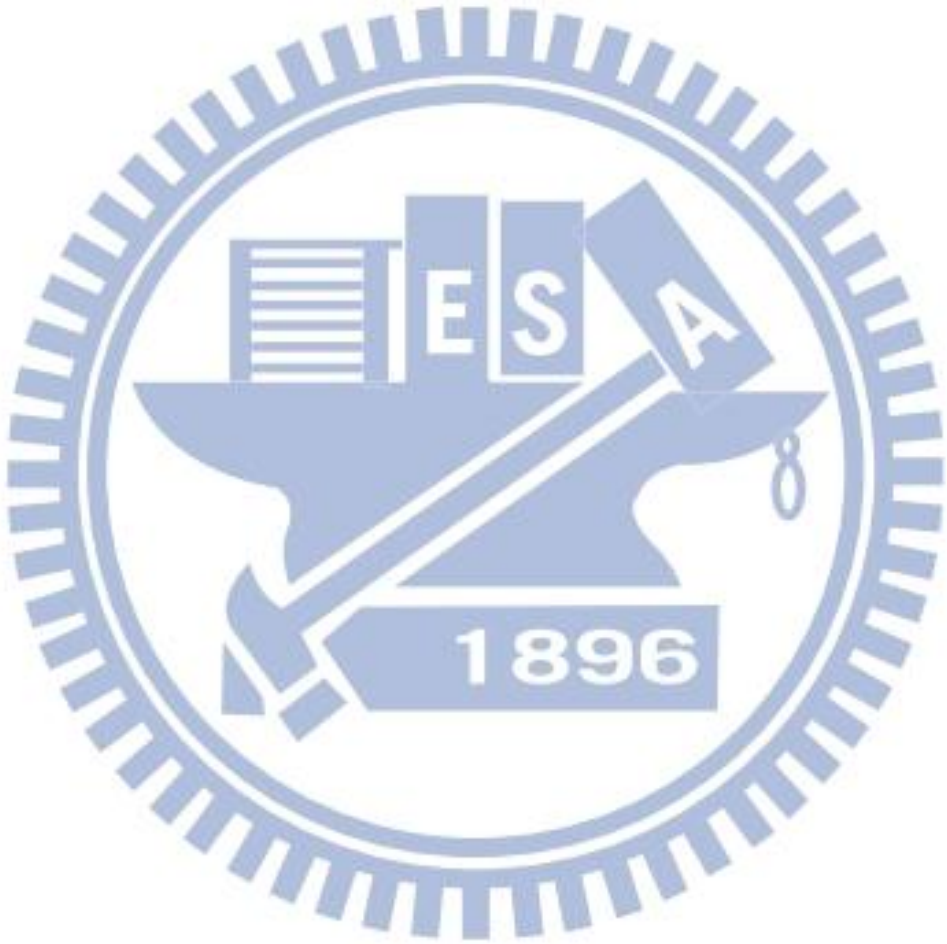
In this chapter, we introduce a hypothesized SEM model for our research question (See Figure 3.1) and the variables used to identify the model. Besides, the hypotheses of the research, the characteristics of the selected PISA samples, the survey instruments PISA used and the analytical statistical methods will be presented in the following sections.

3.1. Hypothesized model and hypotheses

Based on the literature review in the previous chapter, we used the selected PISA 2009 data to investigate the direct and indirect effects of social interaction and information-seeking reading activities on printed and digital text reading literacies. Cognitive strategies, metacognitive strategies and navigation strategies were the interested mediators that mediate the relationship between two different online reading activities and two fashion of reading mediums. To sum up, we proposed the following hypotheses to examine the relationship among these variables:

- The information seeking online reading engagement positively affects students' online and printed reading performance, while the social online reading engagement has weak or negative effect on students' two types of reading performances.
- The information seeking online reading engagement has positive effect on students' self-report learning strategies use, navigation skills, and the awareness of effective metacognitive strategies as well. But the online social reading activities have weak or negative effects on the learning or metacognitive strategies and positively affect navigation skills.
- Students' use of learning strategies, navigation skills and more awareness of useful metacognitive strategies has positive influence on students' printed and digital reading performances.
- Students' learning strategies use, their awareness of useful of metacognitive strategies, and the navigational performances are significantly and positively correlated to each other.

- Students' reading skills including learning strategies use, perceived usefulness of metacognitive strategies and navigation skills can mediate the relationship between two online activities frequency and two reading literacies.



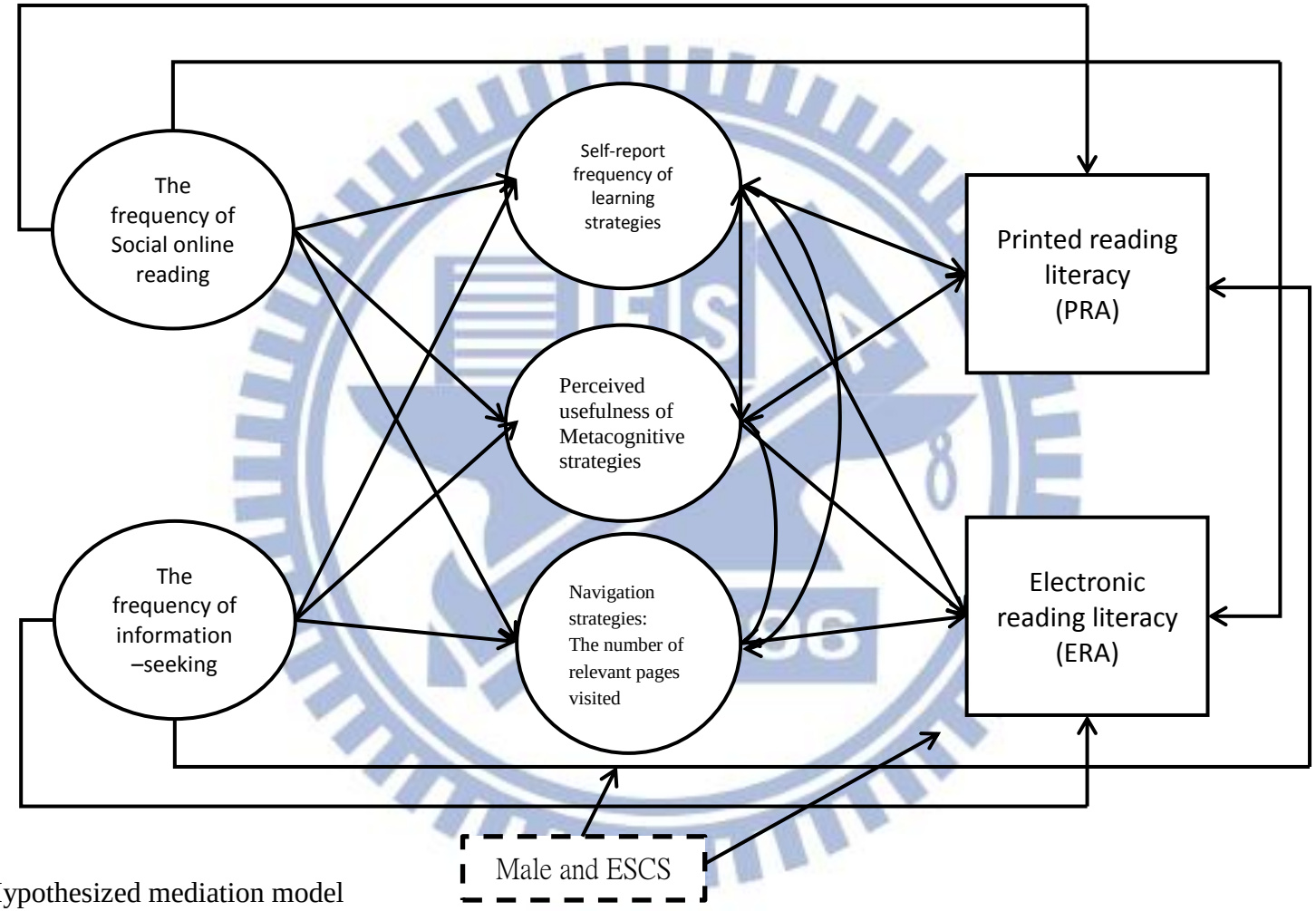


Figure 3.1 Hypothesized mediation model

Note. The effects of gender (male) and ESCS on mediators and outcome variables were controlled.

3.2. Data source

3.2.1. Programme for International Student Assessment (PISA)

Programme for International Student Assessment (PISA), an international study, is planned and carried out by Organization for Economic Cooperation and Development (OECD). Most of the participating countries and economies were OECD members.

The purpose of PISA is to test the abilities (about reading, mathematics and science) of 15-year-old students near the end of compulsory education to examine the extent of students' preparation for the challenges in the future and the outcome of educational systems which had been implemented for recent ten years in the participating countries(OECD, 2010b). The design of PISA focused on the evaluation of students' true abilities of applying knowledge and skills in the real life, rather than the proficiency of certain curriculum or materials learned at school. Therefore, the words "performance" and "literacy" used in this study mean the outcome of students' real cognitive capacity, not the outcome of the extent of students' mastery of the material they had learned.

Every three years, PISA is conducted to test students' ability of three domains, Reading, Mathematics and Science. One of the three domains would be the major domain and the others would be minor ones. The main domain would vary along with the order of Reading, Mathematics and Science. For example, in 2000, the main domain was Reading and the minor domains were Mathematics and Science(OECD, 2011a). The detailed arrangement of the PISA assessments showed in Table 3.1.

Table 3.1 The content of PISA assessment

	2000	2003	2006	2009	2012
Main domain	Reading	Mathematics	Science	Reading	Mathematics
Minor domain	Mathematics; Science	Reading ; Science; Problem solving	Reading ; Mathematics	Mathematics; Science	Reading ; Science; Problem solving

3.2.2. 2009 PISA contextual information

Besides the literacies, PISA also collected the contextual information of students, school and countries. In 2009 PISA survey, students, parents, school principal (or designate) and the countries had to provide the information showed as follows:

Student questionnaire: The questionnaire consists of forty-two main questions. These questions asks for the information below: (a) students' education background; (b) reading activities; (c) strategies for learning and reading; (d) learning time;(e)school-related information; (f)family situation; (g) parents' education background. This questionnaire is the main resource of information in our study and the detailed content we used will show at the section of "Materials and Instrument" (OECD, 2010b, 2011a).

Parent questionnaire: This questionnaire is an international option, so that not all of the countries and economies used it as the resource of contextual information. The questionnaire comprises seventeen major questions and would be completed by students' parents or primary caregivers. The information about parents' personal information, students' and parents' past reading engagement, home reading support , school choice, the extant of involvement in child's school provides a comprehensive

picture of interaction among parents and child, as well as the influence on child's achievement (OECD, 2010b, 2011a).

School questionnaire: School principal or designate is asked to complete the school questionnaire. The questionnaire focus on the characteristics of school, the background of students and teachers, school climate, school's resources, school's policies, as well as the curriculum, instruction and assessment implemented at school(OECD, 2010b, 2011a).

Questionnaire on educational career: There are only seven questions in the questionnaire and these questions concentrates on the processes and students' learning experiences during the educational career. This survey is also an international option (OECD, 2010b, 2011a).

Questionnaire on student familiarity with ICT: With the changes of reading habits and fashion, 2009 PISA tested students' digital reading literacy and surveyed the information about the Information and Communications Technology (ICT), such as available ICT resources at home and school, computer-related activities, students' abilities and confidence on ICT activities, as well as the attitude to computer use (OECD, 2010b, 2011a).

In this study, we focus on the cognition –related variables, such as learning strategies, metacognition- strategies, online reading activities, as well as gender and SES, which were mainly derived from student questionnaire.

3.3. Participants

There were 475460 fifteen-year-old students from sixty-five countries and economies participated in the 2009 PISA survey. (There were ten else countries and economies joined the survey in 2010. Consequently, there were seventy-five countries

and economies accepted the same survey.) Two-stage stratified sampling method was used to decide the participants. In the first stage, based on the criterion of the proportion of the school size, at least 150 schools which enrolled 15-years old students were selected in each country. In the second stage, 35 fifteen-year-old students were randomly sampled from each opted schools (OECD, 2012).

It is noted that the study aimed to investigate the relationships among the reading online activities, learning strategies, metacognitive strategies, navigation strategies and two types of reading performances. There were 107394 students from nineteen of these participating countries and economies (Korea, Japan, Australia, Hong Kong-China, New Zealand, Macao-China, Ireland, Iceland, Sweden, Norway, Belgium, Denmark, France, Spain, Poland, Hungary, Austria, Chile, and Colombia) accepted the examination of printed and digital reading assessment. However, not all of the 107394 students' navigation data were recorded. There was another sampling occurred in nineteen participating countries (OECD, 2012). As a result, 34104 students were sampled, with 17087 females (50.1%) and 17017 males (49.9%). These students' navigating processes were recorded by log files when they did the ERA test.

3.4. Materials and Instruments

3.4.1. Reading Literacies-printed and digital reading assessment

The definition of "Reading Literacy" in 2009 PISA is "Understanding, using, reflecting and engaging with written texts, in order to achieve one's goals, to develop one's knowledge and potential, and to participate in society" (OECD, 2012, p.23). So in PISA, this concept of "Reading literacy" is used in printed and digital reading environments, and also resulted in the design of the two types of PISA reading assessments, that is, printed and online literacy assessments.

In both printed or digital reading, the assessments were task-directed, and these tasks were developed with three major characteristics: (a) *situation* means that the reading tasks were designed according to the purposes of the reading.; (b) *text* infers to the reading materials, the medium of reading, text format and text type; (c)*aspect* means the cognitive processes of reading (OECD, 2010b, 2011a).

In terms of the reading *situation*, the reading tasks could be classified into four categories. These reading tasks presented the texts/contents that are intended to satisfy readers' personal, public, educational, and occupational reading purposes. With respect to the *text*, the text format of the PISA assessments could be classified into continuous, non-continuous, mixed and multiple text formats. Most of the texts in print-medium assessment were continuous (60%), while, in the electronic-medium assessment, the proportion of multiple text format is getting larger (70%). As for the text type, description, narration, exposition, argumentation, instruction, and transaction were also included in the PISA assessments. Finally, the *aspect* of PISA assessment infers to the cognitive processes of both printed and digital reading. When readers read printed or digital texts, the following aspects could give them a better comprehension of the presented text: retrieve information, form a broad understand, develop an interpretation, reflect on and evaluate content of text, and reflect on and evaluate form of text. The items of PISA reading assessments were designed to examine the aspect mention above, and different aspects carry different weights on students' reading performance.

Besides Reading literacy assessments, the implement of 2009 PISA also tested two other minor domains: Mathematics and Science. As a consequence, each of the participating students would be assigned a booklet which contains reading, mathematics and science tasks, and cost about two hours to finish it. As for the digital

reading assessment, twenty-nine digital reading tasks were organized into three clusters, and two of the three clusters would be assigned to the selected students. The participating students could have ten minutes to practice the questions to get used to the digital environment, and then they had forty minutes to complete the formal assessment.

3.4.2. The online reading activities

One of the important contextual variables used at the study is students' online reading activities. Based on the result of the principal component analysis and a Varimax rotation, students' online activities could be divided into (a) *social reading activities* which includes 2 items reflects the frequencies of socially communicative activities, such as e-mail and chatting on line; (b) *information-seeking reading activities* which contains 4 items assesses the frequencies of students use computers and internet to look for information they need, such as using online dictionary or searching engine. The concepts mention above are evaluated by 5 points Likert Scale, ranging from1 (I don't know what it is) to 5 (Several time a day) (OECD, 2010a, 2011a).The respective Cronbach's α coefficient of the scale for the participating countries and economies was from .69 to .93, and the Cronbach's α coefficients of the frequencies of online reading activities for the selected samples was .755.The Cronbach's α coefficient and items of the two variables are showed in Table 3.2.

Table 3.2 The Cronbach's α coefficient of selected sample and items of social online reading activities and information-seeking activities

Q26 How often are you involved in the following reading activities?		
Index	Items	Cronbach's α coefficient
Social reading activities	a) Reading emails b) <Chat on line> (e.g. <MSN® >)	.563
Information-seeking reading activities	c) Reading online news d) Using an online dictionary or encyclopaedia (e.g. <Wikipedia® >) e) Searching online information to learn about a particular topic g) Searching for practical information online (e.g. schedules, events, tips, recipes)	.748
The online reading activities(contain 6 items above)		.755

3.4.3. Learning strategy

The variable of learning strategies is a latent variable constructed by three indicators: *Memorization, Elaboration,* and *Control strategies.* The three indicators were constructed based on the result of the principal component analysis and a Varimax rotation. The items of these indicators were derived from 4-point Likert Scale, ranging from 1(Almost never) to 4(Almost always). Memorization is assessed by 4 items which investigate students' frequencies of using memorization strategies to store information. Elaboration is derived from 4 items assessing the frequencies of using elaboration strategies to connect the information they learned in different situation and applied the knowledge in a new condition. Control strategies include 5 items evaluating the frequencies of students' effective self-regulation learning (OECD, 2010a). The respective Cronbach's α coefficient of the frequencies of control

strategies use for the participating countries was from .69 to .84, and of the frequencies of elaboration strategies use was from .68 to .81, and of the frequencies of memorization strategies use was ranged between .59 and .63. For the selected samples, the Cronbach's α coefficient of the control strategies was .756, of elaboration strategies was .756, of memorization strategies was .698, and of all the items was .844. Table 3.3 showed the Cronbach's α coefficient and items of the three types of learning strategies.

Table 3.3 The Cronbach's **α** coefficient of selected samples and items of memorization strategies, elaboration strategies and control strategies

Q27 When you are studying, how often do you do the following?		
Variables	Items	Cronbach's **α** coefficient
Memorization	a) When I study, I try to memorize everything that is covered in the text. c) When I study, I try to memorize as many details as possible. e) When I study, I read the text so many times that I can recite it. g) When I study, I read the text over and over again.	.691
Elaboration	d) When I study, I try to relate new information to prior knowledge acquired in other subjects. h) When I study, I figure out how the information might be useful outside school. j) When I study, I try to understand the material better by relating it to my own experiences. l) When I study, I figure out how the text information fits in with what happens in real life.	.756
Control strategies	b) When I study, I start by figuring out what exactly I need to learn. f) When I study, I check if I understand what I have read. i) When I study, I try to figure out which concepts I still haven't really understood. k) When I study, I make sure that I remember the most important points in the text.	.756

	m) When I study and I don't understand something, I look for additional information to clarify this.	
Learning strategies (contain 13 items above)		.844

3.4.4. Metacognitive strategy

The metacognitive strategy is a latent construct which formed with two indicators: student's awareness of the usefulness of understanding and remembering as well as the usefulness of summarizing. There are 6 items in the question about the *understanding and remembering strategies* and students have to evaluate the usefulness of the items with a 6 points Likert Scale (1= "Not useful at all" and 6= "Very useful") (OECD, 2010b, 2011a). The results of the indicators were derived from a "rater-scored system". Simply stated, the rater-scored system includes several steps. At the beginning, the usefulness of these items (strategies) would be evaluated by experts and the experts agreed that the effectiveness of the six items were the rules of C>A, C>B, C>F, D>A, D>B, D>F, E>A, E>B, E>F (9 pair-wise rules). Secondly, students' answers will be compared with experts' suggestion. If four of student's answers are consistent with experts', and then the student's scores would be 4/10=0.4. Finally, the scores will be standardized and the higher standardized scores imply the greater students' awareness of the effectiveness of the understanding and remembering strategies (OECD, 2010b, 2011a). With respect for the *summarizing strategies*, there are 5 items designed for assessing the concept and the scoring method is the same with the *understanding and remembering strategies* (OECD, 2010b, 2011a). Table 3.4 shows the items and the scoring rules of two metacognitive strategies.

Table 3.4 The items and scoring rules of metacognitive strategies.

Q41 Reading task: You have to understand and remember the information in a text. How do you rate the usefulness of the following strategies for understanding and memorising the text?		
Index	Items	Scoring rules
Understanding and remembering strategies	a) I concentrate on the parts of the text that are easy to understand b) I quickly read through the text twice. c) After reading the text, I discuss its content with other people d) I underline important parts of the text. e) I summarise the text in my own words f) I read the text aloud to another person	CDE> ABF C>A, C>B, C>F, D>A, D>B, D>F, E>A, E>B, E>F
Q42 Reading task: You have just read a long and rather difficult two-page text about fluctuations in the water level of a lake in Africa. You have to write a summary. How do you rate the usefulness of the following strategies for writing a summary of this two-page text?		
Index	Items	Scoring rules
summarizing strategies	a) I write a summary. Then I check that each paragraph is covered in the summary, because the content of each paragraph should be included. b) I try to copy out accurately as many sentences as possible. c) Before writing the summary, I read the text as many times as possible. d) I carefully check whether the most important facts in the text are represented in the summary. e) I read through the text, underlining the most important sentences. Then I write them in my own words as a summary.	DE>AC>B D>A, D>C, D>B, E>A, E>C, E>B A>B, C>B,

3.4.5. Navigation skills

When students participated in PISA 2009 digital reading literacy assignments, the log file was used to record students' navigation information during the answering process Three navigation indicators provides by the log files: the number of page visits , the number of visits to relevant pages, and the number of relevant pages visited (OECD, 2011a). We choose the number of relevant pages visited as the indicator of students' navigation skill. The number of relevant pages visited infers to the relevant pages visited by students during the digital reading assignment. If the same relevant page was visited several times by the same students, it was still counted as one relevant page visited (OECD, 2011a). However, as mentioned before, not all students answered the same digital reading items. Twenty-nine digital reading tasks were organized into three clusters, and students would response two of the three clusters. In order to take into account of the possible method effects of reading assessment designs and compositions, we used the centered number of pages visited as the navigation indicator in this study.

3.4.6. Controlled variables

Two controlled variables were included in this study, and they were gender and students' economic, social and culture status (ESCS) which is consisted of highest occupational status of parents, highest educational level of parents in years of education according to ISCED, and home possessions (OECD, 2011a). Especially, ESCE was a scale indices which derived from a one-parameter item response model and weighted maximum likelihood estimate (WLE) (Warm, 1989). Once the items of indices had more than two categories, a partial credit model would instead of the one-parameter item response model.

Based on the literature review, students' gender and economic, social and cultural status (ESCS) affect greatly on students' reading performances and the cognition-related mediators. However, in the study, we focused on the effects of students' engagements in online reading activities and reading strategies on two reading literacies. Consequently, we renamed gender variable as "Male" in the following paragraph and Coded 0 for girls and 1 for boys. and controlled the effects of gender (17017 males (49.9%) and 17087 females (50.1%)) and ESCS (M=−.056, SD=1.009) on mediators and two types reading literacies.

3.5. Data Analysis

SPSS ver. 11 and Mplus 6.12(Muthén & Muthén, 2010)were conducted to do the analyses and to perform the mediation model. Four types of statistical analyses were used:

(1) Descriptive statistics

Descriptive statistics were usually the first step of statistical analysis, because the results of the descriptive statistics analysis could be used to depict the characteristics of samples. As a result, SPSS 11 was used to calculate the values of mean, standard deviation and distribution of data.

(2) Internal consistency (Cronbach's **α**)

Reliability infers to the consistency, stability and the dependability of the test scores, or indicates the extent of the true-measure was reflected by the test items. In current study, we used Cronbach's **α** to represent the reliability of the following variables: two online reading activities, and three learning strategies. SPSS 11 was adopted to obtain the coefficient of Cronbach's **α.** The values of coefficient of Cronbach's **α** are ranged between 0 and 1. According to Kline

(2010), value of Cronbach's α coefficient larger than .80 indicates "excellent", value around .70 is fair, and the value between .70 and .50 means acceptable. However, the Cronbach's α coefficient may be low while the items of the variables (or test items) were fewer or the variances among the items were heterogeneous (Miller, 1995). Kline (2010) suggested that, when the sample size was large, a lower level of reliability coefficient was still acceptable in the latent variable methods.

(3) Confirmatory factor analysis (CFA)

Based on theories, a confirmatory factor model could be proposed to explain the linear relationship among latent factors and the observed variables. Model fit Chi square test and model fit indices would be used to evaluate the goodness of fit of the hypothesized model.

Chi square exact model fit test is the formal test to evaluate the exact fit of the proposed model. It was carried out to test the difference between the hypothesized model and the perfect model (i.e. the chi-square of perfect model equals to its degrees of freedom.). If the result of Chi square test is not significant, the proposed model would be considered as exactly fit to the collected data. However, the result of Chi-square test is easy to be significant with a large sample size. Thus, chi-square test would not be the only one criterion of goodness of model fit testing. We will use model fit indices to evaluate the model fit as well.

The commonly used model fit indices were Root Mean Square Error of Approximation (RMSEA) (Steiger, 1989; 1990), Standardized Root Mean Square Residual (SRMR) (Hu & Bentler, 1999), and Comparative Fit Index (CFI)(Hu & Bentler, 1998;1999).

(a) RMSEA

RMSEA infers to how similar the hypothesized model and the perfect model with adjustment for the degree of freedom. RMSEA around .06 indicates good fit. The values of RMSEA between .08 and .10 are acceptable, and larger than .10 are unacceptable.

(b) CFI

CFI involves the disparity between the hypothesized model and the the baseline model. Hu and Bentler (1998; 1999) suggested that the value of CFI larger than .90 is considered “good”.

(c) SRMR

Root mean square residual (RMR) means the discrepancy between the observed variance-covariance matrix and variance- covariance matrix of theoretical model. Nevertheless, there is not a standard to evaluate the goodness of fit of models. Moreover, this index is affected by the scales of the variables and the values of RMR are not easy to interpret. As a result, Sorbom and Joreskog (1982) proposed standardized root mean square residual (SRMR) to resolve the problem. The range of the SRMR is between 0 and 1. The value of SRMR less than .05 indicates a good fit model and the value of .around 08 is fair fit.

In current study, we used Mplus 6.12 (Muthén & Muthén, 2010) to perform the CFA analysis. The relationship between two latent variables (metacognitive strategies and learning strategies) and their observed variables were tested by CFA model; chi-square test, RMSEA, CFI and SRMR were used to examine the goodness of fit of the hypothesized model. The hypothesized measurement model was presented in Figure 3.1.

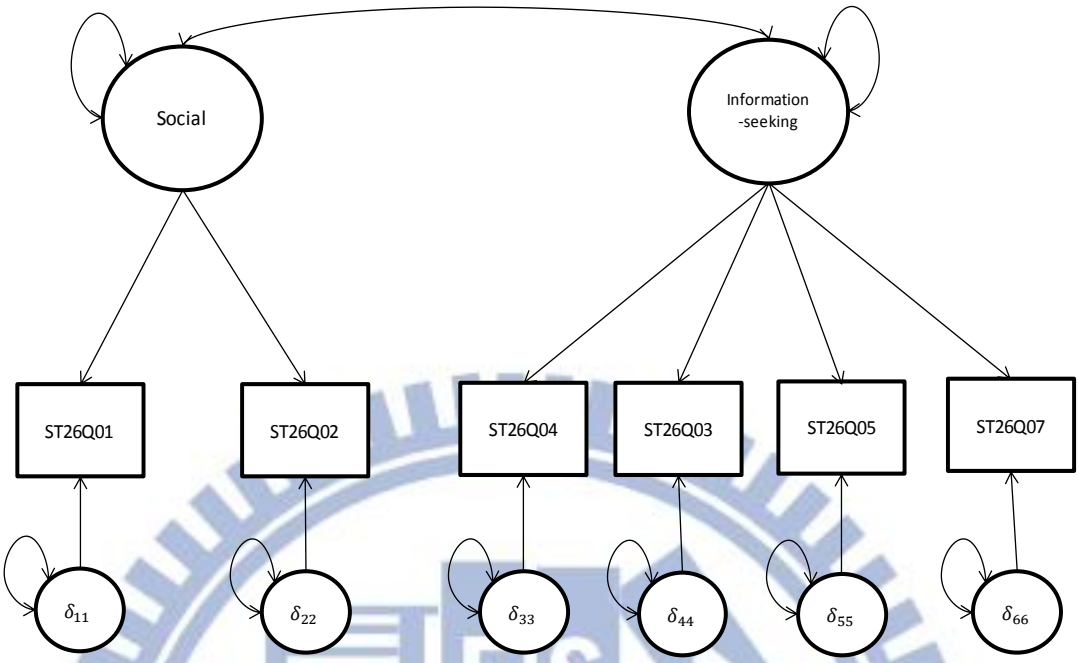


Figure 3.2 The hypothesized measurement model of two online reading activities

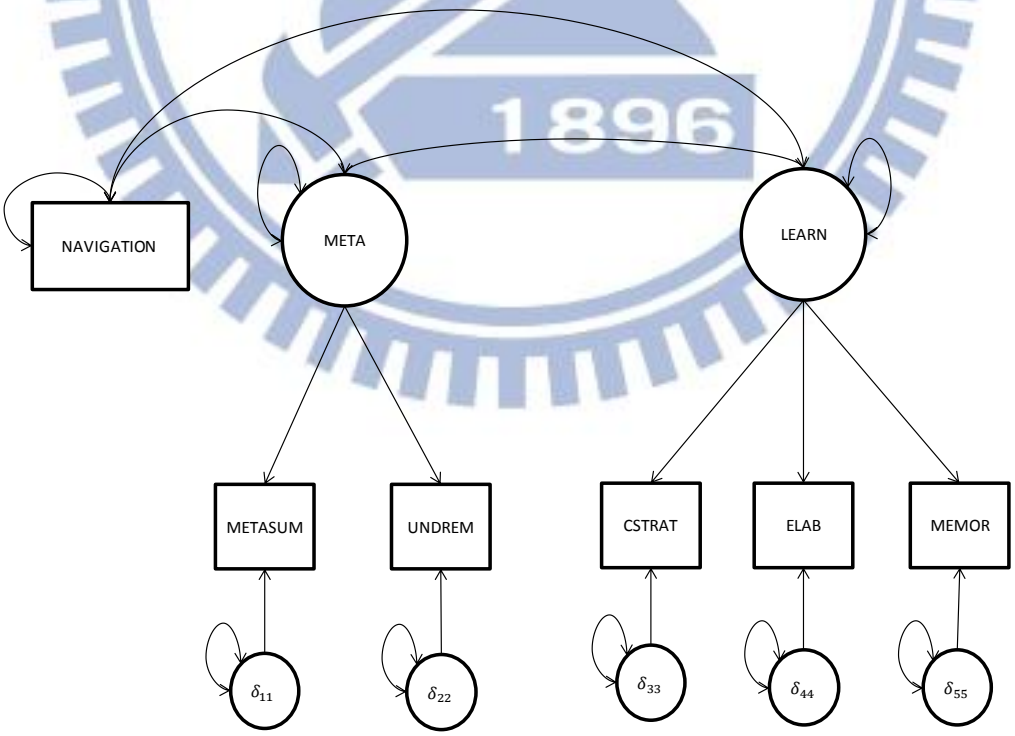


Figure 3.3 The hypothesized measurement model of mediators

(4) Structural equation model (SEM)

Structural equation models (SEMs) which integrate path analysis, confirmatory factor analysis, and regression are usually conducted to exam hypothesized measurement or structural models. For measurement models, SEMs are used to get rid of measurement error, and for structural models, SEMs are adopted to establish a statistically causal relationship between exogenous variables and endogenous variables. Therefore, SEM is a versatile tool to test the mediation model with observed and latent variables in one analysis. Noted that SEM is usually applied to large sample size data sets, and the size of sample is at least larger than 200. PISA is a large sample size data set which is suitable for SEM. Hence, SEM was conducted to test a mediation model we proposed with Mplus 6.12(Muthén & Muthén, 2010). The Full information Maximum Likelihood (FIML) estimation was used to estimate the parameters with the ability to deal with incomplete dataset. On the other hand, PISA data used two-stage complex survey sampling scheme in which the dependent data usually contain extra correlation among observations. This data dependency issue should be dealt with carefully. In addition, the two-stage sampling would lead to incorrect standard error, and replicate weights could be used to adjust the standard error and further to get the correct estimates. Therefore, we will use replicate weights and plausible values to avert biased population parameters and approach students' true abilities. Sobel test (1982) was conducted in Mplus "indirect" routine to exam the significance of indirect effect. Model fit chi square test, RMSEA, CFI, and SRMR were also used to investigate the goodness of fit of the theoretical model.

(5) Mediation model

In the area of psychology, the relationships between independent variables and dependent variables might be affected by third variable. Therefore, the third variable would always be discussed, controlled, and/or analyzed by the researchers in their research. In this study, I defined this kind of third variables as the mediators in the hypothesized model. That is, I supposed that the relationships between students' two types engagements and students' performances in two kinds of reading environments would be mediated by students' perceived usefulness of metacognitive, the usage of learning strategies and navigation skills. In order to examine the mediational effects of the reading and learning skills, the testing steps and assumptions suggested by Baron and Kenny (1986) would be employed. Following were the examining procedure and the assumptions.

(a) Regression analysis is performed to test the effect of independent variable on dependent variable t (b_c) and the effect must be significant.

(b) Regression analysis is performed to check the effect of independent variable on mediator (b_a) and the effect must be significant.

(c) Multiple regression is performed to examine the effects of independent variable and mediator on dependent variable significant or not. The effect of mediator on dependent variable (b_b) must significant, and the effect of independent variable on dependent variable ($b_{c'}$) would be non-significant or smaller, after the inclusion of mediator in the model.

(d) Sobel test (1982) is performed to examine the indirect effect of independent variable on dependent variable via mediator and the effect must be significant.

If all of the assumptions mentioned above are satisfied, and the $b_{c'}$ is non-significant, we called this model as a "full mediation model. " If all of the

assumptions mentioned above are satisfied, and the b_c - is significant but smaller, we called it a "partial mediation model." However, MacKinnon (2008) argued that a mediation model just needed to satisfy the second, third and the last assumptions, the first one was not essential.

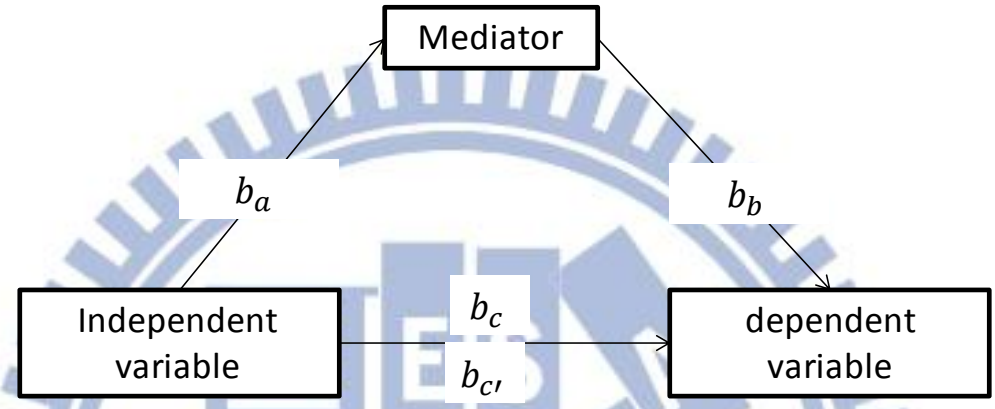


Figure 3.4 Mediation model

Chapter 4 **Results**

The results of CFA and SEM analysis would be presented in this chapter. It should be noted that, in current study with PISA data, replicate weights were used to yield consistent estimates of standard errors. However, while replicate weights were taken into consideration, the model fit chi square and CFI would not be provided in Mplus. Therefore, RMSEA and SRMR would only be used to evaluate the goodness fit of hypothesized model in the study. In addition, the standardized coefficients were also reported, so that I can further investigate the extent of effects of two online reading activities, the usage of learning strategies, perceived usefulness of metacognitive strategies and navigation skills on printed reading and electronic reading performances.

4.1. Descriptive statistic and primary exploring of relationships among variables

The mean, median, mode, standard deviation, variance, skewness, and kurtosis information of the items and indices were presented in Table 4.1. In terms of the samples used in the research, their PRA had a mean of 498.68 and a standard deviation (SD) of 94.70, and their ERA had a mean of 495.93 and a standard deviation of 96.15. The means of the items ranged from 3.15 to 4.01, and the means of the indices ranged from -.036 to .053. Most distribution of the items and indices showed positive or negative skewness, except ST26Q04. As for the kurtosis, all of the items and indices were leptokurtic or platykurtic, and this may attributed to the fact that large sample size leaded to the small standard error, so that the hypothesis tests of platykurtic or leptokurtic would be significant easily (Waternaux, 1976).

Regarding the linear associations among variables, almost all of the correlations in Table 4.2 were significant with the exception of the relationships between gender and ST26Q07, ERA and ELAB, as well as MEMOR and METASUM ($r_{gender\ \&\ ST26Q07} = -.006, p = .238$; $r_{ERA\ \&\ ELAB} = .005, p = .314$; $r_{MEMOR\ \&\ METASUM} = .003, p = .526$). According to Cohen (1992) the results showed that the outcome of PRA and ERA correlates strongly ($r_{PRA\ \&\ ERA} = .850$, $p < .001$). The relationships between PRA and ESCS ($r_{PRA\ \&\ ESCS} = .364, p < .001$), and between ERA and ESCS ($r_{ERA\ \&\ ESCS} = .405$, p $< .001$) yielded medium effect size. As show in Table 4.2 , the correlation between PRA and seven items of online reading activities engagements ranged from -.013 to .221, and the correlation between PRA and the six indicators of three mediators are from -.023 to .623. Regard with students' electronic reading performances, the correlation between ERA and six items of online reading activities engagements were from .038 to .201, between ERA and six indicators of mediators ranged from .005 to .683.

Table 4.1 Descriptive statistic

	ESCS	PV1READ	PV1ERA	ST26Q01	ST26Q02	ST26Q03	ST26Q04	ST26Q05	ST26Q07	CSTRAT	ELAB	MEMOR	METASUM	UNDREM	uni_rel_pages_so_c
Mean	-.068	498.681	495.935	3.650	4.006	3.252	3.230	3.491	3.150	-.036	-.022	.053	-.010	.005	.172
Std. Error of Mean	.005	.513	.521	.006	.006	.006	.005	.005	.005	.005	.005	.005	.006	.006	.051
Median	-.041	503.310	503.600	4.000	4.000	3.000	3.000	3.000	3.000	-.041	.039	.103600	.087	.316	2.212
Mode	.969	526.110	505.350	4.000	5.000	2.000	3.000	3.000	3.000	.216	-.274	.1036	.506	.316	4.672
Std. Deviation	.999	94.700	96.150	1.038	1.125	1.136	.989	.935	.982	.990	.998	.992	1.004	1.003	9.433
Variance	.997	8968.082	9244.887	1.077	1.265	1.290	.979	.874	.965	.980	.995	.983	1.009	1.007	88.984
Skewness	-.337	-.248	-.397	-.429	-.880	.102	-.008	-.157	.122	-.154	-.163	-.162	-.540	-.277	-.783
Std. Error of Skewness	.013	.013	.013	.013	.013	.013	.013	.013	.013	.013	.013	.013	.013	.013	.013
Skewness/SE	-25.292	-18.708	-29.904	-32.197	-66.086	7.669	-.574	-11.795	9.172	-11.557	-12.256	-12.159	-40.017	-20.513	-59.021
sig or not	Sig	Sig	Sig	Sig	Sig	Sig	Non sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
Kurtosis	.148	-.126	.188	-.655	-.407	-1.177	-.600	-.395	-.563	1.298	.570	1.192	-.643	-.917	.436
Std. Error of Kurtosis	.027	.027	.027	.027	.027	.027	.027	.027	.027	.027	.027	.027	.027	.027	.027
Kurtosis/SE	5.541	-4.748	7.081	-24.583	-15.287	-44.103	-22.503	-14.837	-21.122	48.782	21.418	44.802	-23.841	-34.000	16.425
sig or not	Sig	Sig	Sig	Sig	sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig

Note. ESCS: students' economic, social and cultural status; PV1READ:printed reading literacy; PV1ERA:Electronic reading literacy; ST26Q01: Reading emails ; ST26Q02: <Chat on line> (e.g. <MSN® >); ST26Q03: Reading online news; ST26Q04: Using an online dictionary or encyclopaedia (e.g. <Wikipedia® >); ST26Q05: Searching online information to learn about a particular topic; ST26Q07: Searching for practical information online (e.g. schedules, events, tips, recipes); CSRTAT: frequencies of using control strategies; MEMOR: frequencies of using memorizing strategies; ELAB: frequencies of using elaboration strategies; METASUM: perceived usefulness of summarizing strategies; UNDRAM: perceived usefulness of understanding and remembering strategies; uni_rel_page_so_c: the centered numbers of the relevant pages visited by students during the digital reading assignment

Table 4.2 Pearson zero-order correlation between items, indices and observed variables

	Gender	ESCS	PV1READ	PV1ERA	ST26Q01	ST26Q02	ST26Q03	ST26Q04	ST26Q05	ST26Q07	CSTRAT	ELAB	MEMOR	METASUM	UNDREM	uni_rel_pages_so_c
Gender	--															
(1=female,2=male)																
ESCS	.011*	--														
PV1READ	-.184**	.368**	--													
PV1ERA	-.116**	.405**	.850**	--												
ST26Q01	-.055**	.200**	.114**	.140**	--											
ST26Q02	-.025**	.121**	-.013*	.038**	.393**	--										
ST26Q03	.059**	.107**	.096**	.110**	.311**	.342**	--									
ST26Q04	-.022**	.172**	.221**	.201**	.282**	.253**	.423**	--								
ST26Q05	.028**	.190**	.153**	.152**	.279**	.196**	.374**	.548**	--							
ST26Q07	-.006	.163**	.155**	.169**	.259**	.249**	.368**	.408**	.472**	--						
CSTRAT	-.107**	.170**	.232**	.187**	.128**	.018**	.137**	.240**	.264**	.216**	--					
ELAB	.045**	.073**	.037**	.005	.072**	.036**	.191**	.225**	.249**	.235**	.542**	--				
MEMOR	-.080**	-.015**	-.023**	-.059**	.062**	.066**	.151**	.164**	.192**	.161**	.537**	.392**	--			
METASUM	-.166**	.205**	.431**	.388**	.065**	-.014*	.031**	.118**	.091**	.072**	.214**	.049**	.003	--		
UNDREM	-.119**	.171**	.373**	.337**	.069**	-.023**	.034**	.101**	.085**	.070**	.235**	.067**	.034**	.451**	--	
uni_rel_pages_so_c	-.086**	.262**	.623**	.683**	.146**	.088**	.109**	.230**	.156**	.161**	.190**	.055**	.035**	.321**	.269**	--

Note. ESCS: students' economic, social and cultural status; PV1READ:printed reading literacy; PV1ERA:Electronic reading literacy; ST26Q01: Reading emails ; ST26Q02: <Chat on line> (e.g. <MSN® >); ST26Q03: Reading online news; ST26Q04: Using an online dictionary or encyclopaedia (e.g. <Wikipedia® >); ST26Q05: Searching online information to learn about a particular topic; ST26Q07: Searching for practical information online (e.g. schedules, events, tips, recipes); CSRTAT: frequencies of using control strategies; MEMOR: frequencies of using memorizing strategies; ELAB: frequencies of using elaboration strategies; METASUM: perceived usefulness of summarizing strategies; UNDRAM: perceived usefulness of understanding and remembering strategies; uni_rel_page_so_c: the centered numbers of the relevant pages visited by students during the digital reading assignment

* $p \leq .05$. ** $p \leq .01$.

4.2. Measurement model of the two online reading activities and mediators

As shown in Figure 4.1 and Figure 4.2, there were two CFA models: social and information-seeking online activities, and three reading strategies (mediator parts) in this study. The first CFA model that invested the associations and nature of students' online reading engagement contained six observed variables and two latent variables. One of the latent factors was students' social online reading engagement which was indicated by students' frequencies of reading emails (ST26Q01) and frequencies of chatting online (ST26Q02). The other latent factors was students' information-seeking online reading engagement which was constructed by students' frequencies of reading online news(ST26Q03), using an online dictionary or encyclopaedia (e.g. <Wikipedia® >)(ST26Q04), searching online information to learn about a particular topic(ST26Q05) and searching for practical information online (e.g. schedules, events, tips, recipes)(ST26Q07). The second CFA model which examined the construct of and relationships among mediators included the features of two common factors and seven observed variables. Students' self-reported perceived usefulness of metacognitive strategies was one of the latent factors. It was indicated by students' judgments about usefulness of summarizing, remembering and understanding strategies in reading tasks. Students' usage of learning strategies was the other latent variable. It included the features of the self-reported frequencies of using control strategies, elaboration strategies and memorization strategies. In addition, students' outcome of navigation was also included in the model to show the whole picture of the relationships among three mediators. Based on the thresholds suggested by Hu and Bentler (1998), the online reading activities CFA model had a good fit (RMSEA=.065, SRMR=.023). Moreover, the statistically significant factor loadings ranged from .458 to .725. Variance of ST26Q01 and variance of ST26Q02 were explained 21% and 32.5% by social reading engagement ($r^2_{ST26Q01}$ =.210; $r^2_{ST26Q02}$ =.325). Information seeking reading engagement could explain 37.9% variance of ST26Q03, 49.6% variance of ST26Q04, 52.5% variance of ST26Q05, and 39.1% variance of ST26Q07 ($r^2_{ST26Q03} = .379$; $r^2_{ST26Q04} = .496$; $r^2_{ST26Q05} = .525$; $r^2_{ST26Q07} = .391$). As for the CFA model of reading strategies, its SRMR showed good fit (SRMR=.045); RMSEA was not so good, but acceptable (RMSEA=.096). We concluded that the CFA model

had a mediocre model fit. All of the factor loadings in this model, as depicted in Figure 4.2,were statistically significant, and the standardized coefficients of the factor loading ranged from .607 to .909. The values of r^2 indicated that the latent variable, perceived usefulness of metacognitive strategies could explain 55.5% variance of students' judgments about usefulness of summarizing strategies, and 37.5% variance of students' judgments about usefulness of understanding and remembering strategies ($r^2_{METASUM}$ =.555; r^2_{UNDREM} =.375). Students' self-reported learning strategies use could explain 82.6% variance of the frequencies of control strategies use, 37.1% variance of the frequencies of elaboration strategies use, and 36.8% variance of the frequencies of memorization strategies using (r^2_{CSTRAT} =.826; r^2_{ELAB} =.371; r^2_{MEMOR}=.368).

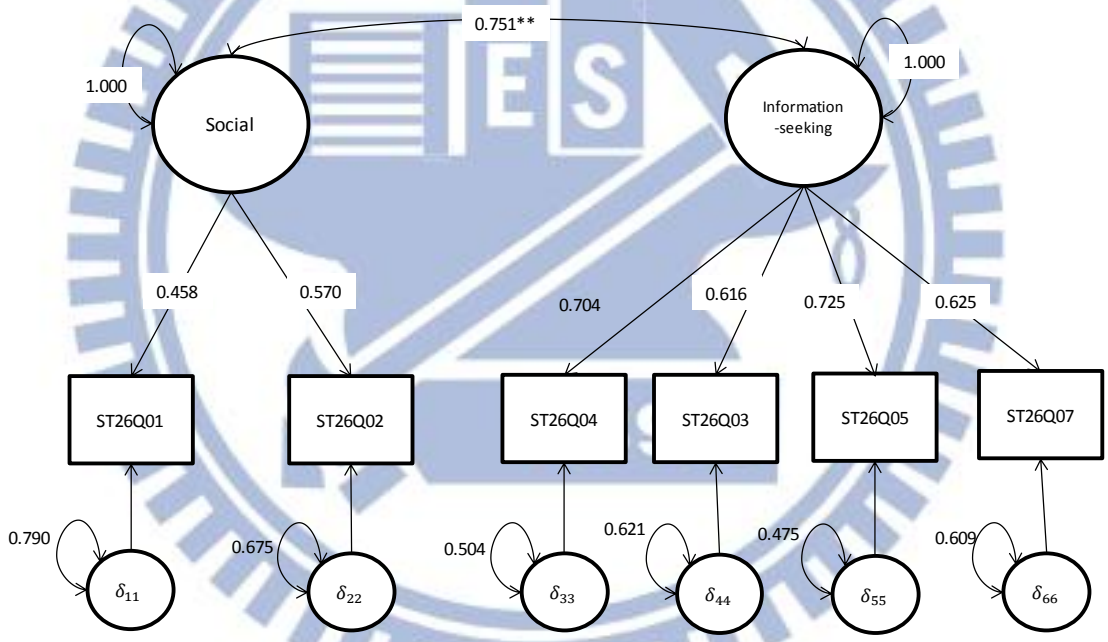


Figure 4.1 CFA model of two exogenous variables (RMSEA=.065, SRMR=.023)

Social: students' engagements in social online reading activities; ST26Q01: students' frequencies of using emails; ST26Q02: students' frequencies of chatting online; Information seeking: students' engagements in information seeking online reading activities; ST26Q03: students' frequencies of reading online news ; ST26Q04: students' frequencies of using an online dictionary or encyclopaedia (e.g. <Wikipedia® >); ST26Q05: students' frequencies of searching online information to learn about a particular topic ;ST26Q07:students' frequencies of searching for practical information online (e.g. schedules, events, tips and recipes)

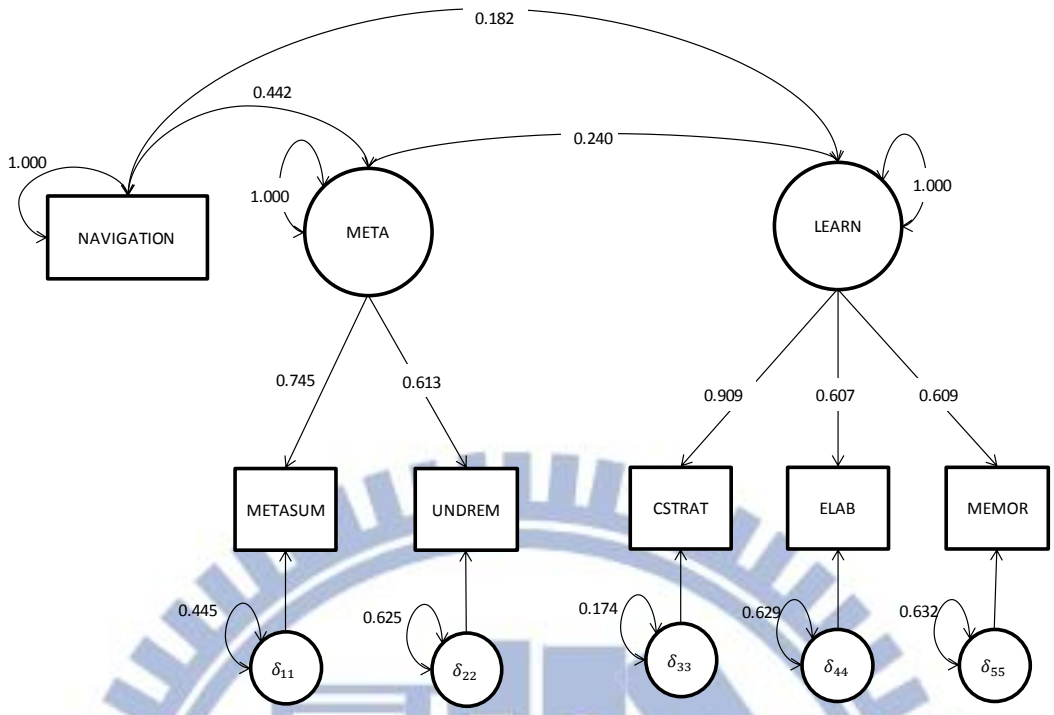


Figure 4.2 CFA model of mediators. META : students' perceived usefulness of metacognitive strategies; METASUM: students' evaluation of usefulness of the summarizing strategies; UNDREM: students' evaluation of usefulness of understanding and remembering; LEARN: students' usage of learn strategies; CSTRAT: students' frequencies of using control strategies; ELAB: students' frequencies of using elaboration strategies ; MEMOR: which indicated, students' frequencies of using memorization strategies; Navigation: the centered number of relevant pages hits.

4.3. Structural equation model (SEM)

This study aimed to investigate the effects of 15 years old students' social and information-seeking reading engagements on their PRA and ERA performances, via perceived metacognitive strategies, the usage of learning strategies and navigation skills, holding the effects of gender and ESCS. Based on the mediation model testing procedure and assumptions listed in chapter three, my hypothesized model satisfied all of the conditions. Moreover, with the inclusion of mediators, the effects of two online reading engagements on two reading literacies became small($\beta_{social\rightarrow \mathrm{PRA}_{\text{exclude mediators}}} = -.430, p < .001; \beta_{social\rightarrow \mathrm{ERA}_{\text{exclude mediators}}} = -.298, p < .001; \beta_{social\rightarrow \mathrm{PRA}_{\text{include mediators}}} = -.335, p < .001; \beta_{social\rightarrow \mathrm{ERA}_{\text{include mediators}}} = -.257, p < .001; \beta_{Inform\rightarrow \mathrm{PRA}_{\text{exclude mediators}}} = .471, p < .001; \beta_{Inform\rightarrow \mathrm{ERA}_{\text{exclude mediators}}} = .377, p < .001; \beta_{Inform\rightarrow \mathrm{PRA}_{\text{include mediators}}} = .338, p < .001; \beta_{Inform\rightarrow \mathrm{ERA}_{\text{include mediators}}} = .283, p < .001$, but they were significant. In other words, the hypothesized model which illustrated in Figure 4.3 was a partial mediation model. According to Hu and

Bentler (1998), the mediation model proposed in this research showed fair fit (RMSEA=.068 and SRMR=.062). Most of the research hypotheses were supported by the results of Structural equation model analyses, except for the effect of social reading engagement on navigation skills, and the effects of self-reported learning strategies use on students' performances in PRA and ERA.

4.3.1. Controlled demographic variables

As shown in the first two columns of Table 4.3 and Table 4.4 gender had significant effects on participants' perceived usefulness of metacognitive strategies, learning strategies use, navigation skills, and PRA and ERA as well ($\beta_{male \rightarrow Meta} = -.192, p < .001$; $\beta_{male \rightarrow Learn} = -.088, p < .001$; $\beta_{male \rightarrow navi} = -.068, p < .001$; $\beta_{male \rightarrow \mathrm{PRA}} = -.086, p < .001$; $\beta_{male \rightarrow \mathrm{ERA}} = -.034, p < .001$, respectively). There was significant difference between boys' and girls' performances in all of the endogenous variables. Overall, girls outperformed boys by .192, .088, .068, .086, and .034 standard deviations (SDs) in perceived usefulness of metacognitive strategies, the usage of learning strategies, navigation skills, PRA and ERA, respectively, holding all other variables. Interestingly, when I checked the results of the separate country, I found that the disparity between boys and girls in ERA performances was not so significant. The results from the 19 individual participating countries showed the same insignificant in most countries, that is, there were not significant difference between boys and girls in the outcome of ERA, except for Macao, Chile, Colombia, Norway, Denmark and Poland. In terms of the ESCS, students' perceived usefulness of metacognitive strategies, navigation skills, PRA and ERA were positively and significantly impacted by ESCS ($\beta_{ESCS \rightarrow Meta} = .308, p < .001$; $\beta_{ESCS \rightarrow Navi} = .258, p < .001$; $\beta_{ESCS \rightarrow PRA} = .224, p < .001$; $\beta_{ESCS \rightarrow ERA} = .266, p < .001$, $respectively$), except for students' frequencies of learning strategies using ($\beta_{ESCS \rightarrow Learn} = .010, p = .549$). On average, when ESCS increases 1 SD, students' perceived usefulness of metacognitive strategies increases .308 SD, navigation skills increases .258 SD, printed reading literacy increases .224 SD and ERA increases .266 SD, holding for all other predictors.

Table 4.3 The path coefficients of controlled variables
(for all of the 19 countries, Asian countries, South American countries and Oceanian countries)

Country or area			19 countries		Hong Kong		Korea		Japan		Macao		New Zealand		Australia		Chile		Colombia	
direct effect			Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE
MALE	→	Meta	***-0.278***	***0.019***	***-.235***	***0.044***	***-0.331***	***0.062***	***-0.283***	***0.088***	***-0.337***	***0.031***	***-0.379***	***0.044***	***-0.312***	***0.038***	***-0.160***	***0.040***	-0.029	0.047
			(-.192)		***(-.162)***		***(-.209)***		***(-.192)***		***(-.251)***		***(-.251)***		***(-.215)***		***(-.133)***		(-.021)	
	→	Learn	***-0.148***	***0.029***	-.078	0.052	-0.078	0.056	0.086	0.103	-0.034	0.030	***-0.366***	***0.049***	***-0.290***	***0.049***	***-0.138***	***0.044***	***-0.229***	***0.050***
			(-.088)		(-.044)		(-.044)		(.046)		(-.022)		***(-.189)***		***(-.142)***		***(-.083)***		***(-.147)***	
	→	Navi	***-1.263***	***0.175***	-.855	0.444	-0.746	0.442	-1.401	0.830	0.255	0.334	***-2.944***	***0.462***	***-2.085***	***0.374***	-0.429	0.496	0.763	0.614
			(-.068)		(-.048)		(-.057)		(-.090)		(.015)		***(-.176)***		***(-.122)***		(-.020)		(.037)	
	→	PRA	***-16.493***	***1.912***	***-22.339***	***3.873***	***-18.805***	***4.026***	-7.704	9.601	***-28.359***	***2.898***	***-14.255***	***3.585***	**-6.846**	**2.776**	***-14.838***	***2.960***	-7.219	4.259
			(-.086)		***(-.134)***		***(-.122)***		(-.046)		***(-.180)***		***(-.073)***		**(-.036)**		***(-.091)***		(-.043)	
	→	ERA	***-6.827***	***1.688***	-2.321	3.239	-3.879	3.844	-0.330	6.114	***-7.574***	***2.452***	-6.058	3.212	1.546	2.589	***-13.033***	***2.527***	-7.498	2.921
			(-.034)		(-.015)		(-.029)		(-.002)		***(-.056)***		(-.033)		(.009)		***(-.075)***		(-.047)	
ESCS	→	Meta	***0.219***	***0.008***	***.084***	***0.027***	***0.239***	***0.037***	***0.142***	***0.046***	***0.096***	***0.026***	***0.252***	***0.028***	***0.245***	***0.027***	***0.189***	***0.022***	***0.161***	***0.023***
			(.308)		***(.121)***		***(.245)***		***(.142)***		***(.129)***		***(.261)***		***(.252)***		***(.370)***		***(.307)***	
	→	Learn	.008	0.014	***.178***	***0.026***	***0.240***	***0.031***	***0.231***	***0.044***	***0.143***	***0.017***	***0.207***	***0.033***	***0.187***	***0.032***	**0.057**	**0.029**	-0.014	0.030
			(.010)		***(.212)***		***(.218)***		***(.184)***		***(.164)***		***(.167)***		***(.136)***		**(.081)**		(-.023)	
	→	Navi	***2.350***	***0.101***	***1.291***	***0.218***	***1.112***	***0.203***	***1.472***	***0.361***	**0.504**	**0.178**	***2.756***	***0.285***	***2.288***	***0.259***	***3.454***	***0.209***	3.208	0.306
			(.258)		***(.154)***		***(.139)***		***(.139)***		**(.055)**		***(.257)***		***(.199)***		***(.389)***		(.400)	
	→	PRA	***21.026***	***0.763***	3.380	2.443	15.342	***2.909***	***11.491***	***3.192***	0.403	1.663	***22.632***	***2.518***	***13.643***	***2.116***	***7.804***	***1.852***	4.156	2.122
			(.224)		(.043)		(.161)		***(.101)***		(.005)		***(.180)***		***(.107)***		***(.113)***		(.063)	
	→	ERA	***26.202***	***0.938***	***6.348***	***1.479***	12.401	***2.146***	***11.487***	***2.897***	-0.083	1.241	***14.700***	***2.132***	***11.634***	***1.921***	***6.661***	***1.564***	***5.624***	***1.840***
			(.266)		***(.087)***		(.148)		***(.123)***		(-.001)		***(.123)***		***(.095)***		***(.090)***		***(.089)***	

Note. Male(Male=1, Female=0)

* $p \leq .05$.; ** $p \leq .01$.; The values put in the Coeff column indicate path coefficients, and the value in the parenthesis was standardized coefficients.

Table 4.4 The path coefficients of controlled variables (for the European countries)

Country or area			Iceland		Sweden		Ireland		Belgium		Norway		France		Denmark		Spain		Hungary		Poland		Austria	
direct effect			Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE
MALE	→	Meta	***-0.525*** ***(-.359)***	***0.059***	***-0.353*** ***(-.242)***	***0.035***	***-0.337*** ***(-.243)***	***0.057***	***-0.262*** ***(-.175)***	***0.042***	***-0.415*** ***(-.305)***	***0.040***	***-0.258*** ***(-.184)***	***0.045***	***-0.429*** ***(-.319)***	***0.054***	***-0.371*** ***(-.270)***	***0.042***	***-0.396*** ***(-.264)***	***0.060***	***-0.335*** ***(-.221)***	***0.049***	***-0.430*** ***(-.308)***	***0.047***
	→	Learn	***-0.246*** ***(-.139)***	***0.062***	***-0.284*** ***(-.157)***	***0.040***	***-0.260*** ***(-.128)***	***0.057***	***-0.170*** ***(-.103)***	***0.038***	***-0.152*** ***(-.085)***	***0.057***	***-0.284*** ***(-.166)***	***0.051***	**-0.152** **(-.100)**	**0.067**	***-0.269*** ***(-.134)***	***0.064***	***-0.225*** ***(-.118)***	***0.051***	***-0.365*** ***(-.203)***	***0.038***	***-0.224*** ***(-.117)***	***0.052***
	→	Navi	***-3.612*** ***(-.209)***	***0.490***	***-2.414*** ***(-.134)***	***0.372***	***-3.105*** ***(-.168)***	***0.577***	***-1.980*** ***(-.109)***	***0.377***	***-2.966*** ***(-.164)***	***0.408***	***-1.521*** ***(-.078)***	***0.533***	***-1.629*** ***(-.094)***	***0.562***	**-1.094** **(-.055)**	**0.472**	***-2.918*** ***(-.134)***	***0.623***	***-2.070*** ***(-.099)***	***0.458***	***-2.290*** ***(-.108)***	***0.719***
	→	PRA	***-16.504*** ***(-.091)***	***5.307***	***-15.836*** ***(-.083)***	***3.149***	***-12.535*** ***(-.068)***	***4.215***	-4.401 (-.023)	2.909	***-17.607*** ***(-.098)***	***3.652***	***-18.297*** ***(-.095)***	***3.745***	***-13.007*** ***(-.081)***	***4.926***	***-10.835*** ***(-.065)***	***3.117***	***-20.149*** ***(-.111)***	***3.492***	***-30.194*** ***(-.174)***	***2.920***	***-15.885*** ***(-.082)***	***4.731***
	→	ERA	-4.304 (-.025)	4.149	-4.433 (-.026)	2.774	-5.495 (-.033)	3.569	-4.185 (-.024)	2.441	**-6.363** **(-.039)**	**2.859**	-4.270 (-.024)	3.303	***10.220*** ***(.064)***	***3.620***	-3.865 (-.021)	2.835	-4.903 (-.024)	3.260	**-9.271** **(-.052)**	**3.014**	4.849 (.026)	4.276
ESCS	→	Meta	***0.169*** ***(.203)***	***0.028***	***0.223*** ***(.250)***	***0.025***	***0.128*** ***(.157)***	***0.026***	***0.284*** ***(.352)***	***0.020***	***0.162*** ***(.176)***	***0.028***	***0.195*** ***(.230)***	***0.030***	***0.220*** ***(.288)***	***0.035***	***0.132*** ***(.205)***	***0.023***	***0.204*** ***(.268)***	***0.060***	***0.296*** ***(.252)***	***0.027***	***0.208*** ***(.240)***	***0.025***
	→	Learn	***0.149*** ***(.148)***	***0.038***	***0.138*** ***(.124)***	***0.029***	***0.204*** ***(.172)***	***0.034***	***0.182*** ***(.204)***	***0.022***	***0.188*** ***(.155)***	***0.034***	***0.182*** ***(.175)***	***0.050***	**0.081** **(.093)**	**0.039**	***0.114*** ***(.122)***	***0.027***	-0.028 (-.029)	0.045	***0.123*** ***(.119)***	***0.024***	**0.081** **(.068)**	**0.036**
	→	Navi	***1.931*** ***(.197)***	***0.357***	***2.765*** ***(.251)***	***0.261***	***1.876*** ***(.174)***	***0.336***	***3.432*** ***(.351)***	***0.206***	***1.800*** ***(.147)***	***0.360***	***3.042*** ***(.255)***	***0.373***	***2.407*** ***(.245)***	***0.319***	***2.450*** ***(.264)***	***0.472***	***4.640*** ***(.419)***	***0.360***	***3.599*** ***(.301)***	***0.282***	***3.683*** ***(.281)***	***0.369***
	→	PRA	**8.820** **(.086)**	**2.347**	***19.466*** ***(.167)***	***2.398***	***13.356*** ***(.124)***	***2.185***	***12.251*** ***(-.023)***	***1.423***	***16.810*** ***(.139)***	***2.196***	***21.351*** ***(.183)***	***3.468***	***16.531*** ***(.181)***	***2.808***	***11.256*** ***(.144)***	***1.893***	***20.308*** ***(.221)***	***2.160***	***11.517*** ***(.115)***	***2.077***	***17.217*** ***(.144)***	***2.309***
	→	ERA	***10.512*** ***(.107)***	***1.953***	***13.139*** ***(.125)***	***2.056***	***9.628*** ***(.097)***	***1.629***	***11.972*** ***(.125)***	***1.269***	***9.596*** ***(.087)***	***1.651***	***11.687*** ***(.106)***	***3.314***	***9.726*** ***(.107)***	***2.010***	***9.173*** ***(.108)***	***1.545***	***19.965*** ***(.197)***	***2.096***	***12.637*** ***(.124)***	***1.663***	***11.104*** ***(.094)***	***1.908***

Note. Male (Male=1, Female=0)

* $p \leq .05$.; ** $p \leq .01$.; The values put in the Coeff column indicate path coefficients, and the value in the parenthesis was standardized coefficients.

4.3.2. Main study variables

4.3.2.1. Direct effect of students' engagement in online reading activities on PRA and ERA

In terms of the relationships between two types of online reading engagements and two types of reading performances, the results supported my hypotheses. The result reflected in Figure 4.3 and Table 4.5 indicated that students' social online reading engagement has significant and negative effects on their printed reading literacy and electronic reading literacy ($\beta_{Social \rightarrow PRA} = -.355, p < .001$; $\beta_{Social \rightarrow ERA} = -.257, p < .001$). For every 1 SD increases in social online reading engagement, the printed reading literacy decreases .355 SD, and the electronic reading literacy decreases .257 SD, controlling other variables. Conversely, students' engagements in information seeking reading activities had significant and positive effects on printed reading literacy and electronic reading literacy ($\beta_{Inform \rightarrow PRA} = .338, p < .001$; $\beta_{Inform \rightarrow ERA} = .283, \mathrm{p} < .001$). For every 1 SD increases in information seeking reading engagements, students' PRA performances improves .338 SD, and ERA performances improves .283 SD, holding other variables.

4.3.2.2. Direct effect of students' online reading engagements on self-reported usage of learning strategies, perceived usefulness of metacognitive strategies and navigation skills.

As Table 4.2 presented, students' social online reading engagements significantly affected students ' usage of learning strategies and perceived usefulness of metacognitive strategies , but had no effects on students' navigation skills ($\beta_{Social \rightarrow Meta} = -.246, p < .001$; $\beta_{Social \rightarrow Learn} = -.196, p < .001$, $\beta_{Social \rightarrow Navigation} = .003, p = .890,$ respectively). For every 1 SD increases in students' social online reading engagements, their perceived usefulness of metacognitive strategies decreases.246 SD and their learning strategies use decreases .196 SD, controlling other variables. Students' information seeking reading engagements, in contrast, had significant and positive effects on all of the mediators

($\beta_{Inform \rightarrow Meta} = .272, p < .001$; $\beta_{Inform \rightarrow Learn} = .545, p <$ $.001$; $\beta_{Inform \rightarrow Navigation} = .230, p < .001$). For every 1 SD increases in students' information seeking reading engagements, their perceived usefulness of metacognitive strategies increases .272 SD, and learning skills increases .545 SD and navigation skills improves .230 SD, holding other variables.

4.3.2.3. Direct effect of students' perceived usefulness of metacognitive strategies, the usage of learning strategies and navigation skills on PRA and ERA

The results shown in Figure 4.3 and Table 4.5 revealed that students' perceived usefulness of metacognitive strategies affected PRA and ERA positively ($\beta_{Meta \rightarrow PRA} = .363, p < .001, and\ \beta_{Meta \rightarrow ERA} = .287, p < .001$). For every 1 SD increases in perceived usefulness of metacognitive strategies, students' printed reading literacy increases .363 SD, and electronic reading literacy increases .287 SD, holding other constants. With regard to navigation skills, students' outcome of PRA and ERA could be positively explained by their navigation skills ($\beta_{Navigation \rightarrow PRA} =$ $.348, p < .001, and\ \beta_{Navigation \rightarrow ERA} = .432, p < .001$). With every 1 SD changes in navigation skills, printed reading literacy changes .348 SD, and electronic reading literacy changes .432 SD.

In terms of the usage of learning strategies, it was surprised that students' usage of learning strategies had negative effects on printed and electronic reading literacies. This was unexpected and irrational. With observing and checking the data further, I found that in the overall sample of nineteen countries, the effects of students' the usage of learning strategies on printed and electronic reading literacies were very small, although the coefficients were statistically significant, ($\beta_{Learn \rightarrow PRA} =$ $-.090, p < .001, and\ \beta_{Learn \rightarrow ERA} = -.159, p < .001$). Consequently, I supposed the significance of coefficients may result from the large sample size (N= 34104). Subsequently, we checked the relationships among the usage of learning strategies and two types of reading literacies in separate participating countries and areas. The results in Table 4.5 and Table 4.6 showed that the relationship between students' usage of learning strategies and PRA outcome was insignificant in most of the

participating countries, but positive in Hong Kong , Japan, Chile, France and Poland ($\beta_{HK} = .092, p = .004$; $\beta_{JAP} = .068, p = .024$; $\beta_{CHL} = .051, p = .039$; $\beta_{FRA} = .079, p = .027$, $\beta_{POL} = .057, p = .004$, respectively), and negative in Iceland($\beta_{ISL} = -.053, p = .049$). Although some countries showed significant pattern, their values of regression coefficients were only very small effect size. In regards to the effects of the usage of learning strategies on ERA, the results in Table 4.5 and Table 4.6 revealed that most of the participating countries also showed the insignificant tendencies , but Chile, Denmark and Hungary showed the significant patterns ($\beta_{CHL} = .051, p = .004$; $\beta_{DNK} = -.100, p = .002$ and $\beta_{HUN} = -.039, p = .034$). As the trends shown in printed reading literacy, Chile, Denmark and Hungary showed significant standardized coefficients, however, these values of the standardized regression coefficients were small.

Based on the evidences presented above, I supposed that this mediator, the usage of learning strategies, may be a "suppressor". Suppressor usually had high correlation with the independent variables, but insignificant or of opposite effects (i.e., The relationship between two variables should be positive, but the results showed the negative effects) on dependent variables (Cheung & Lau, 2008; Cohen, 2003; Maassen & Bakker, 2001; MacKinnon, Krull, & Lockwood, 2000). It could enhance the overall multiple r^2 of the model, as well as the values of regression coefficients between the independent variables and dependent variables when suppressor was included in the model (Cheung & Lau, 2008; Cohen, 2003; Maassen & Bakker, 2001; MacKinnon et al., 2000) . In order to verify my supposition, I employed several checking steps. First of all, I tested a model which the paths from the usage of leaning strategies to the two reading literacies were constrained at zero. The results showed that the absolute value of the standard coefficients between perceived usefulness of metacognitive strategies and two reading literacies became smaller when the paths from the usage of learning strategies to PRA and ERA performance were constrained at zero. The original standardized regression coefficients of perceived usefulness of metacognitive strategies on printed and electronic reading literacies were .363 and .287, respectively ($\beta_{Meta \rightarrow PRA} = .363, p < .001, and\ \beta_{Meta \rightarrow ERA} = .287, p < .001$). In the constrained model, the standardized regression coefficients of perceived usefulness of metacognitive strategies on printed and electronic reading literacies

became .35 and .265, respectively ($\beta_{Meta \rightarrow PRA\_c} = .35, p < .001, and\ \beta_{Meta \rightarrow ERA\_c} = .265, p < .001$). Moreover, the results also showed that the multiple r^2 of the constrained model reduced. The original r^2 of printed and electronic reading literacies were .612 and .608 ($r^2_{PRA} = .612; r^2_{ERA} = .608$), respectively. As the effects between the usage of learning strategies and two reading literacies were constrained, the r^2 of printed and electronic reading literacies became .592 and .575, respectively ($r^2_{PRA\_c} = .592; r^2_{ERA\_c} = .575$). Secondly, I compared the model selection index of original model and the constrained model. According to BIC of two models, we found that these two models were significantly different. The disparity of the BIC values between original model and the constrained model was larger than 10 and the values of BIC in original model was smaller than the original model ($BIC_{constrained\ model}: 1986813.437 - BIC_{original\ model}: 1985864.012 = 949.425 > 10$). In other words, the original model was better than the constrained model (Raftery, 1995). In conclusion, the inclusion of usage of learning strategies could indeed enhance the multiple r^2 of the model and the effects of perceived usefulness of metacognitive strategies on PRA and ERA performances. Furthermore, the model taken this mediator into consideration was better than the constrained model. Based on these evidences, I confirmed that the usage of learning strategies was a suppressor in this mediation model.

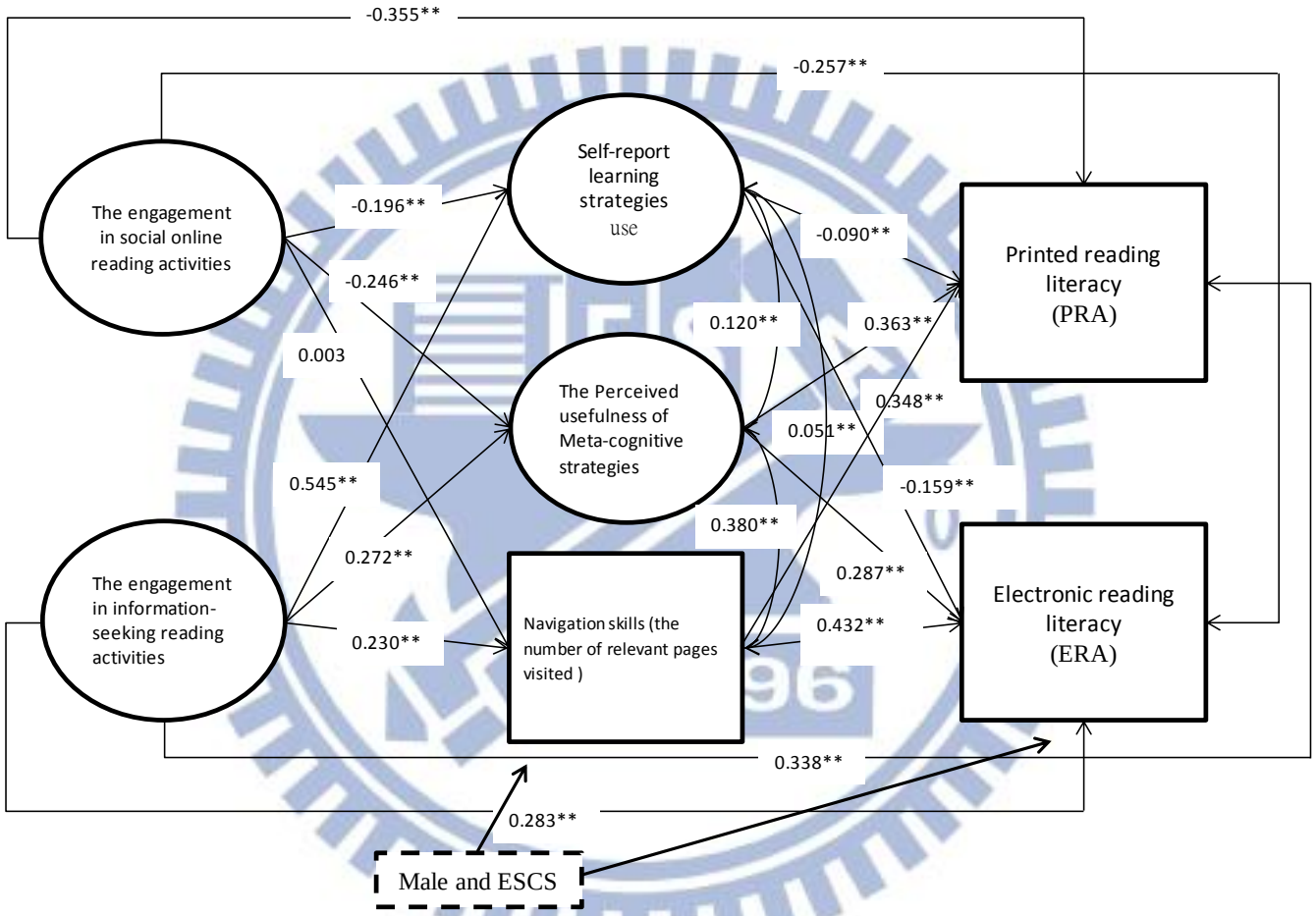


Figure 4.3 The mediation model with standardized coefficients.

Note. Gender and ESCS were controlled in this model.* $p \leq .05$. ; ** $p \leq .01$.

Table 4.5 Direct path estimates of all of the 19 countries, Asian countries, South American countries and Oceanian countries.

Country or area (ranking)			19 countries		Hong Kong (5)		Korea (1)		Japan (4)		Macao (12)		New Zealand (2)		Australia (2)		Chile (18)		Colombia (19)	
Model fit indices			RMSEA=.068 SRMR= .062		RMSEA=.070 SRMR= .056		RMSEA=.055 SRMR= .058		RMSEA=.048 SRMR= .041		RMSEA=.062 SRMR=.058		RMSEA=.071 SRMR= .069		RMSEA= .068 SRMR= .060		RMSEA= .089 SRMR= .120		RMSEA= .077 SRMR= .097	
Direct effect			Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE
Social	→	Meta	***-0.363***	***0.084***	***-0.302***	***0.096***	***-0.968***	***0.285***	-0.287	0.237	***-0.253***	***0.081***	***-0.114***	***0.044***	***-0.105***	***0.038***	**0.082**	**0.041**	**-0.108**	**0.049**
			(-.246)		***(-.242)***		***(-.515)***		(-.120)		***(-.246)***		***(-.128)***		***(-.119)***		**(.123)**		**(-.173)**	
	→	Learn	***-0.333***	***0.075***	***-0.572***	***0.111***	***-0.675***	***0.224***	-0.104	0.245	***-0.264***	***0.075***	***-0.155***	***0.058***	***-0.162***	***0.050***	**-0.146**	**0.066**	**-0.120**	**0.050**
			(-.196)		***(-.375)***		***(-.318)***		(-.035)		***(-.218)***		***(-.135)***		***(-.130)***		**(-.158)**		**(-.164)**	
	→	Navi	0.064	0.462	-0.242	0.975	***-5.160***	***1.712***	-1.564	2.299	0.228	0.639	0.593	0.340	-0.342	0.287	***2.039***	***0.597***	0.987	0.544
			(.003)		(-.016)		***(-.335)***		(-.062)		(.018)		(.060)		(-.033)		***(.175)***		(.103)	
	→	PRA	***-69.358***	***15.119***	***-28.454***	***9.227***	***-95.294***	***27.078***	***-70.469***	***26.005***	***-18.799***	***5.346***	**-7.549**	**3.462**	-5.081	2.812	-1.899	3.923	0.489	4.270
			(-.355)		***(-.199)***		***(-.520)***		***(-.259)***		***(-.155)***		**(-.065)**		(-.044)		(-.021)		(.006)	
	→	ERA	***-52.653***	***11.993***	-8.508	5.590	**-26.045**	**12.854**	-16.824	14.970	2.900	4.066	4.272	2.705	0.225	2.079	1.721	3.499	0.172	3.287
			(-.257)		(-.064)		**(-.162)**		(-.075)		(.028)		(.039)		(.002)		(.018)		(.002)	
Inform	→	Meta	***0.273***	**0.037**	***.412***	***0.084***	***0.686***	***0.186***	0.158	0.084	***0.381***	***0.067***	***0.349***	***0.060***	***0.367***	***0.044***	-0.068	0.074	***0.243***	***0.061***
			(.272)		***(.322)***		***(.540)***		(.181)		***(.343)***		***(.276)***		***(.311)***		(-.075)		***(.258)***	
	→	Learn	***0.632***	**0.043**	***.866***	***0.092***	***0.988***	***0.156***	***0.264***	***0.076***	***0.882***	***0.068***	***0.795***	***0.074***	***0.797***	***0.069***	***0.645***	***0.074***	***0.482***	***0.068***
			(.545)		***(.572)***		***(.689)***		***(.238)***		***(.674)***		***(.490)***		***(.479)***		***(.514)***		***(.438)***	
	→	Navi	***2.966***	**0.297**	***3.045***	***0.784***	***4.478***	***1.061***	***2.842***	***0.837***	**1.735**	**0.639**	***2.502***	***0.584***	***3.499***	***0.447***	***2.109***	***0.727***	***2.637***	***0.844***
			(.230)		***(.202)***		***(.430)***		***(.305)***		**(.126)**		***(.178)***		***(.251)***		***(.134)***		***(.183)***	
	→	PRA	***44.933***	**6.259**	***25.827***	***8.229***	**53.466**	**21.044**	***26.518***	***7.408***	***21.111***	***5.654***	4.903	4.746	***21.691***	***4.163***	1.236	5.626	5.259	5.972
			(.338)		***(.182)***		**(.431)**		***(.266)***		***(.161)***		(.030)		***(.140)***		(.010)		(.044)	
	→	ERA	***39.535***	**5.159**	**19.051**	**5.503**	***26.047***	***9.188***	***19.624***	***4.510***	6.530	4.592	4.044	4.119	***15.228***	***3.377***	6.183	5.601	7.516	5.152
			(.283)		**(.145)**		***(.239)***		***(.239)***		(.059)		(.026)		***(.103)***		(.047)		(.067)	
Meta	→	PRA	***48.052***	**2.108**	***31.645***	***4.275***	***26.947***	***6.151***	***54.174***	***8.008***	***35.314***	***2.556***	**50.250**	**4.379**	***47.666***	***3.987***	**50.823**	**5.594**	**49.622**	**6.130**
			(.363)		***(.277)***		***(.276)***		***(.476)***		***(.300)***		**(.386)**		***(.363)***		**(.376)**		**(.392)**	
	→	ERA	***39.913***	**2.920**	***21.199***	***2.759***	***24.129***	***4.104***	***37.025***	***5.947***	***22.691***	***2.556***	**44.300**	**3.952**	***36.904***	***3.010***	**47.706**	**5.197**	**40.098**	**5.108**
			(.287)		***(.201)***		***(.282)***		***(.396)***		***(.226)***		**(.359)**		***(.294)***		**(.332)**		**(.334)**	
Learn	→	PRA	***-10.390***	**1.627**	***8.601***	***3.022***	4.621	3.923	**6.099**	**2.711**	1.143	2.438	-0.149	2.598	-2.056	2.755	**5.014**	**2.429**	-2.765	3.099
			(-.090)		***(.092)***		(.053)		**(.068)**		(.011)		(-.001)		(-.022)		**(.051)**		(-.026)	
	→	ERA	***-19.186***	**1.424**	2.639	2.483	3.590	2.396	-1.506	2.334	1.806	1.846	-2.593	2.042	-0.990	1.817	***6.979***	***2.441***	-0.456	2.768
			(-.159)		(.030)		(.047)		(-.020)		(.021)		(-.027)		(-.011)		***(.067)***		(-.004)	
Navi	→	PRA	***3.589***	**0.154**	***3.891***	***0.264***	***2.955***	***0.540***	***2.705***	***0.337***	***4.009***	***0.160***	***4.778***	***0.305***	***4.917***	***0.249***	***3.445***	***0.215***	***3.418***	***0.290***
			(.348)		***(.413)***		***(.248)***		***(.253)***		***(.421)***		***(.408)***		***(.442)***		***(.443)***		***(.414)***	
	→	ERA	***4.678***	**0.268**	***5.296***	***0.233***	***4.272***	***0.376***	***3.724***	***0.216***	***4.596***	***0.146***	***5.858***	***0.251***	***6.112***	***0.203***	***4.534***	***0.185***	***4.182***	***0.239***
			(.432)		***(.609)***		***(.408)***		***(.423)***		***(.567)***		***(.528)***		***(.576)***		***(.547)***		***(.534)***	

Note. * $p \leq .05$. ; ** $p \leq .01$. ;The values put in the Coeff column indicate path coefficients, and the value in the parenthesis was standardized coefficients.

Table 4.6 Direct path estimates of all of the European countries

Country or area (ranking)			Iceland (6)		Sweden (7)		Ireland (8)		Belgium (9)		Norway (10)		France (11)		Denmark (13)		Spain (14)		Hungary (15)		Poland (16)		Austria (17)	
Model fit indices			RMSEA=.068 SRMR=.055		RMSEA=.061 SRMR= .058		RMSEA=.064 SRMR= .057		RMSEA=.071 SRMR= .067		RMSEA=.061 SRMR=.049		RMSEA=.082 SRMR= .084		RMSEA= .063 SRMR= .056		RMSEA= .075 SRMR= .074		RMSEA= .068 SRMR= .086		RMSEA=.077 SRMR= .083		RMSEA=.083 SRMR= .067	
Direct effect			Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE
Social	→	Meta	0.002 (.001)	0.107	**-0.145 (-.143)**	**0.066**	-0.026 (-.038)	0.033	***-0.176 (-.154)***	***0.036***	-0.120 (-.121)	0.064	-0.080 (-.090)	0.056	-0.118 (-.115)	0.071	-0.031 (-.034)	0.052	-0.133 (-.115)	0.120	-0.251 (-.240)	0.148	-0.106 (-.112)	0.057
	→	Learn	-0.027 (-.019)	0.093	-0.090 (-.071)	0.064	**-0.083 (-.084)**	**0.035**	***-0.204 (-.161)***	***0.040***	**-0.189 (-.145)**	**0.087**	**-0.229 (-.212)**	**0.080**	-0.097 (-.084)	0.081	***-0.187 (-.141)***	***0.065***	***-0.401 (-.275)***	***0.124***	***-0.793 (-.640)***	***0.189***	***-0.194 (-.149)***	***0.073***
	→	Navi	-0.283 (-.020)	0.915	-0.044 (-.003)	0.497	0.583 (.065)	0.341	0.494 (.036)	0.474	0.095 (.007)	0.705	0.339 (.027)	0.614	-0.810 (-.061)	0.902	-0.535 (-.041)	0.606	-0.467 (-.028)	1.323	0.320 (.022)	1.514	-0.383 (-.027)	0.694
	→	PRA	-14.207 (-.097)	8.334	-2.118 (-.016)	3.410	***-7.407 (-.083)***	***2.771***	-4.177 (-.028)	2.826	**-15.203 (-.116)**	**5.859**	-10.460 (-.086)	8.136	**-13.949 (-.114)**	**5.536**	**-9.086 (-.082)**	**4.050**	-7.910 (-.057)	6.672	0.223 (.002)	9.687	***-20.143 (-.154)***	***5.719***
	→	ERA	0.966 (.007)	5.394	0.621 (.005)	2.926	-0.036 (.000)	1.686	***6.733 (.050)***	***2.342***	-6.292 (-.053)	3.712	1.051 (.009)	3.613	**-8.424 (-.069)**	**4.144**	-3.273 (-.027)	3.400	-6.920 (-.045)	7.717	16.113 (.132)	10.567	**-8.764 (-.068)**	**4.140**
Inform	→	Meta	0.094 (.062)	0.108	***0.245 (.187)***	***0.060***	***0.230 (.180)***	***0.075***	***0.248 (.186)***	***0.049***	***0.310 (.253)***	***0.079***	***0.177 (.161)***	***0.063***	***0.315 (.260)***	***0.088***	**0.138 (.125)**	**0.061**	***0.323 (.310)***	***0.085***	**0.296 (.304)**	**0.029**	***0.337 (.255)***	***0.093***
	→	Learn	***0.549 (.298)***	***0.028***	***0.522 (.322)***	***0.062***	***0.650 (.347)***	***0.072***	***0.623 (.422)***	***0.049***	***0.730 (.453)***	***0.079***	***0.694 (.518)***	***0.083***	***0.619 (.450)***	***0.101***	***0.624 (.387)***	***0.082***	***0.722 (.547)***	***0.112***	***0.973 (.843)***	***0.163***	***0.734 (.403)***	***0.109***
	→	Navi	**2.135 (.119)**	**0.923**	***2.762 (.172)***	***0.562***	***3.199 (.188)***	***0.811***	**1.268 (.078)**	**0.516**	1.778 (.109)	0.925	***2.788 (.181)***	***0.604***	**2.446 (.157)**	**1.091**	***3.901 (.243)***	***0.734***	***4.318 (.285)***	***1.078***	**3.051 (.228)**	**1.373**	***3.925 (.195)***	***1.210***
	→	PRA	**23.500 (.125)**	**7.916**	**10.348 (.061)**	**4.294**	***15.199 (.089)***	***5.476***	2.490 (.015)	4.049	**13.085 (.081)**	**6.226**	5.410 (.036)	7.479	***18.912 (.131)***	***6.747***	***13.755 (.102)***	***4.627***	***16.455 (.131)***	***5.436***	0.834 (.007)	9.384	***25.668 (.140)***	***7.001***
	→	ERA	10.336 (.057)	7.014	***12.808 (.084)***	***3.842***	***13.167 (.085)***	***4.522***	0.433 (.003)	2.939	**8.480 (.058)**	**4.245**	0.432 (.003)	3.847	***20.568 (.143)***	***5.951***	***15.998 (.109)***	***3.664***	**17.766 (.128)**	**7.232**	-2.666 (-.023)	9.771	**14.868 (.082)**	**6.375**
Meta	→	PRA	***41.133 (.332)***	***5.656***	***48.673 (.373)***	***4.257***	***43.115 (.324)***	***4.313***	***53.977 (.421)***	***3.430***	***48.216 (.366)***	***5.456***	***46.271 (.337)***	***6.715***	***40.053 (.336)***	***7.057***	***37.371 (.307)***	***4.262***	***39.466 (.328)***	***4.394***	***31.955 (.279)***	***4.003***	***44.706 (.322)***	***5.828***
	→	ERA	***28.275 (.239)***	***5.607***	***33.039 (.282)***	***3.254***	***25.785 (.212)***	***3.835***	***39.947 (.337)***	***2.863***	***29.245 (.245)***	***3.269***	***21.004 (.162)***	***7.348***	***37.517 (.317)***	***6.143***	***29.453 (.222)***	***4.074***	***24.758 (.186)***	***4.660***	***28.708 (.246)***	***3.943***	***38.640 (.283)***	***5.024***
Learn	→	PRA	**-5.450 (-.053)**	**2.770**	-0.452 (-.004)	1.771	2.895 (.032)	1.984	0.517 (.004)	2.306	-0.031 (.000)	2.706	8.943 (.079)	4.031	-6.116 (-.058)	3.891	2.965 (.036)	1.948	-3.420 (-.036)	2.027	***5.479 (.057)***	***1.917***	-3.909 (-.039)	2.265
	→	ERA	-3.410 (-.035)	2.708	-2.167 (-.023)	1.651	1.647 (.020)	1.837	0.922 (.009)	1.799	-0.153 (-.002)	2.102	3.966 (.037)	2.357	***-10.445 (-.100)***	***3.322***	-2.246 (-.025)	3.400	-4.132 (-.039)	1.947	3.811 (.039)	3.943	-1.820 (-.018)	1.786
Navi	→	PRA	***5.011 (.479)***	***0.285***	***4.569 (.431)***	***0.230***	***4.784 (.478)***	***0.238***	***4.761 (.450)***	***0.214***	***4.478 (.452)***	***0.218***	***4.036 (.411)***	***0.895***	***3.892 (.419)***	***0.341***	***3.953 (.471)***	***0.203***	***3.623 (.438)***	***0.243***	***4.301 (.516)***	***0.198***	***4.297 (.470)***	***0.269***
	→	ERA	***6.113 (.612)***	***0.285***	***5.426 (.570)***	***0.225***	***5.835 (.638)***	***0.215***	***5.457 (.558)***	***0.160***	***5.734 (.639)***	***0.187***	***6.525 (.705)***	***0.951***	***5.362 (.581)***	***0.279***	***5.924 (.647)***	***0.266***	***5.618 (.613)***	***0.241***	***5.211 (.615)***	***0.201***	***5.569 (.620)***	***0.246***

Note. * $p \leq .05$.; ** $p \leq .01$.; The values put in the Coeff column indicate path coefficients, and the value in the parenthesis was standardized coefficients.

4.3.2.4. Indirect effect of students' engagement on printed and electronic reading literacies via perceived usefulness of metacognitive strategies, navigation skills and self-report learning strategies use

As the results shown in Table 4.7, the indirect effects of students' social online reading engagement on printed and electronic reading literacies ,via perceived usefulness of metacognitive strategies were negative ($\beta_{social \rightarrow Meta \rightarrow PRA} = -.089, p < .001$ *and* $\beta_{social \rightarrow Meta \rightarrow ERA} = -.071, p < .001$). Through students' perceived usefulness of metacognitive strategies, every 1 SD increases in students' social online reading, their printed reading literacy decreases .089 SD, and electronic reading literacy also decreases .071 SD. On the contrary, via perceived usefulness of metacognitive strategies, the indirect effects of students' information-seeking online reading engagement on PRA and ERA performances were positive ($\beta_{Inform \rightarrow Meta \rightarrow PRA} = 0.099, \mathrm{p} < .001$ *and* $\beta_{Inform \rightarrow Meta} = .078, \mathrm{p} < .001$). That is, through students' perceived usefulness of metacognitive strategies, every one SD changes in students' information-seeking online reading engagement, printed reading literacy changes.099 SD, and electronic reading literacy also changes.078 SD.

Through navigation skills, students' information-seeking online reading engagement indirectly and positively affected their PRA and ERA performances ($\beta_{Inform \rightarrow Navigation \rightarrow PRA} = .080, p < .001$ *and* $\beta_{Inform \rightarrow Navigation \rightarrow ERA} = .099, p < .001$). Through students' navigation skills, every one SD changes in students' information-seeking online reading engagement, PRA changes .080 SD and electronic reading literacy changes .099 SD. Nevertheless, the indirect effects of social online reading engagements on students' PRA and ERA performances via navigation skills were not significant($\beta_{Socail \rightarrow Navigation \rightarrow PRA} = .228, \mathrm{p} = .891$ and $\beta_{Social \rightarrow Navigation \rightarrow ERA} = .001, \mathrm{p} = .891$).

The indirect effect of students' social online reading engagement on printed and electronic reading literacies via learning strategies use was positive ($\beta_{Socail \rightarrow \mathrm{Learn} \rightarrow \mathrm{ear}} = .018, \mathrm{p} < .05$ and $\beta_{Social \rightarrow Learn \rightarrow ERA} = .031, \mathrm{p} < .001$). The indirect effect of students' information-seeking online reading engagements on printed and electronic reading literacies through the usage of learning strategies was

negative ($\beta_{Inform \rightarrow Learn \rightarrow PRA} = -0.049, \mathrm{p} < .001$ *and* $\beta_{Inform \rightarrow Learn \rightarrow ERA} = -.087, p < .001$). The indirect effects of two types of online reading activities on PRA and ERA showed special patterns, and these would be discussed in chapter five.

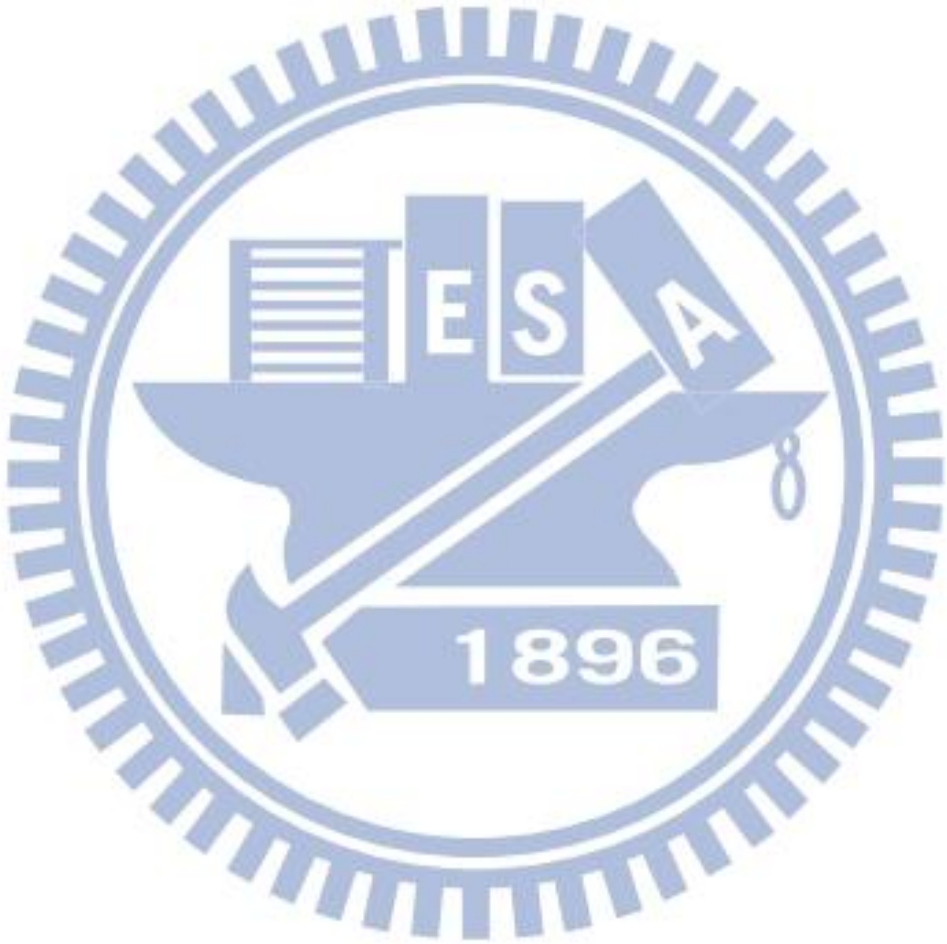


Table 4.7 Indirect path estimates of all of the 19 countries, Asian countries, South American countries and Oceanian countries.

Country or area (ranking)			19 countries		Hong Kong (5)		Korea (1)		Japan (4)		Macao (12)		New Zealand (2)		Australia (2)		Chile (18)		Colombia (19)	
Model fit indices			RMSEA=0.068 SRMR= 0.062		RMSEA=0.070 SRMR= 0.056		RMSEA=0.055 SRMR= 0.058		RMSEA=0.048 SRMR= 0.041		RMSEA=0.062 SRMR=0.058		RMSEA=0.071 SRMR= 0.069		RMSEA= 0.068 SRMR= 0.060		RMSEA= 0.089 SRMR= 0.120		RMSEA= 0.077 SRMR= 0.097	
Indirect effect			Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE
PRA on																				
Social	→	Meta	***-17.456*** ***(-.089)***	***3.706***	***-9.568*** ***(-.067)***	***3.002***	***-26.081*** ***(-.142)***	***5.070***	-15.525 (-.057)	11.962	***-8.929*** ***(-.074)***	***2.827***	**-5.745** **(-.050)**	**2.227**	***-4.984*** ***(-.043)***	***1.808***	4.192 (.046)	2.143	**-5.348** **(-.068)**	**2.640**
	→	Learn	***3.465*** ***(.018)***	***1.150***	***-4.918*** ***(-.034)***	***1.653***	-3.117 (-.017)	2.338	-.636 (-.002)	1.475	-0.302 (-.002)	0.648	0.023 (.000)	0.415	0.332 (.003)	0.479	-0.734 (-.008)	0.480	0.331 (.004)	0.406
	→	Navi	.228 (.001)	1.662	-.942 (-.007)	3.767	***-15.248*** ***(-.083)***	***3.994***	-4.229 (-.016)	5.979	0.914 (.008)	2.569	2.836 (.024)	1.638	-1.682 (-.015)	1.427	***7.023*** ***(.077)***	***2.144***	3.375 (.043)	1.877
Inform	→	Meta	***13.119*** ***(.099)***	***1.563***	***13.032*** ***(.092)***	***2.850***	***18.491*** ***(.149)***	***3.700***	**8.581** **(.086)**	**3.861**	***13.456*** ***(.103)***	***2.618***	***17.513*** ***(.107)***	***3.224***	***17.489*** ***(.113)***	***2.836***	-3.457 (-.028)	3.802	***12.057*** ***(.101)***	***3.426***
	→	Learn	***-6.563*** ***(-.049)***	***1.272***	**7.447** **(.052)**	**2.532**	4.567 (.037)	3.615	**1.609** **(.016)**	**0.761**	1.008 (.008)	2.153	-0.118 (-.001)	2.057	-1.639 (-.011)	2.249	**3.235** **(.026)**	**1.617**	-1.332 (-.011)	1.541
	→	Navi	***10.644*** ***(.080)***	***0.979***	***11.845*** ***(.083)***	***2.966***	***13.232*** ***(.107)***	***2.987***	***7.687*** ***(.077)***	***1.921***	***6.955*** ***(.053)***	***2.555***	***11.957*** ***(.073)***	***2.731***	***17.203*** ***(.111)***	***2.364***	***7.264*** ***(.059)***	***2.550***	***9.015*** ***(.076)***	***3.097***
	ERA on																			
Social	→	Meta	***-14.499*** ***(-.071)***	***3.003***	***-6.410*** ***(-.049)***	***2.204***	***-23.353*** ***(-.145)***	***8.593***	-10.611 (-.048)	8.270	***-5.737*** ***(-.056)***	***2.045***	**-5.065** **(-.046)**	**1.990**	***-3.859*** ***(-.035)***	***1.450***	3.935 (.041)	2.051	**-4.321** **(-.058)**	**2.120**
	→	Learn	***6.398*** ***(.031)***	***1.635***	-1.509 (-.011)	1.440	-2.422 (-.015)	1.731	0.157 (.001)	0.481	-0.477 (-.005)	0.511	0.402 (.004)	0.356	0.160 (.001)	0.305	-1.021 (-.011)	0.574	0.055 (.001)	0.347
	→	Navi	.298 (.001)	2.171	-1.283 (-.010)	5.161	**-22.043** **(-.137)**	**6.892**	-5.823 (-.026)	8.473	1.048 (.010)	2.933	3.477 (.032)	1.981	-2.092 (-.019)	1.779	***9.245*** ***(.096)***	***2.686***	4.129 (.055)	2.291
Inform	→	Meta	***10.897*** ***(.078)***	***1.362***	***8.730*** ***(.067)***	***2.085***	***3.548*** ***(.152)***	***2.404***	**5.865** **(.072)**	**2.656**	***8.646*** ***(.078)***	***1.896***	***15.439*** ***(.099)***	***2.955***	***13.541*** ***(.091)***	***2.058***	-3.245 (-.025)	3.592	***9.743*** ***(.086)***	***2.807***
	→	Learn	***-12.118*** ***(-.087)***	***1.352***	2.285 (.017)	2.156	16.557 (.033)	5.721	-.397 (-.005)	0.628	1.592 (.014)	1.629	-2.062 (-.013)	1.662	-0.789 (-.005)	1.473	***4.503*** ***(.034)***	***1.627***	-0.220 (-.002)	1.353
	→	Navi	***13.876*** ***(.099)***	***1.664***	***16.124*** ***(.123)***	***4.160***	***19.128*** ***(.176)***	***4.568***	***10.584*** ***(.129)***	***2.997***	***7.973*** ***(.072)***	***2.981***	***14.660*** ***(.094)***	***3.356***	***21.387*** ***(.144)***	***2.861***	***9.563*** ***(.073)***	***3.398***	***11.030*** ***(.098)***	***3.586***

Note. * $p \leq .05$. ; ** $p \leq .01$. ; Sobel test was used to examine the indirect effects. The values put in the Coeff column indicate path coefficients, and the value in the parenthesis was standardized coefficients.

Table 4.8 Indirect path estimates of all of the European countries.

Country or area (ranking)			Iceland (6)		Sweden (7)		Ireland (8)		Belgium (9)		Norway (10)		France (11)		Denmark (13)		Spain (14)		Hungary (15)		Poland (16)		Austria (17)	
Model fit indices			RMSEA=.068 SRMR=.055		RMSEA=.061 SRMR= .058		RMSEA=.064 SRMR= .057		RMSEA=.071 SRMR= .067		RMSEA=.061 SRMR=.049		RMSEA=.082 SRMR= .084		RMSEA= .063 SRMR= .056		RMSEA= .075 SRMR= .074		RMSEA= .068 SRMR= .086		RMSEA=.077 SRMR= .083		RMSEA=.082 SRMR= .067	
Indirect effect			Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE
PRA on																								
Social	→	Meta	0.072 (.000)	4.410	**-7.078 (-.053)**	**3.292**	-1.104 (-.012)	1.436	***-9.489 (-.065)***	***1.934***	-5.803 (-.044)	3.118	-3.695 (-.030)	2.580	-4.731 (-.039)	2.965	-1.170 (-.011)	1.987	-5.232 (-.038)	4.763	-8.036 (-.067)	4.702	-4.722 (-.036)	2.574
	→	Learn	0.148 (.001)	0.539	0.041 (.000)	0.168	-0.239 (-.003)	0.197	-0.105 (-.001)	0.471	0.006 (.000)	0.517	**-2.052 (-.017)**	**1.016**	0.596 (.005)	0.746	-0.554 (-.005)	0.374	1.371 (.010)	0.825	**-4.344 (-.036)**	**1.787**	0.768 (.006)	0.521
	→	Navi	-1.418 (-.010)	4.578	-0.200 (-.002)	2.260	2.787 (.031)	1.682	2.354 (.016)	2.255	0.428 (.003)	3.144	1.368 (.011)	2.490	-3.154 (-.026)	3.314	-2.114 (-.019)	2.365	-1.694 (-.012)	4.710	1.377 (.011)	6.544	-1.643 (-.013)	2.966
Inform	→	Meta	3.862 (.021)	4.537	***11.905 (.070)***	***3.068***	***9.906 (.058)***	***3.356***	***13.382 (.078)***	***2.712***	**14.949 (.093)**	**4.016**	***8.199 (.054)***	***2.893***	***12.620 (.087)***	***3.794***	**5.173 (.038)**	**2.398**	***12.759 (.102)***	***3.702***	**9.452 (.085)**	**4.321**	***15.081 (.082)***	***4.364***
	→	Learn	-2.992 (-.016)	1.602	-0.236 (-.001)	0.925	1.883 (.011)	1.315	0.322 (.002)	1.438	-0.023 (.000)	1.951	**6.210 (.041)**	**2.753**	-3.786 (-.026)	2.694	1.850 (.140)	1.239	-2.470 (-.020)	1.499	**5.333 (.048)**	**2.074**	-2.908 (-.016)	1.668
	→	Navi	**10.701 (.057)**	**4.678**	***12.620 (.074)***	***2.611***	***15.302 (.090)***	***3.675***	**6.037 (.035)**	**2.470**	**7.961 (.049)**	**4.028**	***11.255 (.075)***	***3.252***	**9.522 (.066)**	**3.887**	***15.421 (.115)***	***2.722***	***15.645 (.125)***	***3.546***	**13.121 (.118)**	**5.921**	***16.864 (.092)***	***5.396***
ERA on																								
Social	→	Meta	0.050 (.000)	3.073	**-4.805 (-.040)**	**2.300**	-0.660 (-.008)	0.849	***-7.023 (-.052)***	***1.493***	-3.520 (-.030)	1.924	-1.677 (-.015)	1.287	-4.431 (-.036)	2.690	-0.922 (-.008)	1.600	-3.282 (-.021)	3.000	-7.220 (-.059)	4.264	-4.081 (-.032)	2.212
	→	Learn	0.092 (.001)	0.320	0.195 (.002)	0.229	-0.136 (-.002)	0.166	-0.188 (-.001)	0.379	0.029 (.000)	0.409	-0.910 (-.008)	0.555	1.018 (.008)	1.012	0.420 (.003)	0.389	**1.657 (.011)**	**0.836**	-3.021 (-.025)	1.819	0.358 (.003)	0.393
	→	Navi	-1.730 (-.012)	5.619	-0.238 (-.002)	2.699	3.400 (.042)	1.990	2.698 (.020)	2.580	0.547 (.005)	4.026	2.212 (.019)	4.059	-4.344 (-.036)	4.713	-3.168 (-.026)	3.573	-2.627 (-.017)	7.378	1.668 (.014)	7.874	-2.130 (-.017)	3.855
Inform	→	Meta	2.655 (.015)	3.258	***8.081 (.053)***	***2.177***	***5.924 (.038)***	***1.967***	***9.904 (.063)***	***2.067***	***9.067 (.062)***	***2.410***	**3.722 (.026)**	**4.982**	***11.820 (.082)***	***3.495***	**4.077 (.028)**	**2.024**	***8.004 (.058)***	***2.701***	**8.492 (.075)**	**3.921**	***13.034 (.072)***	***3.861***
	→	Learn	-1.872 (-.010)	1.536	-1.132 (-.007)	0.905	1.071 (.007)	1.193	0.575 (.004)	1.129	-0.112 (-.001)	1.529	2.754 (.019)	1.877	**-6.467 (-.045)**	**2.670**	-1.402 (-.010)	1.182	**-2.984 (-.022)**	**1.508**	3.709 (.033)	2.109	-1.355 (-.008)	1.366
	→	Navi	**13.054 (.073)**	**5.709**	***14.989 (.098)***	***3.213***	***18.667 (.120)***	***4.676***	**6.920 (.044)**	**2.797**	10.192 (.070)	5.298	**18.194 (.128)**	**1.606**	**13.116 (.091)**	**5.663**	***23.114 (.158)***	***4.200***	***24.259 (.175)***	***5.690***	**15.895 (.140)**	**7.361**	***21.856 (.121)***	***6.800***

Note. * $p \leq .05$. ; ** $p \leq .01$.;Sobel test was used to examine the indirect effects. The values put in the Coeff column indicate path coefficients, and the value in the parenthesis was standardized coefficients.

4.3.2.5. The partial correlation among mediators

As Table 4.9 and Figure 4.3 presented, the Pearson correlations between all of the mediators were positive and significant ($r_{Meta\ \&\ Learn}$=.12, p<.001; $r_{Meta\ \&\ Navi}$=.38, p<.001; $r_{Learn\ \&\ Navi}$=.051, p<.001). According to Cohen(1992), the results showed that the effect size of the relationship between perceived usefulness of metacognitive strategies and navigation skills was medium. However, the effect size was small in the relationship between perceived usefulness of metacognitive strategies and the usage of learning strategies, as well as it between the usage of learning strategies and navigation skills. On average, as students' perceived usefulness of metacognitive strategies increases, their usage of learning strategies, navigation skills would increase. When students' usage of learning strategies increases, their navigation skills would also enhance. The relationships between mediators could help to explain the association between navigation skills and printed reading literacy, and the discussion will be shown in the next chapter.

Table 4.9 The partial correlation among mediators

	Meta ↔ Learn		Meta ↔ Navi		Learn ↔ Navi	
	r	sig	r	sig	r	sig
19 countries	.120	**	.380	**	.051	**
Hong Kong	.214	**	.267	**	.097	*
Korea	.244	*	.329	**	.100	.165
Japan	.239	**	.387	**	.132	*
Macao	.239	**	.169	**	.040	.141
New Zealand	.264	**	.412	**	.083	*
Australia	.320	**	.403	**	.144	**
Chile	.150	*	.412	**	-.055	.138
Colombia	.005	.906	.366	**	-.097	*
Iceland	.265	**	.398	**	.116	*
Sweden	.277	**	.420	**	.080	*
Ireland	.276	**	.353	**	.116	**
Belgium	.239	**	.478	**	.113	**
Norway	.308	**	.327	**	.099	**
France	.219	**	.344	**	.083	.053
Denmark	.262	**	.428	**	.044	.429
Spain	.299	**	.455	**	.083	*
Hungary	.042	.371	.447	**	-.063	.163
Poland	.119	*	.385	**	.093	*
Austria	.151	**	.540	**	-.009	.772

Note. * $p \leq .05$. ** $p \leq .01$.

Chapter 5 **Discussion**

5.1. Summary of results

Controlling gender and ESCS, students' information-seeking online reading engagements had positive effects on students' perceived usefulness of metacognitive strategies, the usage of learning, navigation skills, printed reading performances and electronic reading outcome. The social online reading activities engagements had negative effects on perceived usefulness of metacognitive strategies, usage of learning strategies and the outcome of PRA and ERA. The link between social online reading engagements and navigation was non-significant. Students' perceived metacognitive strategies and navigation skills had positive influences on students' performances in PRA and ERA, while the frequencies of learning strategies had negative effects on students' printed and electronic reading performances. Three mediators, using of learning frequencies, perceived metacognitive strategies and navigation skills correlated with each other positively. In terms of the indirect effects, through students' perceived usefulness of metacognitive strategies and navigation skills, their information-seeking reading engagement positively impacted students' outcome of PRA and ERA. Students' social online reading engagement had negative effects on PRA and ERA, via their perceived usefulness of metacognitive strategies, whereas through navigation skills, social reading engagement didn't have any effects on PRA and ERA. There were special but unreasonable findings that through the usage of learning strategies, students' engagements in social online reading activities had positive effects on two types of reading literacies, whereas information-seeking reading engagements negatively affected the outcome of PRA and ERA. These findings will be discussed in this chapter.

5.2. Controlled variables

In the present study, there were two covariates, ESCS and gender. For ESCS, in line with previous studies, the findings showed that students with high ESCS had more knowledge about metacognitive strategies, better navigation skills and performed well in PRA and ERA (Bradley & Corwyn, 2002; M. M. Chiu & Khoo, 2005; Ming Ming Chiu & Chow, 2010; Ming Ming Chiu et al., 2007). Families with

high economic, social and culture status afforded students more learning resources, rich culture capital, and more attention on education, thereby promoting students' performances in reading literacies and reading skills(Chiu & Chow, 2010).

With regard to gender, it was not surprising that girls performed better than boys in two reading literacies and three reading skills. However, I found an interesting finding when I checked the results of each of the participating countries. The results suggested that the overall samples showed that girls outperformed boys in electronic reading literacy, but the real disparity between girls and boys in electronic reading performance may be not so far in separate country. Except for Macao, Chile, Colombia, Norway, Denmark, and Poland, there were not significant differences between boys and girls in the other countries (See Table 4.3 and Table 4.4). In other words, the effects of gender on ERA may result from the large sample size, but the assumption should be verified by other empirical evidences.

5.3. The main study variables

The results revealed that information-searching reading engagement (such as using an online dictionary, searching online information for particular purpose, and so on) could foster students' use of learning strategies, knowledge of metacognitive strategies and navigation skills, controlling students' gender and ESCS. Students with more frequencies of searching information on the internet or using online encyclopedia usually reported more frequencies of learning strategies using, better knowledge about metacognitive strategies and greater performance in navigating. A possible explanation was that during the processes of seeking information, students had to memorize the information that they read on last webpage, connect the contents they read with their prior knowledge, try to regulate all the processes of reading (such as setting the goal of searching or identifying information) and choose the correct links to approach the webpages with the information they needed. In other words, the processes of information-seeking provided opportunities for students to increase the experiences of using leaning and metacognitive strategies, and improve their navigation skills. The results were remarkably consistent with previous findings (Coiro, 2003; Naumann et al., 2008; Salmeron & Garcia, 2011).

Conversely, the social online reading engagement (such as chatting online or reading emails) didn't enhance students' frequencies of using learning reading

strategies or perceived usefulness of metacognitive strategies, and even the navigation skills. Furthermore, the results showed that the higher level of engaging in social reading activities, the lower reading strategies using and worse performance in useful metacognitive strategies identifying. The ease of reading contents may be one of the reasons. Students didn't need any reading skills to help them understand the contents in the conversation or emails. Moreover, the teenagers may use the simplified words, grammar or symbols, such as textspeak , instead of the formal words to communicate with each other. This subculture in teenagers was not profitable for students' reading skills improving, and furthermore, it may weaken students' developments in reading skills. Besides, the steps of getting into the chatting rooms or email addresses were routine, and this might explain why navigation skills could not be fostered by students' engagement in social online reading activities.

In addition, the association between two types of online reading activities and two formats of reading literacies also revealed that information-seeking online reading engagements was effective for enhancing students' reading outcome, but social online reading engagement was not. The finding presented that on average, students who engaged in information-seeking reading more had higher scores in printed and electronic reading literacies while students who engaged in chatting room frequently had lower performance in two type of reading literacies. Overall, the results of the present studies supported my hypothesis. Not all of the online reading activities were beneficial to students' developing of reading skills and reading performances. When the social reading activities were not employed in the teaching condition, they were not so good for students' reading performances. They even were harmful to students' reading skills use and two reading literacies.

As for the effects of three types of reading skills on PRA and ERA performances, the findings revealed that students who had better navigation skills and more knowledge of metacognitive strategies performed well in printed and electronic reading assessments. In PISA, no matter PRA or ERA, the designs of reading assessments were task-oriented, students need metacognition to support them reach the task goals. For instance, they had to recognize the goal of the reading assignments and then search for the key information to help then answer the questions. If they found that the methods they used didn't work, they had to try another method to help them get the information or reach the reading purpose effectively. In the self-regulated

process, metacognition played a crucial role, that's why students with richer knowledge of metacognitive strategies usually performed well in PRA and ERA (Azevedo & Cromley, 2004; Zimmerman, 1990).

With regard to the positive effects of navigation skills on students' reading performances, empirical studies showed that good navigation skills helped students' choose the links with information they needed and integrated the information they read, so that navigation skills positively influenced students' electronic reading performances(Salmeron & Garcia, 2011; Ladislao Salmerón, Kintsch, & Kintsch, 2010). However, how could navigation skills affect students' printed reading literacies? OECD(2011a) provided three suggestions to explain the relationship between navigation and printed reading. First of all, the reading tasks in ERA were presented in written form, thus students had to use printed reading skills to identify their assignments before they navigate in the digital reading environment. Second, the features of navigation tools were also presented in textual forms. Third, as a good electronic reading reader, the ability of making good predictions of the links which lead to the key reading contents is very important. However, before he/she chooses the links or predict the contents which links lead to, he/she has to understand the contents of the webpage he/she staying now. In sum, navigation may have strong association with printed reading. In my study, I had different interpretation. The significant correlation between navigation skills and the perceived usefulness of metacognitive strategies could help me to explain the links between navigation and printed reading performance in another way. In fact, the process of navigation could be regarded as a representation of students' metacognitive operating on digital environment, because during the processes of navigation, students had to know what kind of information they needed, what contents the links should be led to, what kinds of reading strategies were most effective for their understanding of reading (Chen et al., 2006; Madrid et al., 2009; H. Van Oostendorp & Juvina, 2007). The processes of navigation provided students opportunity to practice metacognitive skills, and their masterly metacognitive skills also in turn fostered navigation skills. As a result, the students with high navigation skills tended to have high metacognitive skills and students' with good metacognitive strategies usually performed well in navigation. When students were good at navigation, their metacognitive skills would be enhanced, and indirectly influenced their printed reading performances. In other words, through

perceived usefulness of metacognitive strategies, navigation skills may have significant impacts on students' printed reading performances. In addition, in my model, the direct effect of navigation on students' printed reading literacy also provided another evidence. In fact, navigation could be used in the printed reading process. As we read an article, we don't need to read word by word, we just read some key words and then get the whole picture of the article. After reading the first paragraph or the title of the article, we could try to search for key information via the heading of every paragraph, words in bold or italic types, and/or the structure of the article. In addition, the index or catalogs, just like the overview in the hypertext, are also good tools to help reader find the key information (Leu et al., 2007). Finally, students would integrate the information they collect to have a complete picture of the article. In other word, once students have proficient navigation skills, they could read both of printed and electronic reading materials effectively and skillfully.

However, not all of the reading skills were beneficial for students' reading literacies. My result, along with that of Chiu (2007), suggested that learning strategies had negative or weak effects on reading literacies. This result was not expected. Chiu (2007) interpreted this phenomenon that the designs of the items may be not so appropriate that they can't stand for students' real usage of learning strategies. Moreover, the memorization strategies which depend on students' working memories were viewed as superficial and ineffective learning strategies. In spite of the similar findings with Chiu, I had different interpretations. As mentioned in chapter four, although the results showed that learning strategies had negative influence on the outcome of PRA and ERA, the magnitudes of coefficients were small. In addition, the non-significant results in separate participating countries also suggested that the significant results of whole sample may be due to the large sample size, and in fact, the frequencies of learn strategies use had only direct effects with very small effect size on PRA and ERA. In order to verify my assumption, I employed series of examining steps. The correlation between the usage of learning strategies and students' perceived usefulness of metacognitive strategies showed medium effect size. Subsequently, I constrained the effects of the usage of learning strategies on PRA and ERA performance as zero, and the result revealed that the multiple r^2 decreased. Moreover, the absolute value of standardized regression coefficients reduced after the exclusion of the usage of learning strategies. In addition, I compared the BIS of

original model and constrained model, the result yield that the model with the inclusion of learning strategies was better than the model with exclusion of the learning strategies use. Based on the evidences, I confirmed that the latent variable, learning strategies, was indeed a suppressor which could clarify the real relationship between the perceived usefulness of metacognitive strategies and two types of reading literacies (Cheung & Lau, 2008; Cohen, 2003; Maassen & Bakker, 2001; MacKinnon et al., 2000).The spurious effect of learning strategies use on students' outcome of PRA and ERA could not be interpreted, but it could enhance the effect of perceived usefulness of metacognitive strategies on printed and electronic reading literacies.

There were several possible reasons to explain the negative effects of students' self-report learning strategies use on two reading literacies. The first one was the design of the measurements. The latent factor, students' perceived usefulness of metacognitive strategies, was indicated by METASUM and UNDREM. And the two indices were constructed by the items which derived from students' judgment of usefulness metacognitive strategies in reading tasks. Students' judgments would be compared with those of experts'. The process of judgment also involved in students' evaluating skills which was one of the essential metacognitive skills. The design of this variable really examined students' real metacognitive skills. The observed variable navigation skills derived from students' practically navigating behaviors in reading tasks by use of the log files. The navigating results which were recorded by log files could stand for students' real navigating performances. Therefore, students' perceived usefulness of metacognitive strategies and navigation skills directly related to students' PRA and ERA performances. Nevertheless, the usage of learning strategies derived form students' report about the frequencies of three learning strategies use, when they studied. Because they were asked about the experiences of strategies using in the past time, some subjective biases might appear while they recalled their using experiences. Otherwise, students were asked to report their strategies use experiences in study settings, not in reading tasks. But, the main purposes of studying and reading were not exactly the same. In other words, the design of self-report scale may have some bias in assessing students' learning strategies use.

Secondly, memorization strategy is not a good predictor of reading performance. When students study, they just read the contents of certain fixed curriculum. However,

the PISA reading tasks mainly access students' literacy which is identified as the abilities of flexibly applying what they learned in their daily lives. The reading purposes and materials are distinct and the memorization strategy used in the two conditions would show different results. Memorization strategy involves in students' capacities of working memory. If the amount of information exceeds capacities of working memory, it may lead to students' cognitive load and students may fail in reading task. So that memorization strategies which I adopted as one of the learning strategies index may be useful in textbook studying, but less useful in task-oriented reading.

The last reason was that learning strategies use was a suppressor. Students' report learning strategies use could enhance the effects of perceived usefulness of metacognitive strategies on reading literacies, but its impact on PRA and ERA couldn't be interpreted directly. The linear associations among students' perceived usefulness of metacognitive strategies, PRA performance and ERA outcome could be further explained substantively due to the inclusion of the usage of learning strategies in the model. Moreover, the multiple r^2 also increased when students' self-reported usage of learning strategies was included in the model (Cheung & Lau, 2008; Cohen, 2003; Maassen & Bakker, 2001; MacKinnon et al., 2000) . In other words, in order to achieve the reading goals, students need not only enough metacognitive strategies knowledge and skills, but also sufficient learning skills. Even though students have enough abilities and knowledge to monitor their reading process and know which strategies may achieve their goals, as long as they didn't apply these strategies frequently in their reading tasks, the effects of the metacognitive skills on reading outcomes would still reduce. Conversely, if the students with good metacognitive skills practice their learning skills in reading tasks frequently, their reading performance would be improved sufficiently. In sum, the usage of learning strategies played an important role not only in clarifying the relationships among the perceived usefulness of metacognitive strategies and PRA and ERA outcome, but also in increasing the explained variance of PRA and ERA performance. That's why I had to take it into consideration in the model.

I also explored the indirect effect of two kinds of online reading activities on PRA and ERA, via the usage of learning strategies, perceived metacognitive strategies and navigation skills. The findings showed that through the knowledge of

metacognitive strategies and navigation skills, students' engagement in information seeking reading had significant and indirect effects on two types of reading literacies. When students engaged in searching for certain information on the internet, they got opportunities to practice employing metacognitive skills and navigation skills, even thought they might be unskillful at the reading assignments at first. Once they tried to regulate their reading processes and choose the appropriate strategies, their performance in PRA and ERA were likely enhanced at the same time (Akyel & Erçetin, 2009; Jairam & Kiewra, 2010; Souvignier & Mokhlesgerami, 2006; Swalander & Taube, 2007; Vidal-Abarca et al., 2010). In contrast, through students' perceived metacognitive strategies, the indirect effects of social online reading engagement on PRA and ERA were negative. Besides, via navigation skills, the indirect effects of social online reading engagement on two types of reading literacies were not significant. When students engaged in social online reading, as already noted above, they may communicate with each other in informal language which was not beneficial for their reading skills, on the contrary, may be harmful to their reading skills and performances. Unlike navigation skills and perceived usefulness of metacognitive strategies, through learning strategies, the indirect relationships between two types of online reading engagements and two types of reading literacies would become very strange. For example, the social online reading engagement indirectly and positively affected students' performances in PRA and ERA via learning strategies, or information-seeking reading engagements negatively and indirectly influenced students' printed and electronic reading outcomes through learning strategies. These findings mentioned above look like unreasonable, but there were several reasons to explain this situation. That's because of the special role of learning strategies. In my model, learning strategies had negative effects on students' performances in PRA and ERA. Moreover, the engagements of online social reading activities also had negative effects on learning strategies. So that two negatively direct effects could lead to a positively indirect between social online reading engagements and reading literacies. However, this was unreasonable, the effects of learning strategies use on students' reading literacies were spurious and the negative effect didn't exist actually. Stated another way, in fact, through learning strategies, the indirect effects between two types of online reading engagement and students reading performances in printed or digital environments should be seen as non-significant.

5.4. Implication for education

Several educational implications could be drawn from the current study. First of all, teachers and parents should pay more attention on what kinds of online reading activities their children are engaged in frequently. Children should be encouraged to spend more time on information-seeking reading activities instead of social online reading activities.

Secondly, during the process of online reading, through trial and error learning, children may learn how to use metacognitive and cognitive strategies to regulate their reading behaviors. However, this would cost them a lot of time and the regulations were not always successful. Once children always failed to reach their reading goal, they might lose their motivation of reading, moreover, they might learn helplessness(Abramson, Seligman, & Teasdale, 1978).Therefore, based on students' abilities (such as working memory and prior knowledge), teachers and parents should direct children the proper online or printed reading skills to help them read happily and effectively.

Thirdly, the finding revealed that students' perceived usefulness of metacognitive strategies was more effective strategies in reading; however, students' learning strategies use also play a role of accelerator. With the frequency and proficiency of learning strategies use increase, the effects of students' metacognitive skills on their reading performance could be enhanced. After students monitor and evaluate their reading, they have to apply appropriate learning strategies to regulate they reading process and absorb the information. That is to say that the metacognitive skills and proficient learning skills were important in effective reading. Teachers and parents should encourage students to practice their metacognitive and learning skills.

The fourth suggestion was that, as the results showed, navigation strategies use was helpful to students' printed and electronic reading literacies. Nonetheless, the skills were usually ignored by students, teachers and parents, especially for its application in reading printed text. Teachers and parents should teach students the navigating strategies in predicting the contents which links lead to, choosing the correct links, searching for the information they need and integrating the information they need in the digital reading condition. As for the printed reading environments, students should be taught to make good use of printed navigating features, such as the

heading of every paragraph, words in bold or italic types, the structure of the article, the index and the catalogs, which could help them reading effectively.

Finally, the educational authority should not only concentrate on the resources of reading providing. The cultivating of professional reading teachers and inner factors which impacted students' reading improving should receive more emphasis.

5.5. Limitation and future research

In this study, there are some limitations which should be further explored by future research. Firstly, this study could only provide an overall tendency of the links among online reading engagements, three reading skills and the outcome of PRA and ERA, the causal associations of the relationships need being verified by more empirical studies. For example, the finding in this study suggested the indirect effects of navigation skills on printed reading literacies via students' perceived usefulness of metacognitive strategies, yet it was still an inference that needed more strictly empirical evidences to support. The second limitation concerns the instruments used in this study. In order to get various information from students, the short version of all kinds of scales were used in the investigation. However, the chosen items in this short version scale may have some problems in assess the psychological construction which the research would like to investigate. And the constructs of variables may not satisfy the researchers' needs. The third limitation is that my study only concentrate on the effects of cognition-related variables on students' reading performances, the future research may take the motivated variables into consideration to explore the factors which mainly impacted students' reading performances. Lastly, relevant pages hit was used as the index of navigation skills, however, that's not enough. According to the empirical evidences, the path of students' navigation would be more representative for students' navigation skills. If PISA could release the data about students' navigating paths which can provide more information, that would be more beneficial and meaningful for the future research.

Chapter 6 **References**

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