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Self-Regulated Learning in IT-integrated Learning Environment: Its Relationships with Information Literacy and Attitudes towards IT

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ABSTRACT

Self-regulated learning is a vital skill in IT-integrated learning environment. Its importance becomes evident after the explosion of Information Technology (IT). There is now substantial body of research showing that learning in IT-integrated environment is an active, and constructive process. It may be related to the learner's self-attribute such as their information literacy and attitudes towards IT. This study aims to examine the relationships between self-regulated learning, information literacy and attitudes towards IT among smart school students. Self-regulated learning was gauged by the Motivated Strategies for Learning Questionnaire (MSLQ) while attitudes towards IT were measured with the Attitudes towards IT Scale. An Information Literacy Scale was built specifically to measure students' information literacy. Its validity and reliability were established in this study. A total of 322 students from two randomly chosen smart schools were sampled. Findings revealed that students' self-regulated learning was positively and significantly related to their information literacy ($r=.42$, $p<.01$) and attitudes towards IT ($r=.37$, $p<.01$). Further analyses on specific self-regulated learning strategies suggest that students' information literacy is more related to their usage of cognitive and metacognitive strategies, while attitudes towards IT is more related to the use of resource management strategies.

Keywords: Self-regulated learning, learning strategies, information literacy, attitudes towards IT, IT-integrated learning environment, smart schools

INTRODUCTION

In order to keep pace with the development in Information Technology (IT), educational innovations have been undertaken in many countries around the world, including Malaysia. The Smart School Project for instance, was implemented in 1999 with the aim to systematically reinvent the teaching and learning processes in the Malaysian school system and to prepare students for the information age. There are currently 90 established smart schools in Malaysia ("Smart Use of Computers", 2004; Yaqin Ching Abdullah, 2007). These schools integrate IT into their learning materials, learning processes, and learning tasks. As such, it moves away from the conventional school system, which focuses on teacher-centered learning, facts acquisition, memory-oriented learning, local context and textbooks (Ong, 2006; Abdul Razak Hussain, Nor Hafeizah Hassan and Shahrin Sahid, 2001). Smart schools adopt a new approach in their teaching and learning processes. It is important to highlight that the new approach emphasizes student-centered learning, knowledge construction, critical thinking, global context and the application of IT tools, such as personal computers and the Internet, in both the teaching and learning processes. This paradigm shift in the Malaysian educational system is vital, as the mainstream instructional culture lacks the substance to produce self-regulated learners

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("Plan to check exam culture," 2006; Smart School Project Team, 1997; Malaysian Strategic Research Center, 1994).

Self-Regulated Learning in IT-Integrated Learning Environment

Self-regulated learners are active and constructive learners who personally initiate and direct their own learning, without relying too much on teachers, parents or other agents of instruction. These learners plan, organize, self-monitor and self-evaluate at various stages of the learning processes. They are capable of structuring the learning environment so that it will optimize their learning. In addition, self-regulated learners always perceive themselves as competent and they work hard to achieve their academic goals (Perry, Phillips and Hutchinson, 2006; Zimmerman and Schunk, 1989; Zimmerman, 1986). Other research suggested that students' self-regulatory behaviour might be enhanced by IT-integrated learning environment (Lewis and Mendelsohn, 1994; Chen, Lieberman and Paisley, 1985). This is because such environment provides students with personal computers, educational software, and Internet which support and promote self-learning ("School for Industry," 2002; Lepper and Malone, 1987; Collins, Brown and Newman, 1986; Salomon, 1985). Kenning (1996), for example, asserts that the Internet is strongly supportive of self-regulated learning as learners can study whenever they want using a potentially unlimited range of authentic materials. Moreover, they can also converse quite easily with experts in various fields or seek information from other students around the world.

Self-Regulated Learning and Information Literacy

IT has profoundly changed the methods and tools used for learning. For example, students in an IT-integrated learning environment have far greater number of information resources to learn from those in a conventional classroom. Suppose a student is asked to write a 500-word essay. If the student has no access to IT, writing this essay might involve reading and blending information from two or three sources. New technologies such as the Internet can give the student access to literary millions of documents. Working through this much materials and reducing the information to a 500-word essay requires information literacy skills. The essence of information literacy encompasses processes such as clarifying the task, locating appropriate materials, making decisions related to their authenticity, organizing the ideas, using the information to address real-life issues, and then evaluating what has been produced (Jukes, Dosaj and Macdonald, 2000). Obviously, information literacy could help students tremendously when dealing with a great amount of information.

Thome (1996) also emphasizes the importance of information literacy. According to him, students who have to use online resources in learning must be taught to think critically and learn how to recognize bias, propaganda, and commercially driven information. Without the necessary proper skills, the bombardment of information would only be confusing, misleading, and overwhelming (Foertsch, Holum, McNabb, Rasmussen, Tinzmann, Valdez, 2002). Furthermore, Hancock (1993) and Wresch (1997) believe that students without information literacy skills would not be able to regulate their studies efficiently when they use online materials to learn and complete their individual assignments or projects. Therefore, there has been awareness of the importance of teaching students information literacy skills in order to develop individual learning. In fact, the teaching of information literacy is currently and widely recognized as an indispensable element in school curriculum (Hara, 1997). The Vancouver School Board, for an example, acknowledges the need to develop students' information literacy skills as the first priority in achieving educational goals (Hara, 1997). In short, literature reviews show that information literacy is an essential skill which students must possess, particularly when studying in an IT-integrated learning environment. This is because students with information literacy are better at accessing, processing and applying information needed for their learning tasks and assignments. In particular, having information literacy skills can contribute positively in students' self-learning and consequently make them more efficient learners (Hancock, 1993). This indirectly implies that students with information literacy may be more efficient at self-regulated learning.

Self-Regulated Learning and Attitudes towards Information Technology

The use of self-regulated learning strategies may depend on students' attitudes towards IT. This is because students' attitudes can influence

not only whether they will welcome or resist IT integration into learning settings, but also their learning behavior when using these IT tools (computers, Internet, educational and multimedia software) (Woodrow, 1991). For examples, students who enjoy using the Internet to search for information may be more incline to use these strategies to access, analyze and apply the vast amount of information which is obtained from the Internet. Conversely, students who believe that searching information from the Internet is a waste of time may spend little time and energy to process the information, thus limit the use of these learning strategies. Furthermore, students with negative attitudes towards IT may not like to use educational software to learn, and find it troublesome to type their work using computers, and feel unconfident in presenting their assignments using the multimedia software. These attitudes may negatively affect their self-efficacy, create anxiety, and consequently influence their self-regulated learning (Czaja and Sharit, 1998; Pintrich and Roeser, 1994).

In addition, literature reviews seem to suggest that students' self-regulated learning in an IT-integrated learning environment may be related to their information literacy and attitudes towards IT. Yet, very limited studies have looked into this postulation, particularly in the local context. The scarcity of standardized instruments in measuring information literacy may partly be contributed by the lack of research in this area. Hence, the objectives of this study were twofold; first, it aimed to establish an Information Literacy Scale, primarily to measure the smart school students' information literacy; and secondly, it attempted to examine the relationships between information literacy, attitudes towards IT, and self-regulated learning. The specific dimensions of self-regulated learning, which consist of (a) cognitive and metacognitive and (b) resource management, ought to be explored as they could reduce the literature gap.

METHODS

A quantitative co-relational research design was employed to achieve the objectives of the study. The sample size was determined based on the pre-requisite for the statistical analyses. At least 300 cases were needed to run the factor analysis (Tabachnick and Fidell, 1996). Therefore, 322 students from 2 randomly chosen smart schools were sampled in the current study. The selected schools are equipped with computers in the computer and multimedia labs (Smart School Project Team, 2002).

Instruments

Self-Regulated Learning. Students' self-regulated learning was measured using the adapted Learning Strategies Scale, taken from the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich, Smith, Gracia and McKeachie, 1991). This 7-point Likert instrument measured the use of self-regulated learning strategies by selected students. Prior to data collection, items in the scale had to be modified and translated into Malay Language, so they could be applied in the local context. Under the learning concept of the smart schools, individual assignment is an integral aspect of learning as it promotes students' abilities to self-direct. Six extra items were also constructed by the researchers to gauge the students' usage of self-regulated learning strategies in completing their assignments. The revised instrument comprised of 56 items. After running the Cronbach's alpha analysis, the scale was confirmed to be a highly reliable instrument, with an alpha coefficient of .92 to be employed in the current study.

Attitudes towards IT Scale. The attitude towards IT Scale was also examined to measure the students' affective, cognitive and behavioral attitudes towards the application of computers and Internet in their learning. For this purpose, the scale was adapted from Wong's (2002) Attitudes towards IT Subscale and Jones and Clarke's (1994) Computer Attitudes Scale for Secondary Students. A panel of experts in the field of Educational Technology had verified the content validity of the scale, and every item was also checked by language experts. Its construct validity was established by the factor analysis. In addition, the Cronbach's alpha analysis confirmed that it was highly reliable, with an alpha coefficient of .83.

Information Literacy. Data for information literacy was gauged using the Information Literacy Scale. This is a self-report, which uses a 7-point Likert instrument, developed by the researcher to measure students' abilities in managing information from the Internet. This scale was written in the Malay Language. According to Jukes, Dosaj and Macdonald (2000), there are

five important aspects in information literacy; these are forming key words, finding information, analyzing information, applying information and assessing information skills. These five aspects formed the basis for the content specification and guided the researcher in items construction. The Information Literacy Scale comprises of 10 items which were used to measure a single construct, information literacy. A panel of experts in the field of Educational Technology had verified the content of Information Literacy Scale. Each item had also been checked by the language experts. Even so, given that this was a newly constructed scale, the factor analysis and Cronbach's alpha (α) analysis were carried out to ensure the validity and reliability of the instrument. The outcomes of these analyses would be discussed in the section on results.

RESULTS AND DISCUSSION

The Reliability and Construct Validity of the Information Literacy Scale

One of the most commonly used reliability coefficients is Cronbach's alpha, which is based on the average correlation of items within a test. This analysis determines how all items within the instrument measure the same construct (Sweet and Grace-Martin, 2003). In this study, the alpha coefficient for the Information Literacy Scale was found to be .83. According to DeVellis's (1991) guidelines, the obtained value suggested that the scale was highly reliable.

The construct validity of the Information Literacy Scale was statistically established statistically the factor analysis. The assumptions and practical considerations, underlying the application of the factor analysis, were examined before the analysis was conducted. Based on various visual displays such as histogram, stem-and leaf plot, normality probability plot, detrended normal plot and box plot, the data was found to be normally distributed. The researchers also examined the suitability of the data, for the factor analysis, using the correlation matrix. At the same time, the strength of the intercorrelations among the items was also examined using this matrix. The results showed that a number of correlations exceeded .30; thus it was found to be suitable for factoring. The measurement of the sampling adequacy was also displayed by the anti-image correlation matrix. For this purpose, the variables with a measure of sampling adequacy which were below the acceptable level of .50 should be excluded from the factor analysis. The anti-image correlation matrix revealed that all the values were above the acceptable level of .50; these provided further evidence that the items were factorable. In addition, two statistical measures were also generated by SPSS to help assess the factorability to the data; these were the Bartlett's test of sphericity and Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy. The Bartlett's test of sphericity was found to be significant at .01, suggesting that there was no zero correlation and the Kaiser-Meyer-Olkin measure of sampling adequacy was indicated as .86; the value which is greater than .60, i.e. the minimum value required in running a factor analysis. Therefore, it is appropriate to proceed with the factor analysis.

The examination of the initial statistics revealed that the items included in the Information Literacy Scale did not load on a single factor, as postulated by the researcher. The results derived from the extraction of the common factors are shown in Table 1.

In fact, these items loaded on three factors and were accounted for 63% of the variance. Each of the factors had eigenvalues of 1 and above. The eigenvalues greater than one were accepted for the latent root criterion as recommended by Hair, Anderson, Tatham and Black (1992). The scree plot in *Fig. 1* graphically displays the eigenvalues

TABLE 1
Results for the extraction of common factors in information literacy scale

Factors	Eigenvalues	Percentage of Variance	Cumulative Percentage
I	4.14	41.41	41.14
II	1.10	11.08	52.49
III	1.00	10.01	62.50

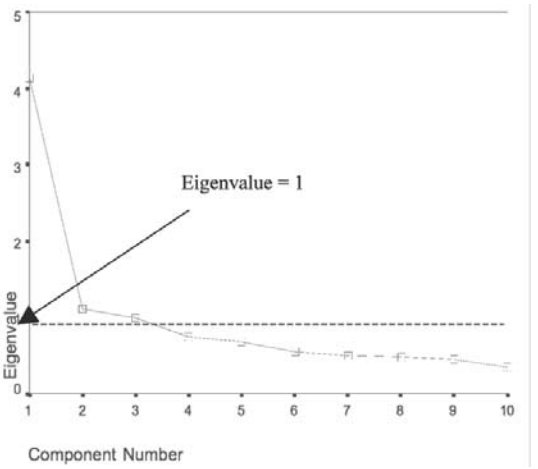

Fig. 1: Scree plot of the factors in information literacy scale

for each factor. The factors above the inflection point of the slope should be retained. The scree plot suggested that a single factor solution, more appropriate as Factor I, was a predominant factor.

However, the researcher decided to retain Factors II and III, due to the fact that Factor I was only represented by three items, whereas a three-factor solution covered all the items in the scale. Furthermore, Factor II and III are interpretable and have eigenvalues greater than 1. The item loadings on Factors II and III are above .50 (Table 2), indicating that these loadings are very significant (Hair *et al.*, 1992). In this case, a three-factor solution is more appropriate. Varimax rotation method was used to assist the interpretation of the factors. Based on the rule of thumb proposed by Hair *et al.* (1992), the factor loadings of .30 or higher were accepted. The result of this analysis is showed in Table 2 below.

Items with multiple loadings were placed under the factor which yielded the highest loadings. The rotated solution indicated that Factor I consisted of items 8, 9, and 10. This factor was labeled as Apply Information, given that these items were measuring the students' ability to *apply* information. On the other hand, Factor II consisted of items 5, 6, and 7, which were meant to measure the students' ability to *process* information. Thus, it was labeled as Process Information. Factor III consisted of items 1, 2, 3, and 4. Further examination of these items showed that they were measuring the students' ability to *access* information. Consequently, Factor III was labeled as Access Information. In conclusion, items included in the Information Literacy Scale did not load on a single factor, as postulated by

TABLE 2

Factor loading matrix using principal component analysis with varimax rotation on factors in Information Literacy Scale

Items	Factor I	Factor II	Factor III
INFOR1		.415	.584
INFOR2	.402	.356	**.561**
INFOR3			**.796**
INFOR4	.305		**.676**
INFOR5		.798	
INFOR6	.310	**.692**	
INFOR7		.778	
INFOR8	**.796**		
INFOR9	**.695**		
INFOR10	**.799**		

Note: Only loadings above.3 are displayed.
Factor I : Apply Information
Factor II : Process Information
Factor III : Access Information

the researcher. This scale could be divided into three dimensions; literacy in applying, processing and accessing information. In this study, the Information Literacy Scale was analyzed as a single construct.

The Relationships between Self-Regulated Learning, Information Literacy and Attitudes towards IT

The relationships between information literacy, attitudes towards IT, and self-regulated learning were investigated using the Pearson product-moment correlation coefficient. The interpretation on the strength of the correlation was based on the guidelines proposed by Cohen (1988). Table 3 shows that both information literacy ($r=.42$, $p<.01$) and attitudes towards IT ($r=.37$, $p<.01$) were positively and significantly related to self-regulated learning. The strength of the correlation between these two variables with self-regulated learning was medium, based on Cohen's (1988) guidelines.

The strength of the correlation, however, was expected to be higher. This was due to the fact that it was suggested in the literature review that information literacy and attitudes towards IT could be the determinants of self-regulated learning, particularly in the IT-integrated learning environment such as the smart schools (Foertsch, Holum, McNabb, Rasmussen, Tinzmann, Valdez, 2002; Woodrow, 1991). The integration of technology in the sampled schools might have contributed to the obtained results. Nevertheless, it is important to highlight that in this study, the randomly chosen smart schools only had a low level of technology integration. Currently, close to 90% of the Malaysian smart schools are categorized as low technology-integrated schools. These schools are only equipped with computers in the computer and multimedia labs. Hence, the strength of the association between self-regulated learning, information literacy, and attitudes towards IT could be stronger, if the schools involved had higher levels of IT-integration.

To self-regulate efficiently in the IT-integrated learning settings, such as the smart schools, students would have to be equipped with a competency in processing information from different sources, particularly from the Internet. The smart school project signifies a dramatic change in the Malaysian educational system, whereby information technology is utilized in every aspect of education. Students are no longer being passively 'instilled' with information and knowledge. In fact, they have to actively be involved in knowledge construction and self-regulating their own learning activities. Based on these reasons, providing students with information literacy is crucial in order to develop a self-regulated learning among them. Information literacy is about recognizing the nature and extent of the information needed to accomplish a task and also the ability to access, analyze, and apply information. This skill may help smart school students to complete their learning tasks or assignments more efficiently, independently and proactively. As such, smart school teachers need not to spoon-feed students with facts or information; on the contrary, they are rather required to play a facilitative role in the teaching and learning processes. This view is supported by the results of this study, which found that self-regulated learning is positively related to information literacy.

Information literacy skills can be taught during formal teaching and learning lessons or during extra lessons. Given the fact that the smart school project also involves primary schools, the teaching of such skills should begin as early as possible. This is in accordance with the current focus of the early childhood education on the development of students' information literacy skills, from the time they enter formal school

TABLE 3

Correlation between information literacy and attitudes towards IT with self-regulated learning

Variables	Self-Regulated Learning
Information Literacy	.42**
Attitudes towards IT	.37**

** Correlation is significant at .01 level (1-tailed).

programs (Berthelsen, Halliwell, Peacock, Burke, and Ryan, 2004). Without proper guidance, young students may encounter difficulties in managing the enormous amount of information from the Internet, and the available educational software. Smart school teachers and administrators must be made aware of the importance of information literacy, so that necessary actions could be taken to teach information literacy skills.

Apart from information literacy, positive attitudes towards IT may also ensure students' abilities to self-regulate in smart schools. These attitudes can be described as learned predisposition to respond in a consistently favourable or unfavourable manner towards the usage of personal computers, educational software, and the Internet. The results gathered in this study showed that smart schools students would self-regulate more often as their attitudes towards IT improved. This also means that students with positive attitudes towards IT will always welcome the integration of IT into their learning settings. They will be able to utilize the facilities provided to assist them in self-learning. These students are also more confident in using the computer, surf the Internet more frequently and are capable of using various software to help them complete their learning activities (Francis, 1994; Jones and Clarke, 1994; Eagly and Chaiken, 1993). For these reasons, teachers should constantly encourage and guide students, particularly those from the rural areas, in using the various IT-tools provided.

Every effort should be taken so as to avoid the development of negative attitudes towards IT among students. For instance, teachers must ensure that students are familiar with software such as Microsoft Words, Power Point, Micromedia Flash or Easy Web Editor, before requiring them to use these software for their assignments and presentations. In addition, they should never assume that students have basic knowledge in this area. If students are not confident in using any of the software in completing their presentations or assignments, they may feel humiliated or have low self-efficacy and thus develop negative attitudes towards IT. To avoid this problem, lessons can be provided to those students who may need help. These lessons can be conducted by teachers or other smart school IT coordinators.

Table 4 shows the relationships between information literacy and attitudes towards IT, with the two dimensions of self-regulated learning, cognitive and metacognitive self-regulation and resource management self-regulation. The Pearson product-moment correlation coefficient analyses revealed that information literacy and attitudes towards IT were positively and significantly related to these dimensions. The strength of the correlation between information literacy with cognitive and meta-cognitive self-regulation was medium ($r=.35$, $p<.01$). Information literacy, however, was found to have a low or small strength correlation with resource management self-regulation ($r=.29$, $p<.01$). Conversely, the attitudes towards IT were more related to resource management self-regulation. Similarly, the strength of the correlation between students' attitudes towards IT with resource management was medium ($r=.34$, $P<.01$). However, its relationships with the cognitive and metacognitive self-regulation was slightly lower ($r=.31$, $p<.01$).

The results discussed above demonstrated that information literacy had a higher association with cognitive and metacognitive self-regulation as compared to resource management self-regulation. Information literate students may be more inclined to use various cognitive and metacognitive strategies such as rehearsal, elaboration, organization, critical thinking and

TABLE 4
Correlation between information literacy and attitudes towards it with the dimensions of self-regulated learning

Variables	Information Literacy	Attitudes towards IT
Cognitive and Metacognitive Self-Regulation	.35**	.31**
Resource Management Self-Regulation	.29**	.34**

** Correlation is significant at .01 level (1-tailed).

metacognitive strategies. In other words, these students may be more competent to self-regulate their assignments and exercises completion as well as examinations revisions. In completing their assignments for instance, students need to use organizational and critical thinking strategies to systematically organize information, connect it with their existing knowledge and apply it into their assignments. More individual assignments should be given to students so that they have the opportunities to practice cognitive and metacognitive self-regulation.

The relationship between resource management self-regulation and information literacy was rather weak. However, it was more related to attitudes towards IT. Students with positive attitudes towards IT might be more willing to structure and manage their own learning environments and resources. This is possible as attitudes towards IT could influence not only whether students would welcome or resist IT-integration into learning settings, but also their learning behavior (Woodrow, 1991). Thus, smart school students with positive attitudes towards IT might have higher motivation and willingness to plan their studies, organize their learning environment, and seek help if they faced any difficulties in using computer software or hardware. These results further demonstrated that students' attitudes towards IT must be taken into consideration in the teaching and learning processes.

CONCLUSIONS

This study has developed an Information Literacy Scale to measure information literacy among Malaysian smart school students. A panel of experts in education verified the content validity of the scale and every item was checked by the language experts. In addition, factor analysis was performed to establish its construct validity. This analysis confirmed that the Information Literacy Scale is a valid instrument. It also revealed that the scale is not a single dimensional instrument as postulated by the researchers. The scale was made up of applying, processing and accessing information dimensions. The Cronbach's alpha analysis further demonstrated that the newly developed scale yielded an alpha coefficient of .83, and thus it is reliable. Based on the reasons discussed above, the Information Literacy Scale could be used to measure information literacy in the local context.

This study also looked into the relationships between the students' information literacy and attitudes towards IT with their self-regulated learning. Both these variables were found to be positively and significantly related to self-regulated learning. These factors must be taken into considerations if teachers wished to improve their students' self-regulated learning in IT-integrated learning environments, such as the smart schools. In other words, by improving students' information literacy and cultivating positive attitudes towards IT, teachers might be able to improve students' self-regulated learning.

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