Predictors of self-regulated learning in Malaysian smart schools

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This study sought to uncover the predictors of self-regulated learning in Malaysian smart schools. The sample consisted of 409 students, from six randomly chosen smart schools. A quantitative correlational research design was employed and the data were collected through survey method. Six factors were examined in relation to the predictors of self-regulated learning. These factors were levels of IT-integration, student-teacher interactions, motivational beliefs, self-regulative knowledge, information literacy, and attitudes towards IT. Multiple regression analysis showed that levels of IT-integration, student-teacher interactions, motivational beliefs, and self-regulative knowledge significantly predict self-regulated learning in Malaysian smart schools.

Self-regulated learning, smart schools, levels of IT-integration,
motivational beliefs, student-teacher interactions

INTRODUCTION

The implementation of the Smart School Project in 1999 signifies a dramatic change in the Malaysian education system. This project aims systematically to reinvent the teaching and learning processes in schools, whereby information technology (IT) is utilised in every aspect of education (Ministry of Education, 2004). There are currently 90 established smart schools in Malaysia and by 2005 another 300 schools will be converted into smart schools. The use of IT tools, such as personal computers, educational software and the Internet, in these schools supports and enhances students' self-learning (School for Industry, 2002). In addition, smart schools teaching and learning concepts emphasise student-centred learning, active knowledge construction, as well as critical and creative thinking. It moves away from the conventional pedagogy, which focuses on teacher-centred learning, facts acquisition, and memory-oriented learning (Hussain, Hassan, and Sahid, 2001). As such, students have to construct their knowledge actively. Additionally, students have to self-direct, self-access, and self-pace in learning, without relying too much on teachers (Curriculum Development Centre, 2002). To put it in a nutshell, smart schools promote self-regulated learning among students (School for Industry, 2002). This paradigm shifts in the

Malaysian education system is vital as the mainstream teaching and learning processes lacks the substance to produce self-regulated learners (Malaysian Strategic Research Centre, 1994). Hence, it is not surprising that a great number of Malaysian students are actually passive learners and spoon-fed learners, who rely heavily on rote learning (Mustapha, 1998). The Malaysian Ministry of Education hopes that with the Smart School Project, the current scenario will be changed and more self-regulated learners can be produced by the school system. Self-regulated learners are efficient and independent learners. They metacognitively, motivationally and behaviourally promote their own academic achievement and are more persistent in learning (Pressley and Harris, 1990; Corno, 1986; Zimmerman, 1986).

In order to produce self-regulated learners as envisaged in the smart school concept, teachers must be able to gear the teaching and learning processes towards this goal. Many teachers, however, may not be able to do so as they are not aware of the factors related to self-regulated learning (Zimmerman, 2002). Even though many local educational research studies have been conducted on smart schools, there is no study on self-regulated learning in this particular setting to date (Educational Planning and Research Division, 2003). Furthermore, the teachers' in-service training does not provide teachers with adequate knowledge in this aspect (Ministry of Education, 1998). For these reasons, there is a need to uncover the predictors of self-regulated learning in Malaysian smart schools.

PREDICTORS OF SELF-REGULATED LEARNING

Literature reviews suggest that self-regulated learning is influenced by environmental and personal factors (Bandura, 1997, 1986, 1977). Environmental factors are divided into two categories: the physical context of a learning setting and the social experiences that students have during the learning processes (Zimmerman, 1997). There is now a substantial body of research showing that learning in IT-integrated environments is an active and constructive process (De Corte, 1990). Competency in self-regulated learning, thus, plays an important role in determining the success of learning. According to Lewis and Mendelsohn (1993), students in schools with a high level of IT-integration have more opportunities to self-regulate than those in schools with low or minimum level of IT-integration. This implies that levels of IT-integration in smart schools may predict students' self-regulated learning. The Malaysian Ministry of Education has classified the existing smart schools into three categories based on the levels of IT-integration: level A, B+ and B. Smart schools with level A technology are equipped with computerised classrooms, an electronic resource centre, computers in science laboratories, and a self-access centre. Schools with level B+ technology, on the other hand, are equipped with at least five computers in 15 selected classrooms. These schools also have computers in the computer laboratory. Schools with level B technology are only equipped with computers in the computer, and multimedia laboratories.

From a social environment perspective, students' interactions with teachers are the most important experiences that affect self-regulated learning (Zimmerman, 1989). Students may be more inclined to self-regulate if teachers promote student-centred learning, provide them with appropriate feedbacks during the teaching and learning processes, and teach them learning strategies (Butler and Winne, 1995).

Apart from the environmental factors, relations between motivational beliefs (intrinsic goal orientation, extrinsic goal orientation, self-efficacy, control beliefs, task values and anxiety) and self-regulated learning have been widely researched (Kwon, 2001; Riverto, Cabanach and Arias, 2001; Eom and Reiser, 2000; David, 1999; Pintrich and Roeser, 1994). These studies generally found that students' self-regulated learning is positively related to their motivational beliefs.

Recent research also suggests that other personal factors such as information literacy, attitudes towards IT, and self-regulative knowledge may influence self-regulated learning (Ee, 2000; Jukes, Dosaj and Macdonald, 2000). Students with positive attitudes towards IT and who are information literate tend to be better self-regulated learners in IT-integrated learning environments. These students may be more competent in utilising IT tools such as personal computers, the Internet and multimedia software to facilitate self-learning. Besides, students' self-regulative knowledge, which is their knowledge and beliefs about self-regulated learning strategies, is recognised as an important factor that can affect self-regulated learning (Zimmerman, 1989) because effective self-regulated learners know how, when and why they employ certain regulating strategies.

In short, levels of IT-integration, student-teacher interactions, motivational beliefs, self-regulative knowledge, information literacy and attitudes towards IT may predict self-regulated learning in smart schools. The relationships between these factors and self-regulated learning were examined in this study. Six research questions were formulated to guide the research.

METHODS OF RESEARCH

Research Questions

1. Do levels of IT-Integration predict self-regulated learning in smart schools?

2. Do student-teacher interactions (student-centered learning, feedback provided by teachers and strategy instruction) predict self-regulated learning in smart schools?

3. Do motivational beliefs (intrinsic goal orientation, extrinsic goal orientation, self-efficacy, control beliefs, task values, and anxiety) predict self-regulated learning in smart schools?

4. Does self-regulative knowledge predict self-regulated learning in smart schools?

5. Does information literacy predict self-regulated learning in smart schools?

6. Do attitudes toward IT predict self-regulated learning in smart schools?

Research Samples

The targeted population for this study was smart school students. According to the Curriculum Development Centre (2002) and the Ministry of Education (2004, 2002), there are at least 1000 students in each of the 90 smart schools. In other words, the population for this study consisted of approximately 90,000 smart schools students. Smart schools are scattered in Peninsular Malaysia and East Malaysia. However, due to cost and time constraints, only secondary schools in Peninsular Malaysia were involved. The population was sampled by cluster sampling methods.

Using a table of random numbers, six smart schools were randomly selected for this study, with two schools representing each level of IT-integration; level A, level B+ and level B. For example, in order to select two schools from level A randomly, the researchers first listed all level A schools and numbered them consecutively. Next, an arbitrary number in the table of random numbers was selected. The researchers only used the last two digits of the number as the schools in each level of technology were less than 100. If the number corresponded to the number assigned to any of the schools, it would be included in the sample. These steps were continued until the sixth school was selected. Two Form Four classes were then randomly chosen from each school.

A total of 409 students (average 16 years old) was sampled in this research, which is more than the minimum size of 383 students proposed by Krejcie and Morgan (1970). The appropriateness of this sample size was also determined with Cochran's Formula (1977), which suggests a size of 400 students.

Data Collection Procedure

The researchers obtained formal approval from the Educational Planning and Research Division (EPRD) to carry out this study. Upon receiving permission from the EPRD, clearance from the relevant states Education Department was obtained. Prior to data collection, a preliminary visit was paid to the schools' authority to explain the purpose and details of the study. During this visit, information such as the number of students and Form Four classes were collected. The date and time for the data collection was also arranged. The researchers then identified the class teacher involved and explained the purpose, procedure and importance of the study. The researchers were able to obtain cooperation from these teachers. In the second visit, the researchers administered the questionnaire. The purpose of the study was explained briefly to the students before they were required to fill in the questionnaire. Students were assured that their answers were confidential and would only be seen by the researchers. They were also told that the study was not concerned with them as individuals but only in averages or norms. Thus, it was important for them to answer the questions honestly. Students began to fill in the questionnaire only after they were clear about the instructions given.

Instruments

Seven instruments were employed to measure the variables in this study:

Self-Regulated Learning. Students' self-regulated learning was measured by the adapted Learning Strategies Scale, taken from the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich, Smith, Gracia, and McKeachie, 1991). This 7-point Likert scale measures students' usage of self-regulated learning strategies. Its items have to be modified and translated into Malay Language in order to apply in the local context. The revised instrument contains 56 items. After running Cronbach's alpha analysis, the scale was confirmed to be a highly reliable instrument (alpha coefficient = 0.92).

Levels of IT-Integration. Based on the information provided by the Ministry of Education, level of technology for each smart school involved was written in the questionnaire by the researcher, this was to facilitate data analysis.

Student-Teacher Interactions. Student-teacher interaction was measured by a 12-item Student-Teacher Interactions Scale, developed by the researchers. It was a 7-point Likert instrument written in Malay. The scale was divided into three dimensions: student-centered learning, feedback provided by teachers, and strategy instruction, or teaching and learning strategies. Its content validity was verified by a panel of experts in Educational Psychology, while the construct validity was supported by factor analysis, conducted prior to the study. Cronbach's alpha showed that the scale also had high level of internal consistency (alpha coefficient = 0.88).

Motivational Beliefs. Motivational beliefs were measured by the 33-item Motivation Scale, taken from MSLQ. This 7-point Likert instrument was developed by Pintrich et al. in 1991. There were six subscales in this instrument (Intrinsic goal orientation, extrinsic goal orientation, self-efficacy, control beliefs, tasks values, and anxiety subscales), which measured different motivational beliefs. Minor modification was done to the instrument to suit the local context. The revised scale was found to be highly reliable (alpha coefficient = 0.87).

Self-Regulative Knowledge. Students' knowledge about self-regulated learning strategies and their beliefs about the values of these strategies were measured by the Self-Regulative Knowledge. This 12-item instrument was written in Malay by the researchers. It was a 7-point Likert scale. A panel of experts in Educational Psychology verified the content validity of the scale and each item had been checked by language experts. Factor analysis was also carried out by the researchers to

establish its construct validity. Cronbach's alpha analysis indicated that the scale was highly reliably (alpha coefficient = 0.87).

Information Literacy. The Information Literacy Scale was a self-report instrument, developed by the researchers to measure students' abilities to access, process, and apply information from the Internet. This 10-item, 7-point Likert scale was written in Malay. A panel of experts in Educational Technology verified the content of Information Literacy Scale. Each item had also been checked by language experts. Even so, given that this is a newly constructed instrument, factor analysis and Cronbach's alpha analysis were carried out to ensure the validity and reliability of the instrument. Results showed that the scale had construct validity and it was reliable (alpha coefficient = 0.83).

Attitudes towards IT. The Attitudes towards IT Scale was employed to measure students' affective, cognitive and behavioral attitudes towards the application of computers and Internet in learning. This 7-point Likert scale consisted of 10 items, and was modified from Wong's (2000) Attitudes towards IT subscale and Jones and Clarke's (1994) Computer Attitudes Scale for Secondary Students. Items in the scale were written in Malay. A panel of experts in Educational Technology verified its content validity and every item was checked by language experts. Cronbach's alpha analysis confirmed that it was a highly reliable instrument (alpha coefficient = 0.83).

RESULTS

The researchers employed Pearson's product-moment correlation coefficient and standard multiple regression to analyse the associations between self-regulated learning and the six selected independent factors. Pearson product-moment correlation coefficients were obtained to ensure that the factors had at least moderate ($r \geq 0.30$) strength relationships with self-regulated learning. Factors which failed to meet this criterion were omitted from the multiple regression analysis.

Based on the results and feedback provided by teachers, a dimension in student-teacher interaction was not included in the analysis as it only had a small relationship with self-regulated learning ($r = 0.17$, $p<0.01$). So were control beliefs ($r = 0.11$, $p<0.01$) and anxiety ($r = -0.07$, $p>0.01$), two of the dimensions in motivational beliefs. The researchers have also decided to analyze intrinsic goal orientation ($r = 0.29$, $p<01$) and extrinsic goal orientation ($r = 0.36$, $p<0.01$) as a combined variable, called goal orientation. Information literacy ($r = 0.02$, $p>0.01$) and attitudes towards IT ($r = -0.01$, $p >0.01$), were also excluded from the analysis as these two variables were not significantly related to self-regulated learning in smart schools.

Prior to multiple regression analysis, the researchers had also conducted exploratory analysis to test the various assumptions (ratio of cases to independent variables, normality, linearity, outliers, homoscedasticity, multicollinearity, and singularity) underpinning this analysis (Coakes and Steed, 2000). Since no assumption was violated, the standard multiple regression analysis could be carried out. The alpha level was set at 0.05. It is important to note that one of the independent variable, levels of IT-integration, is a categorical variable. It was coded as two dummy variables: level A and level B+ IT-integrations. The interpretation of these variables was relative to the excluded or referenced category, in this case, level B IT-integration. As such, five independent variables were actually entered into the regression equation simultaneously. The results of this analysis are shown in Table 1.

Table 1 shows that the R value was 0.72, which was quite high indicating that the linear regression model predicted well (Pallant, 2001). The obtained R^2 was 0.51 [F (5, 403) = 84.48, $p < 0.01$], showing that 51 per cent of the observed variability in self-regulated learning score was explained by the set of independent variables, included in the regression model.

Table 1. Multiple regression on predictors of self-regulated learning

Model	R	R^2	ΔR^2	F
Level A IT-Integration,	0.72	0.51	0.51	$F(5, 403) = 84.48**$
Level B+ IT-Integration,				
Student-Teacher Interactions,				
Motivational Beliefs, and				
Self-Regulative Knowledge				

** p <0.01

In order to determine which of the factors contributed to the prediction of self-regulated learning, the standardised regression coefficients or beta weights (β) were examined (Table 2). 'Standardised' means that the values for the different variables have been converted to the same scale so that they can be compared. It revealed the relative predictive power of each variable independently after the contributions of all other variables in the model were controlled.

Table2. Standardised beta coefficient of predictors of self-regulated learning

Variables	B	SE B	β	t	Sig.
Constant	1.59	.22		7.24	0.01
Levels A IT-Integration (dummy variable 1)	.68	.08	.38	8.90	0.01
Level B+ IT-Integration (dummy variable 2)	.11	.07	.06	1.49	0.14
Student-Teacher Interactions	.02	.00	.18	4.80	0.01
Motivational Beliefs	.71	.07	.38	10.30	0.01
Self-Regulative Knowledge	.01	.00	.13	3.33	0.01

Note: Level A IT-Integration and level B+ IT-Integration were dichotomies; they were compared to level B IT-Integration

Table 2 shows that the largest beta weight, 0.38, was recorded for motivational beliefs, and for level A IT-integration. The predictive powers for these variables were significant at the alpha value of 0.01. It meant that both motivational beliefs and level A IT-integration had equal and singular contributions in explaining self-regulated learning in smart schools, when the variance explained by all other variables in the model was controlled for.

The beta weight for student-teacher interaction, on the other hand, was 0.18, after other independent variables in the regression model were statistically controlled. This significant predictive power made it the second strongest predictor of self-regulated learning in smart schools.

The beta weight for self-regulative knowledge was 0.13, which was significant at an alpha value of 0.01. This result suggested that smart school students' self-regulative knowledge significantly explained the variance in their self-regulated learning scores. It was the third strongest predictor of self-regulated learning.

The lowest beta weight was 0.06, which was from level B+ IT-integration. An examination of the t-value indicates that the beta weight was not significant at the alpha value of 0.05. Such results showed that level B+ IT-integration could not significantly predict self-regulated learning, when other variables were controlled. It also implied that the relationships between levels of IT-integration and self-regulated learning mostly resulted from level A IT-integration alone.

Using the unstandardised coefficients, labelled as <u>B</u> in Table 2, a regression equation was produced. This equation consists of the constant, level A IT-integration, level B+ IT-Integration, student-teacher interactions, motivational beliefs, self-regulative knowledge, and a residual value.

$(\hat{Y}) = 1.59 + 0.68(LEVA) + 0.11(LEVB+) + 0.02(STI) + 0.71(MB) + 0.01(SRK) + e$ $(R^2 = 0.51)$

where
  $\hat{Y}$ = Predicted self-regulated learning scores
  Constant = 1.59
  LEVA = Level A IT-integration (coded as 1)
  LEVB+ = Level B+ IT-Integration (coded as 1)

STI = Student-Teacher Interactions
MB = Motivational Beliefs
SRK = Self-Regulative Knowledge
e = Residual
Note: The reference group for level A IT-Integration and level B+ IT-Integration was
level B IT- Integration (coded as 0).

Based on the unstandardised <u>B</u> coefficients for each independent variable (Table 2), self-regulated learning in smart schools can be predicted. In detail, students' self-regulated learning scores are expected to improve by 0.71 units or approximately 10 per cent with every one-unit increase in motivational beliefs scores, $t_{(403)} = 10.25$, $p<0.01$. This result is within the realm of expectations since motivational belief is the underlying premise for self-regulation (Pintrich and Roeser, 1994). Improvement in this aspect may bring considerable positive changes to self-regulated learning in smart schools.

The results on IT-integration were interesting. When the level of IT-integration in smart schools is high (level A), compared to when it is low (level B), there is a predicted increase in self-regulated learning scores by 0.68 units, $t_{(403)} = 8.90$, $p<0.01$. This implies that with all other variables held constant, students' self-regulated learning is expected to improve by 9.7 per cent when they are placed at schools with computerised classrooms, electronic resource centre, computers labs, and self-access centres, as compared to when they are at schools with only computer and multimedia labs. It also shows that students use more self-regulated learning strategies when they are in schools with a higher level of IT-integration. Currently, about 87 per cent of the existing smart schools have low levels of IT-integration. If the technologies in these schools are upgraded to the highest level, which is level A, students' self-regulated learning is expected to improve. On the other hand, when the level of IT-integration in smart schools is moderate (level B+), compared to when it is low (level B), there is an expected increase in self-regulated learning scores by 0.11 units. This improvement, however, was not statistically significant, $t_{(403)}=1.49$, $p>0.05$). Therefore, even if the technology of a smart school is upgraded from low to moderate, there will probably be no significant difference in students' self-regulated learning.

One possible reason behind this result is that the IT facilities in schools with level B and level B+ technology do not differ much. The former have computers in the computer and multimedia laboratories, while the later have additional five computers in 15 selected classrooms (Smart School Project Team, 2002). The effects of physical environment on students' learning in these schools may be quite similar; consequently, there is no difference in terms of self-regulated learning. It is also possible that students in level B+ and level B smart schools still depend more on conventional methods to learn. They may still be spoon-fed by teachers and are less self-directed, self-accessed, and self-paced, compared to their counterparts in level A smart schools. Overall, this study found that levels of IT-integration in smart schools had different effects on students' self-regulated learning. High level of technology integration in the learning setting seemed to influence self-regulated learning more positively and significantly, compared to moderate and low levels IT-integrations. As for student teacher interactions, every one-unit increase in this variable brings about an improvement of 0.02 units in self-regulated learning scores, $t_{(403)} = 4.80$, $p<0.01$. For each additional unit in self-regulative knowledge scores, on the other hand, there is a predicted rise in self-regulated learning scores by 0.01 units, $t_{(403)} = 3.33$, $p<0.01$. The expected increment in self-regulated learning scores, for both variables, is less than 0.5 per cent. For this reason, to create an impact on students' self-regulated learning in smart schools, student-teacher interactions and self-regulative knowledge has to be improved immensely.

DISCUSSION

Self-regulated learning is a relatively new and essential area of study in educational research, both locally and internationally. To date, few local studies have explored this topic and there was no investigation on self-regulated learning in Malaysian Smart Schools. Therefore, this study contributes by providing information to teachers as well as researchers on factors that predict self-regulated learning in these schools.

The findings show that high level of IT-integration, student-teacher interactions, motivational beliefs, and self-regulative knowledge are predictors of self-regulated learning in smart schools. More than half of the variance in students' self-regulated learning can be explained by these four factors, which indicates that to structure a learning environment that is conducive for self-regulated learning these factors should not be overlooked.

Levels of IT-integration and motivational beliefs have equivalent contributions towards self-regulated learning. This implies that both environmental and personal factors are important in students' self-regulation. Currently, about 87 per cent of the existing Malaysian smart schools have low level of IT-integration. These schools are only equipped with computers in computer and multimedia laboratories. The IT-facilities and infrastructure in these schools should be upgraded to produce a learning setting that supports self-regulation. Even though this may be costly, the returns will be worthwhile as smart schools have the potential to produce independent, proactive and self-regulated learners. It may change the negative perceptions of Malaysian students, which are stereotyped as spoon-fed or passive learners (Mustapha, 1998; Malaysian Strategies Research Center, 1994).

Results of multiple regression analysis also suggest that students' self-regulated learning does not differ in smart schools with moderate (level B+) and low levels of IT-integrations (level B). There are possibilities that students in these two categories of schools still depend more on conventional methods to learn. If this is the case, the Ministry of Education and the relevant authorities should re-evaluate the teaching and learning processes in these smart schools to ascertain that the learning activities carried out in these schools are congruent with the smart schools learning concept and that the provided IT-facilities are fully utilised. Since it takes time and money to upgrade the technology integration in level B+ and level B smart schools, perhaps these schools should improve students' self-regulation by focusing on the other three predictors of self-regulated learning. The results of this study show that improvement in student-teacher interactions, motivational beliefs and self-regulative knowledge may also bring positive changes to self-regulated learning.

Teachers can play a vital role in students' self-regulated learning by improving their interactions with students during the teaching and learning process. They may provide opportunities for students to manage their own learning activities. In fact, the learning activities in smart schools are expected to be more self-directed, self-paced, and self-accessed. These concepts are the catalyst to produce self-regulated learners. Nevertheless, teachers must be aware that students may have diverse needs and abilities for learning. Their differences in academic abilities, background knowledge, and interests, no doubt, may pose challenges to arrange for self-regulated learning activities in class. However, through trial and error, determination, and patience, teachers should be able to overcome these problems. Apart from promoting student-centered learning, teachers should also provide students with knowledge on self-regulated learning strategies. The teaching of learning strategies may enhance students' self-regulated learning. Lessons on these strategies can be conducted indirectly during the teaching and learning processes or specifically in separate sessions.

Self-regulated learning in smart schools can also be predicted by students' motivational beliefs (self-efficacy, goal orientations and task values)**.** This finding shows that students not only need to know when, why and how to use learning strategies, but they must also be motivated to use them. Teachers should take initiatives to improve students' self-efficacy beliefs, perhaps by convincing them that they are capable of learning and executing the various self-regulated learning strategies. Students can also be prompted to use strategies to explore their interests on a specific topic, enhance their grasp on the school subjects, as well as to achieve better grades. This is because both extrinsic and intrinsic goal orientations are essential for self-regulated learning in smart schools. In addition, to improve students' perception on task values, teachers can provide them with learning tasks that are interesting, challenging, motivating, exploratory, and constructive in nature (Learning in an Electronic Age, 2002). Furthermore, as smart schools are IT-integrated schools, teachers can also utilise the available technology to produce and design interesting learning materials and learning tasks. For instance, students can be asked to design a web site for a History project, present their English essays with PowerPoint presentations, or complete their mathematics exercises using educational software.

CONCLUSIONS

This study looked into self-regulated learning in smart schools, an area of research that had yet to be explored (Roslan, 2004). The predictors of self-regulated learning were examined comprehensively as both environmental (levels of IT-integration and student-teacher interactions) and personal factors (motivational beliefs, self-regulative knowledge, information literacy, and attitudes towards IT) were taken into account. Results showed that a high level of IT-integration, student-teacher interactions, motivational beliefs, and self-regulative knowledge predicted self-regulated learning in smart schools. This finding has important instructional implications as it may guide teachers to structure learning environments that are conducive for self-regulated learning. The research findings are also congruent with social cognitive theory, in which both environmental and personal factors are found to be related to students' self-regulated learning.

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