

AN EMPIRICAL STUDY OF KNOWLEDGE- MANAGEMENT CONTEXTUAL FACTOR IN THE EMERGENCE OF INFORMATION COMMUNICATION TECHNOLOGY IN SCHOOLS

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Abstract

Information technology in schools aggressively emerged in the late 1990s to reinvent the teaching and learning process in Malaysia. Schools no longer existed merely for the purposes of traditional teaching and learning but were needed to enhance their knowledge activities so as to be able to cope with the rapid changes that were taking place. The objectives of this study are to determine the contribution of knowledge contextual factors to the knowledge activities, with particular reference to the emergence of information technologies in schools, and to evaluate progress with respect to knowledge activities in school education. The research is designed around questionnaires based on a knowledge-management conceptual framework administered to random samples of teachers in information technology-facilitated schools and regular schools so as to be able to make comparisons. Interestingly the findings show that the information technology under the “ICT Facilitated school” is not a key factor contributing to knowledge sharing among the teachers. The findings also provide evidence that culture is the most important factor relating to a knowledge activity. Knowledge friendly, motivating staff, committed leadership, openness and mutual trust are some examples of positive school culture, whereas management factor remains crucial in facilitating learning and sharing among teachers.

Keywords: *Knowledge management, school, culture, management, technology.*

Introduction

The last decade of the 20th century saw unprecedented and accelerating changes in the global market accompanied by advances in ICT (information communication technology). As part of the global

player, Malaysia has initiated a mega project called Multimedia Super Corridor (MSC) which consists of seven flagships; E-Government, Telehealth, Multipurpose Card, Smart School, R&D Cluster, E-Business and Technopreneur Development. It is the intention of MSC to propel the transfer of technology and become the test bed for research and development in high-tech industries.

Information communication technology (ICT) in schools aggressively emerged in the late 1990s when the Smart School project was launched in July 1997. As part of the MSC, the Smart School Project is to engage and reinvent the process of teaching and learning. The major difference between the ICT-facilitated schools and the regular schools was in the technological facilities provided. The ICT infrastructure in the respective schools enabled an integrated management and learning system, so that administrative and supervisory tasks could be streamlined and automated. These new technological challenges led to an explosion of data, information and knowledge; schools no longer existed merely for the purposes of traditional teaching and learning but were needed to enhance their knowledge activities so as to be able to cope with the rapid changes that were taking place.

The ICT-facilitated schools and the regular schools

The ICT-facilitated schools in this study refer to the 90 selected schools which participated in the Smart School Integrated Solution (SSIS) project. The schools were selected from the three school types, namely the regular schools, the fully-residential schools and the religious schools. The 90 schools were chosen based on the schools' overall performance and their strategic locations to be able to function as an education hub to the surrounding area. The regular schools refer to those other than the 90 selected schools that come from the same school type. The decision of having ICT-facilitated schools was to cater for knowledge-driven workers as well as to fulfill the national aspiration for Vision 2020.

The major difference between the ICT facilitated schools and the regular schools lies in the facilities supplied to the schools. For example, a level "A" ICT-facilitated school is equipped with 520 computers, 5 notebooks and 6 servers per school. A level "B", on the other hand, received 81 computers, 2 notebooks and 3 servers. On top of that, they were also supplied with Local and Wide Area Network (LAN & WAN), broadband and wireless facilities at the speed of

512/256 kilobyte per second (kbps) for a level “A” school and 128/64 kbps for a level “B” school. Conversely, the regular schools received far fewer computers based on the number of students. For example, schools with 400 or less students received 10 computers, 1 computer lab and a server. Schools with more than 800 students were given a slightly greater number of computers; i.e. 40 computers, 2 computer labs, 2 servers and 1 LCD projector. Schools with between 400–800 students enrolments received 20 computers, 1 computer lab, 1 server and 1 LCD projector. In terms of networking, the regular schools were only provided with Local Area Network (LAN) and dial-up internet connection. The difference does not stop here as they are also operated with nine Smart School Integrated Solution components which are comparable with Smart School models elsewhere such as in Ireland, New Zealand and the USA (Ministry of Education, 2000 & 2004).

Due to the number of computers and the complexity of the ICT infrastructure, the Ministry of Education set up a centralized help-desk that addresses the maintenance issues relating to the ICT infrastructure. Generally the help-desk centre will handle queries relating to a wide range of hardware, software and communications equipment. ICT-facilitated schools are also given priority by receiving an ICT technician and an Information Technology Coordinator to ensure the facilities are running smoothly. The IT coordinators are appointed from among the school’s teachers who have an interest in and knowledge of computers. Those who are appointed are trained in using and handling the equipment. The school IT coordinator has a very important role as he/she is responsible for supporting all the issues related to the ICT equipment and networking, and conducting periodic training for teachers and students. In order to be always updated with the ICT facilities, the school IT coordinators have their own nationwide Support Group to form a peer-to-peer network for sharing ideas, and experiences and source support. As for the regular schools, the coordinator could be anybody that the school’s principal thought to be a computer-savvy person, who had the best interest, commitment, knowledge and skill in computers. The teacher will have to use his/her own initiative to learn about computers and run the system. However, sometimes they were also invited for computer courses tailored for the regular schools. In terms of teaching and learning materials, the regular schools were also using the same software and courseware as their counterparts because the existence of ICT-facilitated schools does not defeat the purpose of having a centralized curriculum. Therefore, the development of these materials was not for the ICT-facilitated schools alone but to be used by all

schools nationwide. Courseware for four subjects (Malay Language, English Language, Science and Mathematics) was developed by experts in the National Curriculum and classroom settings. However, there seems to be less emphasis on the usage of this courseware in the regular schools as they need to have a more compatible and stable system to support the software. To start with, schools need to have enough computers for each individual student in order to use the courseware interactively.

Secondly, schools also need to have computers which can support the courseware system, for example, computers using 64MB with the XP2000 operating system. Unfortunately some regular schools cannot take advantage of having this courseware either due to the lack of appropriate facilities or less enforcement by the authorities. Apart from having developed courseware, teaching and learning is also integrated and interactive with online activities in order to make learning more interesting. Several websites were developed and teachers and students could access these online, downloading information and sharing knowledge, problem solutions, exam papers, curriculum content, forums and discussions. Again, when it comes to internet connection, ICT-facilitated schools have more advantages than the regular schools. As mentioned earlier all 90 ICT-facilitated schools were connected with LAN, WAN and Wireless broadband. Unlike them, the regular schools were not so fortunate as they were only connected with low speed and dial-up internet connection facilities.

Another aspect of the ICT-facilitated schools is the deployment of a single integrated school and learning management system also known as the Smart School Management System (SSMS). SSMS encompasses 32 modules with a whole range of school functions including school governance, student affairs management, educational resources management, financial and technology management. Technically, SSMS should integrate with other departments such as human resources, accounting and e-commerce, so that administrative and supervisory tasks could be streamlined and automated. This situation differs from the regular schools due to the minimal ICT infrastructure which does not support the SSMS. As an alternative they use a number of individual software suites supplied by the Ministry of Education to cater for different purposes, for example, staff records (Employment Management System), students' database, discipline records and examination records none of which are integrated. Regardless of whether it is SSMS from ICT-facilitated schools or the

individual software for the regular schools, each responsible teacher has to familiarize himself/herself with each of the programmes to be able to enter their data.

Literature Review

The use of technology and computer networks in education indubitably has grown tremendously. Evidence has shown that ICT is no longer about data mining and warehousing, it is also about expanding networks to other schools and gaining access to advice from the schools' communities of practice (CoP), locally and internationally. Studies also show how schools are becoming networks and how computers had impacted upon their work in terms of distributed leadership, knowledge sharing and professionalization (Bushweller, 2000; Haughey, 2006). The role of ICT in facilitating knowledge sharing is imperative for a number of reasons. In principle, ICTs would appear to offer individuals and organisations faster, cheaper, broader sources of data and enable information exchange and the capturing, generating, sharing and storage of knowledge (Walsham, 2001; Huysman & Wulf, 2006). The availability of a range of new technologies and tools has been a major catalyst to knowledge management initiatives (Davenport & Prusak, 2000; Alavi & Leidner, 2001; Barret, Cappleman, Shoib & Walsham, 2004; Alavi & Tiwana, 2005) and some, such as e-mail, video-conferencing and virtual teaching and learning forum, provide valuable learning support to the schools' CoPs. In addition, individuals also believe that the usage of ICT and electronic media contributes to valuable information (Jarvenpaa & Staples, 2000).

However, the importance of face-to-face contact cannot be overlooked, particularly in the dissemination of tacit knowledge (McKinlay, 2002), both in terms of one-to-one and one-to-many interactions. Furthermore, one must consider the issue of cost effectiveness on which ICTs depend (Barret, Cappleman, Shoib & Walsham, 2004) and the balancing of benefits, such as superior technical performance and quality, with deficits, such as poor infrastructure, outdated systems and high maintenance budgets. For some, the decision to implement tools is based on the assumption that technology can be the panacea for knowledge problems, however, most organisations which have engaged with ICT soon find the leveraging of knowledge through the use of technology difficult to achieve (McDermott, 1999).

Studies have claimed that, in fact, technology contributes only 20 per cent of the entire success of knowledge management, compared to people and culture (Davenport & Grover, 2001). Whilst technology is by no means unnecessary, it must be employed in a culture that promotes knowledge sharing. No matter how strong the commitment and approach to knowledge management, the organisational culture has a much stronger impact (Fahey & Prusak, 1998). Several studies have examined the relationship of having ICT in initiating knowledge management in organisations. For example, Basu and Sengupta (2007) and Edvardsson (2008) noted that in the case of an exploitative strategy against an explorative Human Resources Management (HRM) strategy, the distinction is merely clear. The exploitative HRM strategy which has a greater emphasis on explicit knowledge depends heavily on IT solution. On the other hand, the explorative HRM strategy which has emphasis on tacit knowledge tends to increase the transfer of knowledge, innovation and organizational learning. In another study involving knowledge management approaches using IT solution Haesli and Boxall (2005) suggested that the two approaches (with and without IT) should not be treated as mutually exclusive but rather as complementing.

Every school has the potential to enhance overall performance by using a knowledge-based approach to support learning and sharing (Zhao, 2010). In an era of economic and political globalization, in which the world is dependent on primary resource industries and bureaucratic industrialization, schools are seen as fundamental to the process of transforming old industrialized systems into knowledge-based societies. As such, schools have become a part of broader policy agendas and need to respond to changes in the economy and to parental and governmental demands for change (Istance & Kobayashi, 2003; Haughey, 2006). By and large, knowledge management can always be used to support changes in educational administration. Through knowledge-management initiatives schools should be able to evolve from traditional bureaucracies to a more educational-knowledge environment that is appropriate in an information-technology and knowledge-economy driven society (Petrides & Guiney, 2002). This agenda is trying to address the quality of teaching, restructure the school management system, and strengthen the teaching profession in order to cater for the changes in educational settings.

Hence, this study is aimed at determining the contribution of knowledge-contextual factors to the knowledge activities in schools with comparisons between ICT-facilitated schools and the regular

schools. Three main contextual factors were chosen in this study, which are management, culture, and technology. The type of school is included as an independent variable to justify the comparison between schools in knowledge activities (capturing, creating, sharing, storing and applying).

The Methods

A conceptual model formed the research framework and essentially encompassed the influences of management, culture and technology on the creation, capture, storage, application and sharing of knowledge, upon which the survey instrument was based. Stratified sampling was used to select 40 ICT-facilitated and regular schools across the four main geographical areas of Peninsular Malaysia. A total of 50 teachers from each school were randomly selected irrespective of their background profiles to participate in the self-administered surveys.

The questionnaire was divided into two sections. The first section was mainly on the respondents' background profile whereas the second section was divided into 5 sub-sections corresponding to the variables in the research model: the importance of managing knowledge; facilities and methods of managing knowledge; knowledge-sharing barriers and knowledge activities. The final section of the questionnaire focused on the contributing factors to managing knowledge, namely management, culture and technology, which are the focus of this paper.

A five-point Likert scale was used for each item, ranging from 'strongly disagree' to 'strongly agree'. The questionnaire was piloted among two groups of 30 participants each from ICT-facilitated and regular schools. Finally, the items were tested using the Cronbach alpha and those with low coefficient values were dropped, thereby increasing the overall alpha value from 0.908 for 101 items to 0.913 after the removal of five items. The final questionnaire consisted of 96 items.

The data was analysed using the independent sample t-test for comparison of knowledge-management contextual factors between ICT-facilitated schools and regular schools. The regression model was employed to determine the contributing factors to knowledge activities.

The model was,

$$\text{Knowledge Activities} = \alpha + \beta_1\text{Management} + \beta_2\text{Technology} + \beta_3\text{Culture} + \beta_4\text{ICTFS} + \beta_5\text{Experience} + \epsilon$$

where, *Knowledge Activities* capturing, creating, sharing, storing and applying were the dependent variables; ICT-facilitated school (*ICTFS*) was a dummy for the type of school. Five (5) model regressions were used to represent each knowledge activity.

Results

A total of 2000 questionnaires were distributed among the 20 ICT-facilitated schools and 20 regular schools in Peninsular Malaysia. 900 respondents in total participated in the survey, where 474 (52.7%) were from the ICT-facilitated schools and 426 (47.3%) were from the regular schools. The result shows that there were more respondents from the rural than the urban areas, which was 494 (54.9%) and 406 (45.1%) respectively. 656 (72.9%) respondents were females and 244 (27.1%) were males. This was unavoidable due to the fact that the teaching profession in Malaysia is dominated more by women than men in which out of the 412,720 teachers nationwide, 285,299 are women and 127,421 are men (MOE, 2012). Respondents spanned the range of age categories from below 30 to 50 years or over. This sample comprised less than 30% of the respondents aged 30 years or below, and roughly 45% from the middle group aged 31 to 40 years old. Meanwhile 21% were from the age group of 41 to 50 years old and only 4% were above 51 years old. Most of the teachers held degrees in several fields. The sample indicated that 81.8% of the respondents were degree holders, whereas 10.5% held masters degrees with the balance of 7.7% being diploma holders. As far as the length of experience was concerned, 47.1% of the respondents had 10 years or less teaching experience while 39.0% had between 11 to 20 years of teaching experience. Only a handful of respondents (13.9%) had more than 30 years of teaching experience.

Knowledge Activities

The mean scores for these variables were quite high, demonstrating their importance in managing knowledge in schools. As for *knowledge capture*, both respondent groups stressed the importance of collaborative relations, with the majority believing the basic source of new knowledge to be external, such as the Ministry of Education,

Department of Education or other schools. *Knowledge creation* tended to be effected through social discussions, teamwork or work projects, additionally, through individual activities such as reading and self-reflection. *Knowledge sharing* through informal discussions was agreeable, with respondents perceiving that their friends were always ready to share and contribute new ideas. Mentoring was also a way of sharing knowledge. *Knowledge application* in context could increase individual experience. Knowledge could also be applied through problem solving when people ask for advice, during work tasks set by the management and through rules, procedures and organisational routines.

Finally, in terms of *knowledge storage*, it was regarded as easier to access explicit than tacit knowledge. Respondents perceived that they could access information easily, including important information. However, perceptions were not so clear as to whether it was better to store knowledge in paper form or electronically. The overall mean scores demonstrated that knowledge management initiatives are gathering pace, albeit at a relatively slow.

Differentiating between ICT-Facilitated Schools and Regular Schools

Table 1 shows the t-test output for differences in knowledge activities and contextual factors contributing to managing knowledge reported by respondents from both types of schools, with a significance test of 0.05 level. The results revealed no statistical significance between ICT-facilitated schools and regular schools in knowledge activities, except for storage context. As expected, the facilities of technology used for storage of information showed a significant difference. The t-value was 3.384, $p < 0.05$, demonstrating the understandable difference between the facilities provided to ICT-facilitated schools as opposed to regular schools.

In terms of contextual factors, the technology variables was significant. This result is consistent with ICT-facilitated schools having better equipment and facilities and therefore being able to take greater advantage of technology as an enabler of knowledge management. Nonetheless, technology does not explain all of the variance in knowledge-related behaviour; the human factor no doubt was a mediating factor in technological differences between the two types of schools. Unexpectedly, the mean for knowledge creation among regular school teachers was higher than those in ICT-facilitated schools; the former believing they created more knowledge. However, the 95% interval for the difference in mean is

not significant. Time might be a factor here, with teachers' workload a perennial issue in schools (Lortie, 2002; McDermot & O'Dell, 2000; Rosenholtz, 1989; Louis, 1994). Findings from those studies agreed that lack of time remains the major barrier in managing knowledge, teachers being increasingly required to teach and perform many tedious administrative duties. The culture factor did not show any significant mean difference between the ICT-facilitated schools and the regular schools, possibly because the sample was relatively homogeneous from the same environmental setting. Moreover, school culture across Malaysia tends to be homogeneous under the government and the control of the Ministry of Education with the resulting top-down style of management.

Table 1

Independent Samples Test (T-Test for Equality of Mean)

Variables	t	df	Sig. (2-tailed)	Mean difference	95% confidence interval of difference	
					Lower	Upper
Capture	-0.900	898	0.369	-.135	-0.431	0.160
Creation	-1.814	898	0.070	-.261	-0.544	0.021
Sharing	0.624	898	0.533	0.113	-0.241	0.467
Application	0.175	898	0.861	0.029	-0.296	0.354
Storage	3.384	898	0.001	0.624	0.262	0.986
Management	1.870	898	0.062	0.434	-0.022	0.889
Technology	3.994	898	0.000	1.062	0.540	1.585
Culture	0.814	898	0.416	0.208	-0.293	0.709

Regression Results

Knowledge activities constituted the dependent variables for the regression models, with the predictors, being management, technology, culture, school type, gender and experience. The results are shown in Table 2.

The overall result showed that among the three contextual factors, management and culture were seemingly significant for all the knowledge activities; capturing, creating, sharing, applying and storing. Whereas for the technology factor, only sharing, applying and storing show evidence of significance. In terms of school types, the coefficient for school type (ICT-facilitated school as a dummy variable) is significant for knowledge creation, showing that teachers at regular schools experience more knowledge-creation activity as

compared to teachers from ICT-facilitated schools. Apparently, teachers from ICT-facilitated schools are statistically significant for knowledge-storing activity than their counterparts in regular schools. The result also revealed that there were no significant differences between male and female and, experienced and inexperienced teachers in all knowledge activities.

Table 2

Regression Results

Independent variables	Knowledge activities (n=900) Dependent variables				
	(1) Capture	(2) Create	(3) Share	(4) Apply	(5) Store
Constants	10.51*	13.10*	14.31*	14.76*	10.26*
Management	0.129*	0.080*	0.219*	0.155*	0.077*
Technology	0.034	0.230	0.670*	0.062*	0.103*
Culture	0.114*	0.100*	0.075*	0.103*	0.199*
School type	-0.255	-0.337*	-0.053	-0.124	0.439*
Gender	0.105	-0.151	-0.476	-0.050	0.001
Experience	-0.017	-0.011	-0.017	-0.005	0.004
F	26.051	15.098	32.288	27.336	37.085
R ²	0.149	0.100	0.178	0.155	0.199

Note. *significant at 5 per cent and below.

The beta value for knowledge capture was significantly related to management and culture, with the former being suggested as the most important predictor of the three. The coefficient for school type is not significant, showing that there is no difference in the activity of knowledge capture for both school types. For knowledge creation two factors were statistically significant, with culture being the most important predictor of knowledge creation followed by management. As for knowledge sharing all factors were statistically significant, except for school type, gender and experience suggesting that knowledge-sharing activity occurs beyond time and space. Knowledge application activity has shown that all three contributing factors were statistically significant with evidence of management as the most important predictor followed by culture and technology. For knowledge storage all factors were also statistically significant, with school culture being the best predictor followed by technology and management.

In summary, culture was very important in contributing to sharing, applying, creating, capturing and storing knowledge, while technology was less important for knowledge capture and creation. Knowledge storage was perceived to be better in ICT-facilitated schools with better ICT facilities and equipment but technology did not support knowledge capture and creation. Similarly a study by Chu, Wang and Yuan (2011) also shows that people and culture were critical for promoting knowledge management in schools. Meanwhile, the knowledge capture, sharing and application activities were not significantly different between these school types. On the other hand, gender and experience were found to be not statistically significant with all five knowledge activities possibly suggesting that knowledge activities are boundary less.

Discussion and Conclusion

Knowledge management contextual factors are vital in school settings. Culture appears to be a significant factor in generating knowledge activities. Schools need to embrace a positive culture to foster learning and sharing. Teachers and school leaders need to play a prominent role to ensure that knowledge management initiatives can be accomplished. This study suggested that school cultures were identified as knowledge-friendly, motivating staff to share knowledge with a committed leadership, showing openness to change, mutual trust and learning, appearing along with technology and management as the important factors in generating knowledge-activities in school.

Management is inevitably essential in supporting the success of knowledge-management initiatives in schools. The management factor defines the chain of command governing communication and decision-making, as well as encouraging knowledge-sharing and facilitating continuous transformation of ideas. This study pointed out that management encouraged staff-learning, organised appropriate training and promoted knowledge acquisition both internally and externally.

There was also evidence for technology as a factor in knowledge-management initiative in schools. As expected schools with more facilities were able to share, apply and store knowledge but did not necessarily have an advantage in knowledge capture and creation. Considering the relative difference between ICT-facilitated schools and regular schools in terms of funding allocation, facilities and

bureaucracy, school type is not a determinant factor in knowledge activities. ICT-facilitated schools are expected to act as the educational hub for their surrounding areas and have superior resources in terms of infrastructure, manpower and funding. They could take on the responsibilities for networking, dissemination and activity generation amongst the group of schools to work with other schools and share best practices. Meanwhile, ICT facilities seemed to be widely used and were functioning well in schools nationwide, with information and records stored in electronic databases and being accessible to all members of staff in those schools.

As far as the contribution of the contextual factors to knowledge activities, culture was an important instrument in all the knowledge activities, but it was certainly not the only or the most prominent one.

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