The effects of knowledge management capabilities on perceived school effectiveness in career and technical education

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Abstract

Purpose – *This study aims to investigate the impact that knowledge management (KM) capabilities have on school effectiveness in career and technical education (CTE) in Taiwan.*

Design/methodology/approach – *The study adopted a survey research. A total of 439 valid samples were obtained and subsequently verified with structural equation modeling.*

Findings – *The results indicated that KM capabilities consist of two main dimensions, namely, the KM enabler capabilities and the KM process capabilities. The former includes structures, cultures and information technology support, whereas the latter includes acquisitions, storage, sharing and applications. In terms of the relationships among the dimensions of the model structure, the KM enabler capabilities managed to effectively predict the KM process capabilities, and the KM process capabilities managed to effectively predict the perceived school effectiveness.*

Research limitations/implications – *Based on the results, improvement of the KM enabler capabilities and process capabilities of higher education institutions of CTE is recommended so that their school effectiveness may be improved. Because the participants were not randomly selected, the generalizability of the results should be further examined.*

Practical implications – *This study encourages practitioners to focus their KM practices on KM enabler capabilities and the KM process capabilities.*

Originality/value – *The current study provided an insight into and further understanding of the model regarding the relationships among the KM enabler capabilities, the KM process capabilities and the school effectiveness.*

Keywords *Structural equation modeling, Knowledge management, School effectiveness, Career and technical education*

Paper type *Research paper*

1. Introduction

Throughout the world, organizations and higher education institutions (HEIs) are meeting the challenges arising from rapid changes involving the new knowledge economy (Ali Zwain *et al.*, 2012; Hargreaves, 2001). With "knowledge" forming the core resource of an organization in such an economy (Muhammad *et al.*, 2011), the quality of knowledge management (KM) has in turn become the vital factor in whether an organization has the ability to improve its competitiveness (Ali Zwain *et al.*, 2012; Anantatmula, 2007; Kiessling *et al.*, 2009; Yeh, 2005). Because education is the basis of knowledge economies, only through a qualified education can distinguished talents be produced. HEIs are where knowledge is imparted and distributed, and, as such, their ability to manage knowledge should be emphasized so that their management, administration, teaching and research resources can be effectively utilized for the improvement of their school effectiveness (Ali Zwain *et al.*, 2012; Yeh, 2005).

"The results of this study indicated that the culture, structure and IT support of KM enabler capabilities could be considered first when establishing the infrastructure to facilitate KM process capabilities in order to improve school effectiveness."

The development of KM may provide helpful assistance to knowledge workers employed by HEIs (Ali Zwain *et al.*, 2012; Muhammad *et al.*, 2011; Yeh, 2005). The preservation of tacit knowledge of teachers and administrative members is frequently being ignored because only a limited portion of such knowledge within an organization can be converted to explicit knowledge (Gandhi, 2004). Though KM is crucial to teaching and administrative efficiency, the practice of KM remains challenging for HEIs in Taiwan. In the past several decades, the development of career and technical education (CTE) efforts, which are primarily undertaken by colleges and universities in Taiwan, has always adjusted and expanded based on the needs that arose for economic planning and development. In recent years, colleges providing CTE have faced huge challenges because of the rapid changes in HEIs, such as the drop in the birth rate (Yeh, 2005). In Taiwan, administration units and teaching departments are two of the main structural elements of HEIs of CTE that are similar to those of HEIs of CTE in the USA. The administration units may incorporate academic affairs, students' affairs, general affairs, libraries or computer centers, whereas teaching departments may incorporate colleges of engineering, management or social sciences that themselves comprises several departments. The HEIs of CTE in Taiwan focus on providing apprenticeships, an approach to CTE, which emphasizes the inheritance of practical skills and knowledge. The preservation of tacit knowledge is thus relatively important (King, 2009). There is a concern for HEIs of CTE to revise their operating strategies of KM so as to boost the general school effectiveness for a better competitive advantage.

In comparative studies of KM frameworks for promoting organizational effectiveness, several researchers have suggested three major components of KM, namely, enablers, processes and organizational effectiveness (Gold *et al.*, 2001; Lee and Choi, 2003; Lee and Lee, 2007; Soon and Zainol, 2011). Lee and Choi (2003) argued that most studies have examined the relationships of KM enablers, processes or organizational effectiveness in isolation and, thus, suggested that an integrative perspective of KM is necessary. Some education researchers (Ali Zwain *et al.*, 2012; Muhammad *et al.*, 2011) have also provided insights into how KM can be used to enhance school effectiveness. However, these studies failed to examine an integrative model but rather suggested frameworks to verify the KM processes and school effectiveness. In this study, an integrative knowledge management capabilities (KMC) model is built and empirically tested in an educational context. It is thus hoped that the current results can verify the correctness of the theoretical model and, at the same time, investigate whether KMC have effects on school effectiveness in the HEIs of CTE. The integrative model contributes to the existing knowledge, which currently lacks studies using an integrative KM model in an educational context. It is further hoped that the present study can serve as a reference for the implementation of KM in HEIs of CTE so that the process can be conducted more smoothly to boost the effectiveness and general competitiveness.

2. Literature review

2.1 Knowledge management in education

KM has been defined as the processes or practices that apply knowledge facilitated by enabler infrastructures to improve organizational performance (Gold *et al.*, 2001; King,

2009; Lee and Choi, 2003; Lee and Lee, 2007; Soon and Zainol, 2011). From this context, KM consists of enabler infrastructures and processes. The former are the resources that organizations possess when knowledge activities are implemented (Gold *et al.*, 2001; Lee and Choi, 2003), whereas the latter are the activities that transform knowledge from implicitness to explicitness (Nonaka, 1994; Tahir *et al.*, 2013). The concept of KM involves a combination of tools such as information technology (IT) and has become a key potential strategy for improving the effectiveness of an organization (Ali Zwain *et al.*, 2012; Kiessling *et al.*, 2009; Petrides and Zahra, 2002; Soon and Zainol, 2011; Tahir *et al.*, 2013; Zack *et al.*, 2009).

In recent years, educational organizations have actively conducted KM. Meanwhile, the definitions of KM in the field of education are similar to those mentioned above. For instance, Tahir *et al.* (2013) define KM as the processes that engage members of HEIs in efforts to renew their schools' knowledge while also assuring their own professional development. Guzman and Trivelato (2011) posited that KM recruits the IT-based conception and tools for capturing, storing and sharing knowledge in the practice context. According to Sallis and Jones (2002), KM can be defined as a tool that gives clues to the managers and staff members of educational organizations to meet the challenges of the knowledge era.

To summarize the points, the definition of KM adopted in this study can be stated as follows: a practice-driven process facilitated by enabler infrastructures to apply knowledge in educational contexts. With the strategies by the HEIs' leadership, the effective supervision that is enacted on assets such as the implicit knowledge and experience of the teachers, staffs and managers via IT tools and their HEIs' culture is built so that the processes of knowledge sharing and renewal can be shaped in the educational context.

2.2 Knowledge management capabilities

KMC are the existing capabilities within an organization and potentially affect how organizations manage their knowledge (Freeze, 2006; Gold *et al.*, 2001; Lee and Lee, 2007). KMC are inclusive of the abilities to convert the inputs to its maximum outputs through their internal resources and to make use of knowledge to create value. How organizations manage knowledge is a determining factor in their KMC level (Freeze, 2006). Various studies have identified two key aspects of KMC: enablers and processes (Lee and Choi, 2003; Soon and Zainol, 2011); infrastructure and processes (Gold *et al.*, 2001); and capability and processes (Lee and Lee, 2007). This study adopts two aspects of KMC, namely, the KM enabler capabilities and process capabilities.

The KM enabler capabilities are the pre-determined conditions and organizational resources that organizations possessed when KM activities are implemented (Gold *et al.*, 2001; Ichijo *et al.*, 1998; Lee and Choi, 2003). It is only with the possession of these pre-determined conditions and organizational resources that KM can be promoted within organizations. Different researchers have identified several key aspects to KM enablers, including structure, culture and technology (Gold *et al.*, 2001); structure, culture, IT and people (Lee and Choi, 2003; Lee and Lee, 2007); and culture and people (Soon and Zainol, 2011). Thus, the elements of KM enabler capabilities in this study were inclusive of structures, cultures and IT support. "Structures" refers to the

"KM enabler capabilities are the foundation and predetermined infrastructures as well as resources for KM processes to be enabled smoothly."

"The results of this study also indicated that the acquisition, storage, sharing, and application of KM process capabilities can distribute tacit knowledge in order to improve school effectiveness."

presence of norms and encouraging strategies within KM (Gold *et al.*, 2001; Lee and Choi, 2003) and includes the KM leadership and team, the promotion of strategic plans and any rewards for the examination and assessment (Bhatti *et al.*, 2013; Bozdoğan, 2013; Gold *et al.*, 2001; Lee and Choi, 2003; Mas-Machuca, 2014). "Culture" refers to the members' behavior that keeps the knowledge inside the organization for innovative advantage (Lee and Choi, 2003; Lee and Lee, 2007) and includes the culture of cooperation, trust, sharing and learning. "IT Support" addresses the technology-enabled ties that exist within the firm (Gold *et al.*, 2001) and includes the fundamental IT infrastructures and KM systems.

The KM process capabilities are the basic implementation of knowledge activities so as to increase the effectiveness of knowledge flow and to transform knowledge from implicitness to explicitness (Nonaka, 1994). Different researchers have identified several key aspects to KM processes, including creation, storage, transfer and application (Alavi and Leidner, 2001); acquisition, conversion, application and protection (Gold *et al.*, 2001); acquisition, conversion and application (Liao and Wu, 2009); generation, codification, sharing and utilization (Muhammad *et al.*, 2011); and identification, acquisition, storage, sharing and application (Ali Zwain *et al.*, 2012). The elements of KM processes adopted in this study were inclusive of the acquisition process, storage process, sharing process and application process. The acquisition process consists of the accumulation of knowledge from both internal and external sources (Ali Zwain *et al.*, 2012; King, 2009; Gold *et al.*, 2001). The storage process involves the organizing and structuring of knowledge within an organization for the utilization of its members (Ali Zwain *et al.*, 2012; Gold *et al.*, 2001) and reduces the risk of losing organizational memory acquired from individuals in the form of tacit knowledge (Alavi and Leidner, 2001; King, 2009). The sharing process refers to the actions of members in using various channels to effectively exchange and distribute knowledge to an individual or a unit so that the value of knowledge can be expanded (Ali Zwain *et al.*, 2012; Muhammad *et al.*, 2011). The application process refers to the improvement and utilization of existing knowledge (Ali Zwain *et al.*, 2012; Liao and Wu, 2009; Muhammad *et al.*, 2011), so as to develop valuable knowledge (Alavi and Leidner, 2001; Gold *et al.*, 2001).

Schools are viewed in this study as "organisms" (Wilson, 2001) whose capabilities adaptively grow, change and adjust according to external influences or internal operations. For HEIs to successfully implement KM, both the KM enabler capabilities and the KM process capabilities are acquired. For HEIs to conduct KM, enabler capabilities such as structures, cultures and technologies are first acquired. Subsequently, through combining and utilizing knowledge resources with the KM process capabilities, HEI organizations may achieve the purpose of adequately preserving, utilizing and creating general knowledge power and general competitiveness.

2.3 School effectiveness

A system approach is often used to develop models that help to understand what leads to school effectiveness. Creemers and Kyriakides (2006); Scheerens (2013) reviewed several school effectiveness studies and found evidence for three important models, namely, the dynamic model, the micro-economic approach and the sociological perspective. The

micro-economic theory and sociological perspective mainly focused on factors at the student level which are assumed to predict students' achievement (Creemers and Kyriakides, 2006). The factors affecting student achievement are multilevel and interactive (Creemers and Kyriakides, 2006). Scheerens (2013) pointed out that the dynamic model provides a broad outlook on effectiveness criteria rather than simply students' cognitive outcomes. In contrast, a single dimension may not provide a full picture of school effectiveness. The dynamic model proposes a multi-dimensional structure and views the facilitating process of schooling, teaching and learning as the core of development (Scheerens, 2013). In this study, the view of school effectiveness was thus adopted from the dynamic model.

Previous studies have identified various aspects for the multidimensional structure of school effectiveness, including administrative leadership, environment and facilities, teachers' instruction, students' performance, school ambience and social relations (Lin, 2003); administrative leadership, educational quality, students' performance and parents' approval (Yan, 2007); school-level factors, quality of teaching and students' output measures (Creemers and Kyriakides, 2010; Heck and Moriyama, 2010); and school-level categorical variables, school-level interval variables and pupil-level variables (Levačić and Jenkins, 2006). From the business perspective, organizational effectiveness may include the abilities to innovate (Gold *et al.*, 2001; Lee and Choi, 2003) or to produce new products (Gold *et al.*, 2001). A comparison of these differing multi-dimensional structures for school effectiveness indicates that they have three major levels in common, namely, the school, teacher and student levels and also take into account innovation, such as the creation of patents. The school effectiveness in this study thus focused on the administrative efficiency (school level), the research outcome (teacher level) and the teaching effectiveness (student level). In Taiwan, the scores that students receive on a comprehensive examination determine which colleges and universities of CTE that they are given the opportunity to enroll in. Each college or university may develop their distinctive marks according to students' features, such as design, engineer or management. The student outcomes may differ because of the different orientations of the different colleges and universities. Student-level effectiveness in this study thus adopted teaching effectiveness as the representation.

The term "school effectiveness" in this study refers to the multi-dimensional effectiveness of the leadership, teachers and students of a school in achieving their educational goals (Creemers and Kyriakides, 2010; Lin, 2003; Scheerens, 2013). In the school leadership dimension, the effectiveness is achieving outcomes such as the communications and co-ordinations, environmental planning and course arrangements. In the teachers' dimension, the effectiveness is inclusive of the research outcomes, job satisfaction and the level of interactions with colleagues. In the students' dimension, the effectiveness is inclusive of the academic achievements, discipline and instructional quality.

2.4 The relationship between knowledge management and school effectiveness

Understanding the relationship between KM and school effectiveness is crucial for the successful importation of KM into HEIs (Ali Zwain *et al.*, 2012; Muhammad *et al.*, 2011). Muhammad *et al.* (2011) found that KM practices, namely, knowledge generation, knowledge codification, knowledge sharing and knowledge utilization have positive and significant relationships with school effectiveness. Ali Zwain *et al.* (2012) found that Iraqi HEIs can benefit from KM processes. All processes of KM have significant correlations with school effectiveness measures. Through these KM processes, tacit knowledge may be converted to explicit knowledge, and this renewed knowledge may promote school effectiveness. As KM processes and school effectiveness are closely correlated, the former is beneficial for improving the latter, whereas the latter is also helpful in the permanent operation of the former.

In the management studies of general enterprises, after inspecting KM from an organizational standpoint, Gold *et al.* (2001) suggested a model for KMC. It has been determined that the infrastructure and process capabilities of KM directly influence organizational effectiveness and suggested that the successful promotion of KM has a positive influence on the operating effectiveness of an organization. Lee and Lee (2007) also conducted an empirical research and proposed the model for enabler, processes and performance. The results from Lee and Lee's study discovered that a significant relationship among the enablers, processes and performance. The KM enablers had effects on KM processes, and successful KM processes in turn had effects on organizational performance. KM enabler capabilities may serve as the infrastructures for organizational members in utilizing KM process capabilities. Members' practical know-how, diffused and inherited through KM process capabilities, may enhance organizational effectiveness. From the abovementioned studies, it can be seen that a possible positive correlation may exist between KMC and the effectiveness of HEIs or organizations.

This study investigated the structural relationships among the KM enabler capabilities, the KM process capabilities and school effectiveness in HEIs of CTE. HEIs are seen as a type of organization and some researchers have proposed organization theories in the pursuit of school effectiveness (Creemers and Kyriakides, 2006; Scheerens, 2013). This study adopted a previously validated KM model from an organizational standpoint (Lee and Lee, 2007) to determine school effectiveness. Past empirical studies have also shown the relationship between KM enabler capabilities and KM process capabilities (Lee and Choi, 2003; Lee and Lee, 2007) and the relationship between KM process capabilities and school effectiveness (Ali Zwain *et al.*, 2012; Muhammad *et al.*, 2011).

This study tried to further the research into two different models of KM and school effectiveness. KM enabler capabilities are organizational infrastructures for acquiring knowledge, storing knowledge and facilitating knowledge sharing in an organization (Lee and Lee, 2007). These capabilities are identified with great benefits in HEIs' environments in terms of research processes, curriculum development, student services, administrative services and strategic planning (Ali Zwain *et al.*, 2012). Moreover, KM process capabilities can be thought of as providing structured coordination between KM enabler capabilities and school effectiveness for managing knowledge effectively (Lee and Lee, 2007; Gold *et al.*, 2001). This study thus investigated the relationship between KMC and school effectiveness with a focus on the input-process-output model (Scheerens, 2011). The fundamental assumption is that the input factors affect output factors through some kind of mediating processes. Based on this model, it can be assumed that KM enabler capabilities affect school effectiveness through KM process capabilities.

2.5 Research questions

Based on the abovementioned references, this study primarily aimed to examine the relationships among the KM enabler capabilities, the KM process capabilities and school effectiveness. The research questions (*RQs*) of the study, therefore, were as follows:

RQ1. Did the KM enabler capabilities have effects on the KM process capabilities?

RQ2. Did the KM process capabilities have effects on the perceived school effectiveness?

RQ3. Did the KM process capabilities have mediating effects between the KM enabler capabilities and the perceived school effectiveness?

3. Methodology

3.1 Research method and framework

This study adopted survey methodology. Data were gathered through questionnaires and verified with the structural equation modeling (SEM) to investigate the relationship between

KMC and school effectiveness. With the referenced theories as the basis of this study, a research framework was suggested for the investigation of structural relationships among the KM enabler capabilities, the KM process capabilities and school effectiveness in HEIs of CTE shown in Figure 1.

3.2 Participants

The purposive sampling method was utilized in this study. To increase the representativeness of the samples, stratified multistage sampling procedures were used in this study (Babbie, 2009). Specifically, three stages of sampling focusing on, respectively, the school, the unit and the staff, were conducted (as shown in Table I). During stratified sampling, certain homogeneous sub-populations should be isolated to several strata such that these different strata are heterogeneous (Daniel, 2012). In the development of CTE in Taiwan, the classification of technological universities and technical colleges depends upon the sizes and development of schools. According to statistical data from the Ministry of Education in Taiwan (www.edu.tw/statistics/), these two kinds of HEIs are heterogeneous in school structures, teacher attributes and student numbers.

In Phase 1, during sampling, 7 out of 15 technological universities were selectively chosen, and 6 out of 12 technical colleges were selectively chosen, according the proportion of staff between technological universities and technical colleges. In total, 13 HEIs were selected. As a small number of HEIs expressed reluctance in the questionnaires, they were filled in subsequent with replacement HEIs. The same proportion was applied to choose the unit samples and staff samples in Phase 2. The administrative units involved were primarily the presidents' office and units such as academic affairs, students' affairs, general affairs, libraries or computer centers. For the teaching departments, 6-8 departments were chosen. In the Phase 3, the same proportion was applied to choose staff samples. The 50 questionnaires had been sent to each school, amounting to a total of 650 copies in 13 HEIs. For administrative units, each unit was given four copies – two for supervisors and two for staffs – amounting to a total of 24 copies. For academic departments, 6-8 departments were chosen in each school with one department supervisor, and three teachers in each department, amounting to 26 copies. A total of 503 questionnaires were returned. With the deduction of 64 invalid copies, a total of 439 copies were valid. The valid rate of the questionnaires was 87 per cent, including responses from supervisors, teachers and staff members, and, thus, represented the views of all the main promoters of school effectiveness.

Figure 1 Research framework

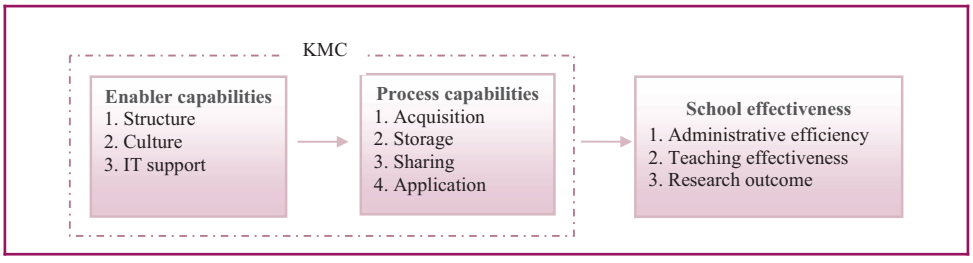


Table I The sampling procedure

Stratum	*Staffs*	*Proportion*	*Phase 1 school samples*	*Phase 2 unit samples*	*Phase 3 staff samples*	*Completed samples*
Technological universities	24,507	0.54	7	87	350	273
Technical colleges	20,815	0.46	6	75	300	166
Total	45,322	1.00	13	162	650	439

The overall numbers of respondents from public and private HEIs were 141 (32.1 per cent) and 298 (67.9 per cent), respectively. Of those respondents, 132 (30.1 per cent) were supervisors, 165 (37.6 per cent) were teachers and 142 (32.3 per cent) were staff members. Of those, 261 were male respondents (59.5 per cent) and 178 were female respondents (40.5 per cent). These respondents' age ranges, as well as their percentages of the sample, were as follows: below 30 (15.3 per cent), 31-40 (27.6 per cent), 41-50 (42.4 per cent) and above 50 (14.8 per cent). The overall numbers of respondents with doctoral, master's and bachelor's degrees were 160 (36.4 per cent), 156 (35.5 per cent) and 123 (28.0 per cent), respectively.

3.3 Instrument

The research team referred to previous studies suggesting that the existing scales could be used. The drafts of the KMC questionnaire were prepared based upon the literature review, and the question items were confirmed with five experts. The classifications of the question items, their manner of expression and narration were edited to build on the expert validity of the questionnaire. Ten teaching staff members from one university in Southern Taiwan were then invited to participate in the checking and editing of the question items. A questionnaire for a pilot study was created after edits from these consolidated opinions and was subsequently administered to 140 staff members from two chosen universities.

The item analysis and exploratory factor analysis of this pilot study were then carried out (Appendix). One failed item whose item-total correlation was lower than 0.5 was deleted during the item analysis step, leaving a total of 59 items. During exploratory factor analysis, principal component and orthogonal rotation analyses were used which revealed ten factors that had Eigenvalues greater than 1. After rotation, the factor loadings were found to range from 0.46 to 0.86 (Appendix), and the explained cumulative variance of the three scales were 66.54, 69.61 and 66.54 per cent, respectively. With the validity of the scales examined, after the deletion and editing of question items, the formal questionnaire was created.

The contents of the KMC questionnaire for HEIs of CTE were inclusive of three main components, namely, the KM enabler capabilities scale, the KM process capabilities scale and the school effectiveness scale (as shown in Table II). All the components adopted the Likert-type scale for scoring, with "strongly agree", "agree", "neutral", "disagree" and "strongly disagree" being assigned from five points to one point, respectively.

School effectiveness scale. Created with reference to the studies by Gold *et al.* (2001); Lee and Choi (2003); Lin (2003), the scale in this study had a total of 18 items for analysis. It was discovered that the factor loading for the various items were ranged from 0.56 to 0.83. The accumulated percentage of explained variance from three factors was 66.45 per cent, and the factors were named as administrative efficiency, teaching effectiveness and research outcome. The Cronbach's α coefficient of each scale ranged from 0.93 to 0.94, and the Cronbach's α coefficient of the whole scale was 0.97.

Knowledge management process capability scale. Created with reference to the studies by Coukos-Semmel (2002); Lee and Choi (2003), this scale had a total of 24 items for analysis. One failed item was deleted in the item analysis, remaining a total of 23 items. It was discovered that the factor loadings for the various items ranged from 0.46 to 0.86. The accumulated percentage of explained variance from four factors was 69.61 per cent, and the factors were named as acquisition, storage, sharing and application. The Cronbach's α coefficient of each scale ranged from 0.78 to 0.94, and the Cronbach's α coefficient of the whole scale was 0.95.

Knowledge management enabler capability scale. Created with reference to studies by Coukos-Semmel (2002); Lee and Choi (2003), this scale had a total of 18 items for analysis. It was discovered that the factor loading for the various items were ranged from 0.58 to 0.86. The accumulated percentage of explained variance from three factors was 66.45 per cent, and the

Table II The item quantities, example items and related coefficients of the KMC questionnaire

Scales	*No. of items*	*Example items (factor loadings)*	*Cronbach's α*	*ICC*
School effectiveness				
Administrative efficiency	6	The completion rate of work programs in my school's various departments has significantly increased in recent years (0.74)	0.94	0.02
Teaching effectiveness	6	Recently, there is a significant improvement for the instructional quality of the teachers in our school (0.66)	0.93	0.00
Research outcome	6	The number of patents at my school has significantly increased in recent years (0.82)	0.94	0.00
KM process capabilities				
Acquisition	4	Members at my school acquire the necessary knowledge through the internet (0.77)	0.84	0.01
Storage	3	Staffs at my school digitize and store materials (0.77)	0.78	0.00
Sharing	6	Members at my school interexchange work techniques and specialized knowledge (0.75)	0.88	0.00
Application	10	Members at my school apply knowledge to create new ideas (0.71)	0.94	0.00
KM enabler capabilities				
Structure	6	My school provides its members with various social gatherings to encourage the sharing of knowledge (0.69)	0.88	0.01
Culture	6	Members at my school express willingness in passing down knowledge and experiences (0.81)	0.92	0.01
IT support	6	My school leaders provide IT for helping my coworkers manage knowledge effectively (0.60)	0.88	0.00

Note: *ICC* = intra-class correlation

factors were named as structure, culture and IT support. The Cronbach's α coefficient of each scale ranged from 0.88 to 0.92, and the Cronbach's α coefficient of the whole scale was 0.93.

3.4 Data analysis

For theoretical and empirical reasons, researchers may use item parceling strategies to combine item-level responses into aggregate scores in the SEM context (Hall *et al.*, 1999). With regard to the theoretical reasons, Hall *et al.* (1999) pointed out that item parceling may "keep the ratio of manifest indicators to latent constructs manageable, reduce the number of free parameters in the model to decrease sample size requirements and increase the chances of adequate model fit". With regard to the empirical reasons, Bandalos and Finney (2001) reviewed 317 articles in education and psychology and found that 19.6 per cent of them had used item parceling. Considering that there were 59 items in the present study and the chance of adequate model fit, item parceling strategies were thus utilized. The items within the same construct were averaged into a single observed variable. Thus, a total of 59 items were aggregated into 10 observed variables.

As the staffs were nested in schools, multi-level analyses should have been taken into account first. The intra-class correlation coefficients (LeBreton and Senter, 2008; Lee, 2000) were estimated (Table II). Most of the coefficients among the supervisors, teachers and staff members of the schools did not meet the criteria. The smaller coefficients which were estimated according to the equations in Lee (2000); LeBreton and Senter's (2008) studies revealed that the variances between groups were not high compared to those within groups. The multi-level analyses were thus not taken into account.

This study used the data from the 439 valid questionnaires and SEM to test the goodness of fit of the theoretical model. The software that was used for SEM was AMOS 18. The parameters were estimated using the maximum likelihood. For the test for the goodness of fit of the theoretical model, Hair *et al.* (1998) advocated the inclusion of the assessment of both the measurement model fit and the structural model fit. For this study, both aspects had been investigated with the external and internal qualities:

1. *The standard for goodness of fit of the external qualities depended on the standard of the following criteria*: The root mean square error of approximation (RMSEA) was smaller than 0.10 (Browne and Cudeck, 1993), the standardized root mean square residual (SRMR) was smaller than 0.08 (Hu and Bentler, 1999) and the fit measures included the goodness-of-fit index (GFI) and the comparative fit index (CFI) that was greater than 0.90 (Hu and Bentler, 1999).
2. *The internal qualities were depended on the following criteria*: The average variances extracted (AVE) from the latent variables to be greater than 0.5 and the composite reliability to be greater than 0.6 (Bogozzi and Yi, 1988).

4. Results

4.1 Descriptive statistics and correlation matrix of the variables

With focus on the mean, standard deviation, skewness and kurtosis of the various observed variables, the statistical results are reported in Table III. The skewness values are between −0.08 and 0.32, and the kurtosis values are between −0.42 and 0.03. This situation, in which the skewness was smaller than three and the kurtosis was smaller than ten, was a representation of data from these observed variables going in line with normal distribution (Kline, 2005).

To assess the interrelationships between the variables, a correlation matrix was constructed using the Pearson product-moment correlation (Table III). The correlation coefficients between the perceived school effectiveness, the KM process capabilities and the KM enabler capabilities ranged from 0.35 to 0.68 ($p < 0.001$). In addition, the perceived school effectiveness and the KM process capabilities had a correlation coefficient of 0.64 ($p < 0.001$). The perceived school effectiveness and the KM enabler capabilities had a correlation coefficient of 0.64 ($p < 0.001$). The KM process capabilities and the KM enabler capabilities had a correlation coefficient of 0.66 ($p < 0.001$). The inter-correlations between explanatory variables were all less than 0.80, implying the absence of multicollinearity (Hutcheson and Sofroniou, 1999).

4.2 Assessment of the measurement model fit

Measurement model fit is used to determine the relation of an observed variable and a latent variable (Kaplan, 2009). Analysis results of the measurement model indicated that for the assessments on the goodness of fit of external qualities, RMSEA = 0.09, SRMR = 0.04, GFI = 0.94, CFI = 0.95, thereby showing that all the fit standards had been met (Browne and Cudeck, 1993; Hu and Bentler, 1999). For internal qualities, results of the reliability test

Table III Descriptive statistics and Pearson's correlation matrix of the variables

Latent variables	*School effectiveness*			*KM process capabilities*				*KM enabler capabilities*		
Observed variables	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
M	3.52	3.50	3.53	3.67	3.56	3.50	3.33	3.41	3.52	3.67
SD	0.57	0.54	0.64	0.55	0.61	0.48	0.46	0.60	0.53	0.59
Skewness	0.18	0.22	0.32	0.11	0.06	0.04	0.06	−0.08	0.21	0.08
Kurtosis	−0.19	−0.07	−0.01	−0.42	−0.16	−0.34	−0.31	0.03	−0.32	−0.39
1. Administrative efficiency	1.00									
2. Teaching effectiveness	0.68	1.00								
3. Research outcome	0.55	0.64	1.00							
4. Acquisition	0.44	0.37	0.43	1.00						
5. Storage	0.47	0.36	0.38	0.59	1.00					
6. Sharing	0.49	0.47	0.43	0.56	0.61	1.00				
7. Application	0.54	0.56	0.56	0.49	0.45	0.62	1.00			
8. Structure	0.49	0.48	0.42	0.43	0.37	0.43	0.50	1.00		
9. Culture	0.44	0.51	0.44	0.38	0.38	0.43	0.52	0.49	1.00	
10. IT support	0.53	0.38	0.35	0.51	0.49	0.47	0.38	0.54	0.39	1.00

Note: All the p values of correlations were small than 0.001

indicated that the latent variables of school effectiveness, the KM process capabilities and the KM enabler capabilities had AVE values of 0.63, 0.50 and 0.51, respectively, and were therefore above the suggested cutoff of 0.5 (Bogozzi and Yi, 1988). The composite reliability values of these three latent variables were 0.83, 0.80 and 0.75, respectively, and were therefore above the suggested cutoff of 0.6 (Bogozzi and Yi, 1988). The GFI for the external qualities and internal qualities for the measurement model were considered good. The abovementioned results indicated that the three latent variables of school effectiveness, the KM process capabilities and the KM enabler capabilities could be used to explain the observed variables with considerable explanatory power.

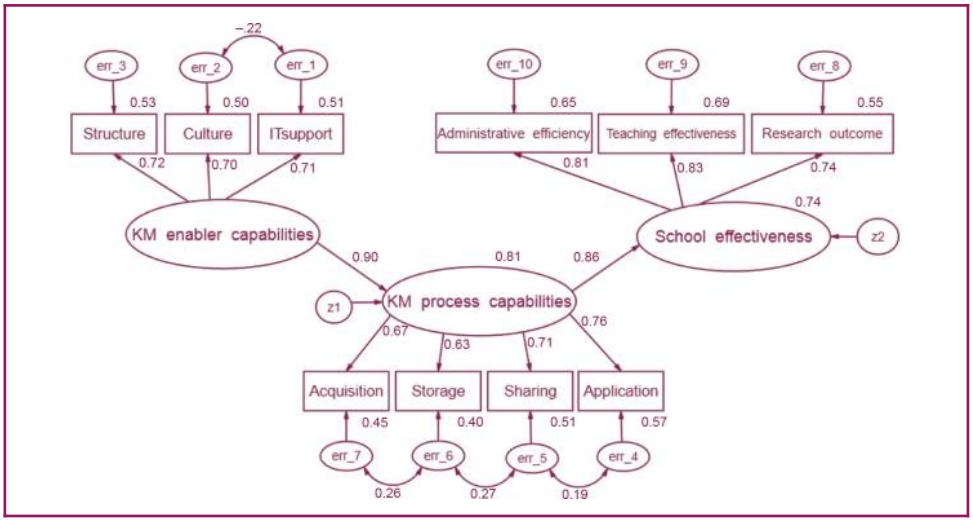
4.3 Assessment of the structural model fit

This study combined past references for building a theoretical model for the effects that KMC have on school effectiveness and investigated the influences that latent variables in the theoretical model had on each other. The relationships among KMC factors and school effectiveness were estimated. By analyzing the paths among the KM enabler capabilities, the KM process capabilities and school effectiveness, SEM produced a model with path coefficients (Figure 2). All of the standardized coefficients shown in Figure 2 reached significance.

The overall model fit criteria for external quality, with the GFI = 0.94 and the CFI = 0.95. If the two fit indices GFI and CFI have values larger than 0.90 that represents a reasonable fit (Hu and Bentler, 1999). The SRMR was 0.04, and a value of SRMR lower than 0.08 is considered a good fit (Hu and Bentler, 1999). The RMSEA was 0.09, and a value of RMSEA lower than 0.10 represents a reasonable fit (Browne and Cudeck, 1993). For internal qualities, results of the reliability test indicated that the latent variables of the school effectiveness, the KM process capabilities and the KM enabler capabilities had AVE values of 0.63, 0.48 and 0.50, respectively, and were therefore close to or above the suggested cutoff of 0.5 (Bogozzi and Yi, 1988). The composite reliability values of these three variables were 0.83, 0.78 and 0.73, respectively, and were therefore above the suggested cutoff of 0.6 (Bogozzi and Yi, 1988). The theoretical model had good external and internal qualities and could explain the observed factors affecting the school effectiveness.

In Figure 2, the straight arrows represent the paths of the direct effects. The figure reveals that the KM enabler capabilities had direct effects on the KM process capabilities (β = 0.90) and that the KM process capabilities had direct effects on the perceived school effectiveness (β = 0.86). This means that staff members who perceived a greater extent of

Figure 2 The structural model



the KM enabler capabilities also reported a higher extent of KM process capabilities in their HEIs. This also means that staff members who perceived a greater extent of KM process capabilities also reported a higher extent of the school effectiveness in their HEIs. The figure further reveals that the KM enabler capabilities explained 81 per cent of the variance in the KM process capabilities and that the KM process capabilities explained 74 per cent of the variance in the school effectiveness.

4.4 test for mediation of knowledge management process capabilities

The SEM bootstrap analysis is often used to confirm the mediation effect and is based on Baron and Kenny's (1986) approach (Cheung and Lau, 2008). In the bootstrap analysis, the mediation effect can be confirmed if the estimates of the indirect effects reach the level of statistical significance and the confidence intervals (95 per cent) do not contain zero. Next, if the estimate of the direct effect at the confidence intervals contains 0, full mediation would be confirmed (Cheung and Lau, 2008). The results of the current study (Table IV) showed that the confidence intervals of indirect effect between KM enabler capabilities and the perceived school effectiveness (0.23 −1.18) did not contain 0 and that the confidence intervals of direct effect between two latent variables (−0.19 −0.62) did contain 0. This indicated that the KM process capabilities exhibited the full mediation effect between KM enabler capabilities and the perceived school effectiveness.

5. Discussions

5.1 The effects of knowledge management enabler capabilities on knowledge management process capabilities

The KM enabler capabilities had direct effects on the KM process capabilities (β = 0.90) and explained 81 per cent of the variance in the KM process capabilities; thus, *RQ1* was answered. This showed that the KM enabler capabilities (structure, culture and IT support) played an important role in predicting the KM process capabilities. This evidence is in agreement with previous studies (Lee and Choi, 2003; Lee and Lee, 2007; Soon and Zainol, 2011). This finding reveals that the enhancement of the KM enabler capabilities could be helpful in promotion of the KM process capabilities. The KM enabler capabilities in this study were inclusive of constructs such as structure, culture and IT support. The following points discuss the effects these constructs have on the KM process capabilities.

Structure in this study implied the integration of leadership, norms and strategies. Previous studies (Bhatti *et al.*, 2013; Bozdoğan, 2013; Mas-Machuca, 2014) have shown that leadership plays an important role in KM enablers and encourages KM processes. An environment in which organization members engage in the knowledge-creating process more spontaneously could be facilitated by a decentralized organizational structure (Lee and Lee, 2007). Flexibility and less emphasis on work norms are helpful for effective knowledge processes (Ichijo *et al.*, 1998). The HEIs provide their members various social

Table IV Mediation effect analysis

Effects	*Estimate*	p *value*	*Confidence interval (95%)*
Indirect effect			
KME → KMP → SE	0.49	<0.05	0.23-1.18
Direct effect			
KME → KMP	0.87	<0.05	0.79-0.94
KMP → SE	0.57	<0.05	0.22-1.04
KME → SE	0.30	>0.05	−0.19-0.62
Total effect			
KME → SE	0.79	<0.05	0.70-0.86

Notes: KME = KM enabler capabilities; KMP = KM process capabilities; SE = school effectiveness

gatherings (i.e. the communities of practice) through a flexible organizational structure and organizes seminars and talks that may promote the KM process capabilities.

Gold *et al.* (2001) pointed out the most significant hurdle to effective KM is organizational culture. An important component of organizational culture is corporate vision. Emphasis in vision statements allows organizations to encourage the occurrence of effective KM processes (Gold *et al.*, 2001). The willingness of the members of HEIs in cooperating with each other, sharing knowledge, passing down experiences and participating in organization cultures such as groups and learning activities may promote the KM process capabilities.

Several researchers have found that IT is a critical element for effective knowledge processes (Gold *et al.*, 2001; Lee and Lee, 2007). Lee and Lee (2007) pointed out the following reasons: first, IT facilitates rapid acquiring, storage and sharing of knowledge; second, a fragmented flow of knowledge could be integrated by well-developed technology; and third, the knowledge processes such as generating, facilitating, usage and transferring could be supported by IT. IT support provided by HEIs in such forms as KM platforms, e-learning systems and online storage facilities can effectively help its members in KM and may promote the KM process capabilities.

In the current study, structure, culture and IT support were found to have similar weightings in terms of constituting the KM enabler capabilities. Some studies, however, have claimed that organizational culture is more important than IT support for KM implementation. For example, Gold *et al.* (2001) found that culture had a higher weighting than technology in terms of constituting knowledge infrastructure capabilities which served as the KM enabler to affect organizational effectiveness. Nevertheless, in a more recent study, Lee and Lee (2007) found that IT support had a stronger effect on KM processes than culture. These different findings reflect the fact that IT support may be playing an increasingly important role in the KM context.

From the social-technical perspective, organizational structure, culture and members are viewed as a social system, whereas IT support is viewed as a technical system. These two systems serve as the infrastructure for knowledge creation (Lee and Choi, 2003). Nevertheless, one fact that should be noted is that the strong direct effect between the KM enabler capabilities and the KM process capabilities implied that these two latent variables might be subsumed within a single latent variable.

5.2 The effects of knowledge management process capabilities on the school effectiveness

The KM process capabilities had direct effects on the perceived school effectiveness (β = 0.86) and explained 74 per cent of the variance in the perceived school effectiveness; thus, *RQ2* was answered. This result showed that process factors (acquisition, storage, sharing and application) played an important role in predicting the perceived school effectiveness. This evidence is in agreement with earlier studies in business (Gold *et al.*, 2001; Liao and Wu, 2009; Lee and Lee, 2007) and academic environments (Ali Zwain *et al.*, 2012; Muhammad *et al.*, 2011). According to the studies conducted by Ali Zwain *et al.* (2012), it was discovered that the KM processes, including identification, acquisition, storage, sharing and application, could provide an explanation for 47.5 per cent of the variance in school effectiveness. This finding reveals that the enhancement of the KM process capabilities could be helpful in the promotion of the school effectiveness. The KM process capabilities in this study were inclusive of constructs such as knowledge acquisition, storage, sharing and application. The following points discuss the effects these constructs have on the perceived school effectiveness.

Knowledge acquisition involves the exploration, identification and adaptation of valuable knowledge from external sources (King, 2009) and requires accessing knowledge-based resources to capture new knowledge in making decisions (Lee and Lee, 2007). The

processes for acquiring knowledge for various practices consist of searching on the internet, gathering knowledge during meetings, selecting the appropriate sources to use and grafting to the organization (King, 2009). After new knowledge is acquired, there is a possibility that the knowledge may be absorbed into the institutional memory of the organization for the long-term reusability (King, 2009). This process provides an approach to create new knowledge aimed at achieving better performance (Ali Zwain *et al.*, 2012).

Knowledge assets used in various practices include organized documents from internal meetings and teaching demonstrations, digitized teaching materials, patents and manuals and process documents that focus on problem solving (King, 2009). Knowledge storage enables the required knowledge to be coded and recorded and provides members with easily reusing such knowledge (Kiessling *et al.*, 2009; King, 2009). Such coded and recorded knowledge can be seen as a form of organizational memory that can be helpful to members when the reuse of knowledge is needed in dealing with a work flow (King, 2009). This storing process may enable HEIs' members to discover the critical tacit knowledge (Lubit, 2001).

Knowledge sharing involves the practice of exchange of knowledge between the source and the receiver of knowledge (Muhammad *et al.*, 2011). It plays a major role in ensuring shared thoughts and adequate internal communication throughout the educational organization and that aids members in terms of achievement and sustaining their performance (Ali Zwain *et al.*, 2012; Muhammad *et al.*, 2011). If members of HEIs can exchange work techniques or specialized knowledge, it may promote the school effectiveness.

One of the common forms of knowledge application consists of adopting the best practices for the use of knowledge (Muhammad *et al.*, 2011). Such practices create opportunities for educational partners to apply new knowledge, which in turn leads to enhancements in their performance (Ali Zwain *et al.*, 2012). If members of HEIs can apply knowledge and create new ideas, it may promote the school effectiveness.

The KM process capabilities consist of sequential constructs of knowledge acquisition, storage, sharing and application for the purpose of knowledge creation, which is the sound management foundation for enhancing academic performance (Ali Zwain *et al.*, 2012). Through these processes, the knowledge in HEIs might be transformed from implicit knowledge to explicit one (Tahir *et al.*, 2013) and, thus, renew itself for knowledge creation to promote the school effectiveness (Muhammad *et al.*, 2011; Tahir *et al.*, 2013). The strong direct effect between the KM process capabilities and the school effectiveness implied that the KM process capabilities were the crucial factors for the promotion of the school effectiveness.

5.3 The mediation of knowledge management process capabilities and overall knowledge management capabilities effect

The KM process capabilities had mediating effects between the KM enabler capabilities and the perceived school effectiveness; this model had a total effect of 0.79 on the perceived school effectiveness. Thus *RQ3* was answered. This evidence is in agreement with the earlier study (Lee and Lee, 2007). That study indicated that the KM enabler capabilities are needed to facilitate the KM process capabilities that, in turn, then drive the school effectiveness (Lee and Choi, 2003; Lee and Lee, 2007). This conceptual model can be helpful for understanding the complexity of education today and can yield useful information about the interplay between different KM enabler and process in enhancing school effectiveness.

KM enabler capabilities are organizational infrastructures for establishing KM in HEIs. These enabler capabilities may be helpful when KM process capabilities can provide suitable activities for the school members applying these organizational infrastructures (Lee and Choi, 2003; Lee and Lee, 2007). KM enabler capabilities are the foundation of KM

process capabilities, and KM process capabilities, in turn, promote KM enabler capabilities. The KM processes may help HEIs' members utilize the infrastructures to manage and distribute tacit knowledge (Lee and Choi, 2003). This might be why KM process capabilities had mediating effects on KM enabler capabilities and the perceived school effectiveness. The effect implies that KM process capabilities form an operational perspective for the model (Lee and Lee, 2007) which is positively related to school effectiveness.

KM enabler capabilities in the form of structure, culture and IT support served as the infrastructures for HEIs' members in utilizing KM process capabilities. KM process capabilities may further foster social learning activities among school members, including mentoring and coaching, and shape the vital mechanisms for sharing intellectual capital and building social capital (Hargreaves, 2001; Shoham and Perry, 2009), which consists of the values, trust and norms shared between HEIs' members. The overall KMC may create strong ties and cohesion between individuals within the HEIs' network and thus create social capital (Hoffman *et al.*, 2005; Gold *et al.*, 2001). Such capital may make HEIs' members join together for problem solving to enhance the school effectiveness (Fu, 2004; Hargreaves, 2001). Moreover, team-level activities create a context in which constructive individual behaviors are expected, thus leading to cross-level effects (Li, 2013), which might complement KM capabilities in explaining the perceived school effectiveness.

5.4 The contribution of this study

Notwithstanding the significant affinity that exists between KM and organizational effectiveness, empirical research on the connection between KMC and school effectiveness has barely been touched upon, especially in the context of HEIs (Ali Zwain *et al.*, 2012; Muhammad *et al.*, 2011) or CTE. Previous studies (Ali Zwain *et al.*, 2012; Muhammad *et al.*, 2011) proposed the frameworks that validate the relationships between the KM process capabilities and school effectiveness, but they failed to examine the KM enabler capabilities. KM in educational contexts should be designed for the given structure with people and technologies in mind (Petrides and Zahra, 2002; Yeh, 2005), such that it will be able to effectively help staff members share and manage knowledge.

The current study extended the lens on the broader effect of KMC on school effectiveness and provided insight into and further understanding of the model regarding the relationships among the KM enabler capabilities, the KM process capabilities and the school effectiveness in KM-related studies. By examining the moderating effect of the KM process capabilities, this study provides a more thorough understanding with regard to the relationship between the KMC and the school effectiveness and fills the gaps left by earlier research. HEIs of CTE have played important roles in educating students to become contributing members of society, but many challenges remain to be addressed and overcome (Wilkin and Nwoke, 2011). This study examined the existing model thoroughly and added a number of relevant findings to the literature. It allows policy makers to gain in-depth understanding of the impact of KM in education, especially in the CTE context.

6. Conclusions

This study investigates the effects that KM has on the perceived school effectiveness for the development of a KMC model for the HEIs of CTE. This model was constructed from three latent variables, which is inclusive of the KM enabler capabilities, the KM process capabilities and the perceived school effectiveness. Results of the verification of positive data indicated that most of the standards for goodness of fit can be agreed with, and the external and internal qualities of the model exhibited a reasonable quality. For the relationships between structures in the model, the KM enabler capabilities can effectively predict the KM process capabilities, and the KM process capabilities can effectively predict the perceived school effectiveness. If HEIs of CTE hope to effectively conduct KM,

the KM enabler capabilities may be first acquired and subsequently combine and utilize knowledge resources via KM processes to improve their school effectiveness.

The results of this study indicated that the culture, structure and IT support of KM enabler capabilities could be considered first when establishing the infrastructure to facilitate KM process capabilities to improve school effectiveness. KM enabler capabilities are the foundation and pre-determined infrastructures, as well as resources for KM processes to be enabled smoothly. It is recommended that these KM enabler capabilities may be established when HEIs' members process KM activities. Schools of CTE can focus their efforts on the shape of culture in the dimension of the KM enabler capabilities. KM processes such as sharing seldom happen automatically in a group, and the school leaders play an important role in encouraging such processes to emerge. School leaders may shape group members' efficacy beliefs, which, in turn, facilitate school members to collectively acquire and exchange information with each other (Li, 2013). In terms of the school structure, supervisors of schools could commission a KM-specialized unit for the development of KM organizations and promotion of strategies. Schools may actively perform the programmed and systematic management of knowledge assets and effectively utilize administrative and academic knowledge. Also, they may improve their IT support so as to promote the KM enabler capabilities (Gold *et al.*, 2001; Lee and Choi, 2003; Lee and Lee, 2007). IT support, KM platforms, e-learning systems, as well as online storage devices can be effective in helping members of schools with KM activities.

The results of this study also indicated that the acquisition, storage, sharing and application of KM process capabilities can distribute tacit knowledge to improve school effectiveness. When KM is introduced into HEIs, KM process capabilities could be coordinating activities between KM enabler capabilities and school effectiveness. Improved strategies such as actively participating in more researches and learning, strategic alliances and proper use of the internet and library resources can increase the acquisition of knowledge. The explication, digitization and documentation of knowledge can help in the storage of knowledge (Kiessling *et al.*, 2009). The establishment of a community of practice, the provision of communication channels and cooperating with each other can encourage the sharing of knowledge (Gold *et al.*, 2001). Moreover, the tireless learning of new knowledge, innovations in educational activities and taking part in inventions can promote the application and creation of knowledge.

There were some limitations in this study. In the SEM, as shown in Figure 2, some correlated errors were found within the construct. That meant that a set of items collected may correlate more highly among constructs. Although Brito and Pearl (2002) posited that correlated errors are acceptable and indeed necessary in some models as long as the correlated errors do not exist between a cause and its direct effect, future research could seek to track the extent of KMC effects on the school effectiveness and re-examine the items with different contexts. In addition, the respondents in the current study were supervisors, teachers and staff members. Different respondents in different positions might perceive school effectiveness in different ways that might not accurately reflect the school-level situation. Moreover, because the participants were not randomly selected, the generalizability of the results should be further examined. Future research could seek to replicate the results of the current study using different contexts with differing characteristics according to the theoretical model established in this study.

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Appendix

Table AI The exploratory factor analysis of the KMC questionnaire

Scales	*Factor loadings*	*Cronbach's α*	*Eigenvalues*	*Explained variance*	*Cumulative explained variance*
School effectiveness					
Administrative efficiency	0.83,0.80,0.79,0.74,0.71,0.69	0.94	4.41	24.27	
Teaching effectiveness	0.81,0.77,0.76,0.66,0.62,0.56	0.93	3.85	21.37	
Research outcome	0.82,0.82,0.81,0.76,0.69,0.67	0.94	3.76	20.90	66.54
KM process capabilities					
Acquisition	0.86,0.77,0.75,0.46	0.84	3.12	13.57	
Storage	0.77,0.76,0.49	0.78	3.23	14.06	
Sharing	0.78,0.75,0.74,0.58,0.49,0.49	0.88	3.57	15.50	
Application	0.84,0.82,0.82,0.78,0.73,0.71,0.63,0.62,0.58,0.52	0.94	6.09	26.48	69.61
KM enabler capabilities					
Structure	0.77,0.76,0.72,0.71,0.69,0.63	0.88	3.85	21.37	
Culture	0.86,0.81,0.80,0.80,0.79,0.70	0.92	4.41	24.27	
IT support	0.84,0.83,0.78,0.64,0.60,0.58	0.88	3.76	20.90	66.54

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