A Study Of The Predictive Effect Of Pre-Service Teacher Personal Knowledge Management Competency On Their Instructional Design Skills

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ABSTRACT:

This paper aims to examine the relationship between the personal knowledge management (PKM) competency of pre-service teachers and their instructional design skills. Supporting the sustainable development of teachers as professionals in the knowledge society is a critical issue in teacher education. This study attempts to identify an empirical model and a curriculum framework for nurturing pre-service teachers' PKM competency. Dorsey (2000) PKM skills were adopted for constructing the theoretical framework and the survey instrument. A quasi-experimental research design was used to collect data from pre-service teachers from Hong Kong's largest teacher education institution. A structural equation model was applied to explore the predictive power of PKM competency on their instructional design. Results show that a four-factor PKM competency model, which consists of retrieving, analyzing, organizing and collaborative skills, was identified as a predictor of instructional design. Use of PKM tools, e-learning activities and collaborative action research for developing pre-service teacher PKM competency are recommended to teaching education institute.

Keywords: *Personal knowledge management, Pre-service teacher, Teacher education*

Introduction

Rapid advances in technology and communications have greatly accelerated the emergence of information. The increases in the amounts and formats of information available do not automatically make learners more informed or knowledgeable, if a learner cannot manage and meld the accumulation of information through their daily experience and study to construct knowledge in a systematic fashion. This competency is referred by most literatures (Frand & Hixon, 1999; Dorsey, 2000; Wright, 2005) as personal knowledge management (PKM) competency. Developing learners with PKM competency is not simply a lifelong education issue, it is also an important teacher education issue in terms of sustaining a competitive human capital in the knowledge economy. Teacher development is viewed as an ongoing lifelong learning process as teachers strive to learn how to teach learner to learn how to learn (Cochran-Smith & Lytle, 1999).

The recent education reforms in Hong Kong (Education Commission, 2000) addressed this lifelong education issue by proposing a learning to learn slogan in the policy document. The policy suggests that teachers should develop student learning competence for acquiring knowledge through various methods. To develop students with knowledge acquisition skills, teachers should also be equipped with the competency for knowledge acquisition. However, since publication of the policy paper entitled Information Technology for Learning in a New Era Five-year Strategy that launched IT in education in Hong Kong (EMB, 1998), the Education Bureau has not addressed this issue in any teacher professional development policy documents. Recent calls for consultation on e-learning from the Education Bureau likewise generated additional demand for developing teacher information literacy capable of supporting student learning (EMB, 2004). If the government and teacher education institutions really want to develop competent teachers for the knowledge society, they may consider injecting the elements of personal knowledge management (PKM) into the teacher education curriculum for developing pre-service teachers' teaching competency. However, little studies on teacher education were attempted to examine the effect of PKM on teacher learning and discussed the possibilities of injecting the element of PKM model into teacher education curriculum. This study aims to construct an empirical model for examining the predictive effect of pre-service teachers' PKM competency on their instructional design skills and to discuss a personal knowledge management curriculum framework for teacher education institutions.

Literature Review

A review of the literature related to knowledge management suggests that the development of personal knowledge management (PKM) could be a means of enhancing pre-service teacher professional competency in managing personal knowledge for coping with the acceleration of emerging information. Frand & Hixon (1999)

define PKM as a conceptual framework to organize and integrate important information such that it becomes part of an individual's personal knowledge base. Dorsey (2000) emphasizes the importance of injecting PKM into an educational framework for undergraduate education in order to bridge the gap between general education and other subject disciplines. PKM could serve as a framework for integrating general education and majors and as an approach to technology integration initiatives throughout the curriculum. PKM provides learners with both a common language and a common understanding of the intellectual and practical processes necessary for the acquisition of information and its subsequent transformation into knowledge. The significance of exploring PKM may contribute to human cognitive capabilities (Sheridan, 2008).

Scholars tend to conceptualize PKM as a set of information skills (Frand & Hixon, 1999; Avery et al, 2001), though there is no standard definition or model for PKM. After Frand & Hixon (1999) outlined five PKM techniques as searching, classifying, storing distributing, evaluating and integrating skills, Dorsey and colleagues (Avery et al, 2001) broadened the Frand & Hixon PKM framework well beyond its formulation. Central to PKM, as clarified by Dorsey, are seven information skills which when exercised together are integral to effective knowledge work. These seven PKM skills are retrieving, evaluating, organizing, analyzing, presenting and securing information and collaboration for creating knowledge. Recently, Pettenati and Cigognini (2009) grouped PKM skills under three intertwined macro-competence categories: creation, organization and sharing.

PKM can also be conceptualized as an intertwined macro-competency. Wright (2005) proposes a PKM model that links distinctive types of problem-solving activities with specific cognitive and metacognitive, information, social and learning competencies. As a learning competency, PKM enables learners to apply a set of learning skills that are essential to lifelong learning for information processing, knowledge application and decision-making. As a cognitive and metacognitve competency, it enables learners to apply complex thinking skills to solve problems. It is knowledge concerning the learner's own cognitive processes or anything related to them (Flavell, 1976, p232). As an information competency, it enables learners to link technology tools with a set of information skills, thus providing an intentionality that moves the focus from the technology more directly to the information. As a social competency, its underlying principles include enabling learners to understand others' ideas, develop and follow through on shared practices, build win-win relationships, and resolve conflicts. PKM integrates human cognitive and metacognitive competency (Sheridan, 2008), social competency (Wright, 2005; Pettenati & Cigognini, 2009) and informational competency (Tsui, 2002). Wright (2007) has developed a *PKM Planning Guide* for developing knowledge worker PKM competency. The guide is based on his research findings that the four interrelated competencies are activated in order to plan PKM training. The training process encourages participants to reflect on their knowledge activities and focus on areas for improvement. If learners know how to control this process, they can internalize information into personal knowledge, creating a foundation for effective learning.

Utilizing PKM for acquiring knowledge refers to a collection of information management processes that an individual learner needs to carry out in order to gather, classify, store, search, and retrieve information in his daily activities (Tsui, 2002; Grundspenkis, 2007). In teacher education, knowledge acquisition focuses on the process how teacher apply PKM to support their day-to-day teaching and learning activities: instructional design. Instructional design is closely related to PKM which is also one of the major learning tasks for pre-service teachers. Instructional design is a process that involves determining the current status and needs of the learner, defining the end goal of instruction, and creating instructional and learning strategies to facilitate teaching and learning. There are a wide range of instructional design models, many of them based on the ADDIE model (Seels & Glasgow, 1998; Molenda, M., 2003; Strickland, A.W. 2006) which includes the following phases: analysis, design, development, implementation, and evaluation. This acronym stands for the 5 phases contained in the model. Knowledge acquisition for instructional design is conceptualized as identifying learner entry skills, formulating instructional objectives, test and design specifications, creating instructional or training materials, making recommendations and preparing a project report for lesson implementation.

As instructional design is one of the key components of teacher professional competence, and helps to implement a new curriculum in the information age of the 21st century, exploring the predictive relationships of PKM competency on knowledge acquisition for instructional design becomes key to the development of teacher education.

Research Methodology

It appears that PKM competency can expand individuals' knowledge and enhance their learning competency (Davenport, 1997, p146 ; Frand & Hixon, 1999). It provides learners with a targeted, reflective and adaptable cognitive framework for inquiry and problem solving. In this study, knowledge acquisition will be

conceptualized as the knowledge required for carrying out instructional design. This study attempts to answer the following research questions:

1. What is the empirical factor structure of PKM competency for pre-service teachers?

2. Is there any relationship between the PKM competency of pre-service teachers and their knowledge acquisition for instructional design?

This study adopted Dorsey (2000) PKM skills to conceptualize PKM as a competency for acquiring knowledge (see figure 1). A quasi-experimental research design was used in this study to determine the relationship between PKM skills and knowledge acquisition for instructional design. The exogenous variables were pre-service teachers' perceptions of their PKM skills. The endogenous variable is knowledge acquisition for instructional design. A self-response quantitative questionnaire was devised to collect data from the pre-service teachers of Hong Kong's largest teacher education institution.

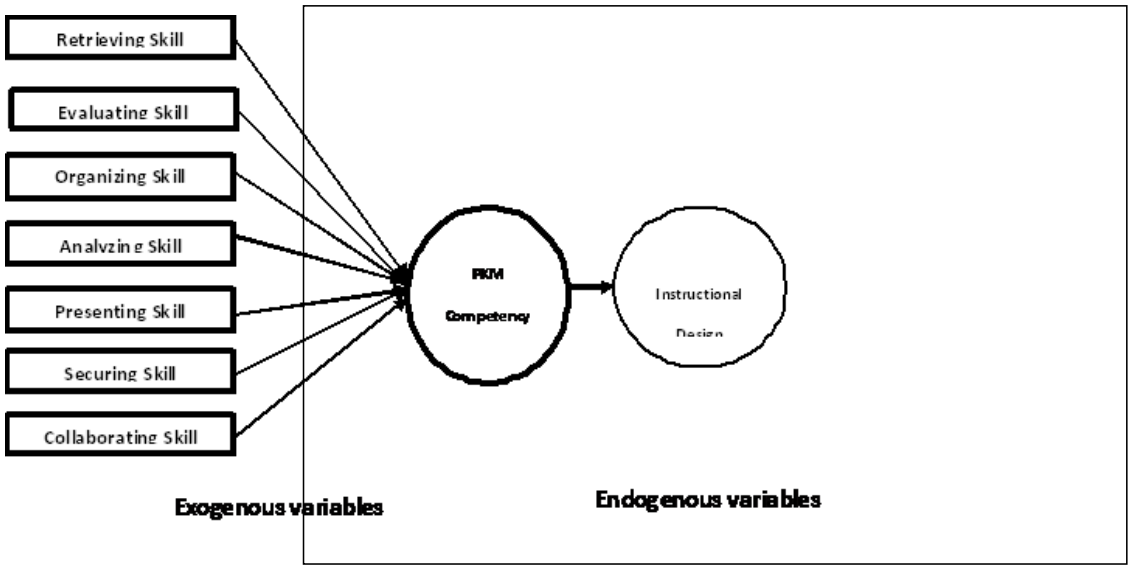

Figure 1: Theoretical Framework Of The Study

The operationalized definitions of Dorsey (2000) PKM skills are as follows:

1. Retrieving skill is the ability of learners to retrieve information from relational databases, electronic library databases, websites, threaded discussion groups, recorded chats, and moderated and unmoderated

lists.

2. Evaluating skill is the ability to make judgments on both the quality and relevance of information to be retrieved, organized, and analyzed.
3. Organizing skill is the ability to make the information one′ s own by applying ordering and connecting principles that relate new information to old information.
4. Collaborating skill is the ability to understand others′ ideas, develop and follow through on shared practices, build win-win relationships, and resolve conflicts between these underlying principles.
5. Analyzing skill is the ability to extract meaning from data and convert information into knowledge.
6. Presenting skill is the ability to familiarize with the work of communications specialists, graphic designers, and editors.
7. Securing skill is the ability to develop and implement practices that help to ensure the confidentiality, integrity and actual existence of information.

This study adopted ADDIE instructional design model to conceptualize instructional design as a multiple competencies that involves analysis, design, development, implementation, and evaluation of a lesson (Molenda, 2003; Strickland, 2006). The acronym ADDIE stands for the 5 phases contained in the model. Pre-service teachers' learning on instructional design is conceptualized by the knowledge and experiences they come across in the 5 phases of ADDIE model including analysis, design, development, implementation and evaluation. The learning outcomes include know how to analyse learner characteristics and task to be learned and identify learner entry skills; to design learning objectives and choose an instructional approach; to develop instructional or training materials; implement the lesson and deliver the instructional materials; and to evaluate the lesson plan and recommend the materials achieved the desired goals. The teaching experience that they had gained include determining the current state and needs of the learner, defining the end goal of instruction, and creating some instructional and learning strategies to facilitate teaching and learning. Instructional design is operationalized to the knowledge for:

- identifying learner entry skills;
- formulating instructional obJectives, test and designs specifications;
- creating instructional or training materials; and
- making recommendations and preparing a project report for lesson implementation (Seels & Glasgow, 1998; Molenda, M., 2003; Strickland, A.W. 2006).

The questionnaire was based on a number of scales constructed to measure the variables of PKM skills and instructional design. In order to develop valid items for these scales, the researcher conducted a content analysis on the PKM literature of Dorsey (2000), Skyrme (1999). Hyams (2000), and on the instruction design literature of Seels & Glasgow (1998), Molenda, M. (2003); and Strickland, A.W. (2006). The questionnaire consists of two sections. Section 1 was used to measure the effectiveness of knowledge acquisition for instructional design based on 4 items. Section 2 contains 21 items designed to measure the teachers' perceptions of their seven PKM skills. Likert 6 point scales were used in both sections to measure the variables. Likert scales are commonly used in attitudinal research. The Likert scale assumes that the difference between answering 'agree strongly, and 'agree' is the same as between answering 'agree' and 'neither agree nor disagree' (Likert 1932, quoted in Gay, 1992). The data was collected directly from target subjects using the questionnaire.

225 pre-service teachers responded to the survey. Data was collected directly from them by means of the questionnaire. The subjects in the study were pre-service teachers from Hong Kong's largest teacher education institution. Random sampling was used to collect data from the population. Exploratory factor analysis was carried out on variables using principal factor axis analysis to confirm the constructed validity of the tools (see table 1). The study is interested in a theoretical solution uncontaminated by unique and error variability and is designed with a framework on the basis of underlying constructs that are expected to produce sources on the observed variables. Principal axis factor (PAF) analysis, which aims to reveal the underlying factors that produce the correlation or correlations among a set of indicators with the assumption of an implicit underlying factor model, was applied separately to the items from the learning processes and learning outcomes. Promax rotation, a method of oblique rotation which assumes that the resulting factors are correlated with one other, was applied to extract the factors. An eigenvalue greater than one was used to determine the appropriate number of factors for the factor solutions. A Structural Equation Model (SEM) was then applied to examine the factor structures and the paths among the variables, using Lisrel 8.3 (Joreskog & Sorbom, 1999). SEM is a collection of statistical techniques that allows the examination of a set of relationships between exogenous variables and endogenous variables.

Findings

The results of exploratory factor analysis, presented in Table 1, clearly suggest a four- factor structure for exogenous variables that are both empirically feasible and theoretically acceptable. An eigenvalue greater than one was used to determine the appropriate number of factors for the factor analysis solution. Items were extracted with factor loadings greater than 0.6 across and within factors. The numbers of factor solutions extracted from a Promax rotation theoretically afforded the most meaningful interpretation. The process used to identify and label the factors that emerged was based on examining the derivation of the highest loading items on each of the factors. The reliability coefficients of the scales ranged from 0.792-0.821, which was judged adequate for this study. The results of descriptive statistics show that the scale means of all the variables are higher than 4.27 within the 6 point-scale, reflecting the participants' tendency to slightly agree with all the items. The reliability coefficient (Alphas) of the scale for instructional design is 0.854, its scale mean is 4.33 (sd = 0.691).

Table 1: Results of Exploratory Factor Analysis

Dimension	Item		Factor 1	Factor 2	Factor 3	Factor 4
Collaborating	Q23	I can share relevant information with other team members for completion of the team tasks.	.890			
	Q25	I know how to share information with team members to enhance team working effectiveness.	.738			
Analyzing	Q15	I can use MS Excel for statistical data analysis.		.769		
	Q16	I can interpret the hidden meaning of research information.		.757		
Organizing	Q11	I use ordering and connecting principles that relate new information to old information.			.839	
	Q12	I connect and organize information using electronic tools such as directories and folders, databases, web pages, and web portals.			.825	
	Q13	I always synthesize and analyze information.			.456	
Retrieving	Q6	I never search the internet without targets.				.822
	Q7	I know how to retrieve the teaching material for my subject effectively.				.702
		Eigenvalue	7.599	1.500	1.058	1.001
		% of Variance Explained	42.21%	8.33%	5.88%	5.55%
		Reliability coefficients (Alphas)	0.821	0.789	0.796	0.792
		Mean	4.35	4.49	4.27	4.45
		SD	0.648	0.612	0.664	0.640
Instructional Design	Q1	Identify learner entry skills				
	Q2	Formulate instructional objectives				
	Q3	Create instructional or training materials				
	Q4	Make recommendations for the lesson implementation				
		Reliability coefficients (Alphas) = 0.854, Scale mean = 4.33, SD = 0.691				

The structural and measurement coefficients from the completely standardized solution under maximum likelihood are presented in Figure 2. The goodness of fit statistics are shown in Table 2. All the paths in the model were significant at the 0.05 level according to the Z statistics. A PKM Model for pre-service teachers was empirically confirmed by the SEM. PKM competency was mainly constructed by the factors of skills of retrieving ($\gamma = 0.92$), organizing ($\gamma = 0.94$), analyzing ($\gamma = 0.76$) and collaborating ($\gamma = 0.75$), and was a predictive factor for knowledge acquisition ($\gamma = 0.19$).

Table 2: Goodness Of Fit Statistics Of The Structural Equation Model

χ^2	df	p-value	RMSEA	SRMR	CFI	NNFI	IFI
70.6	59	0.1433	0.031	0.044	0.99	0.98	0.99

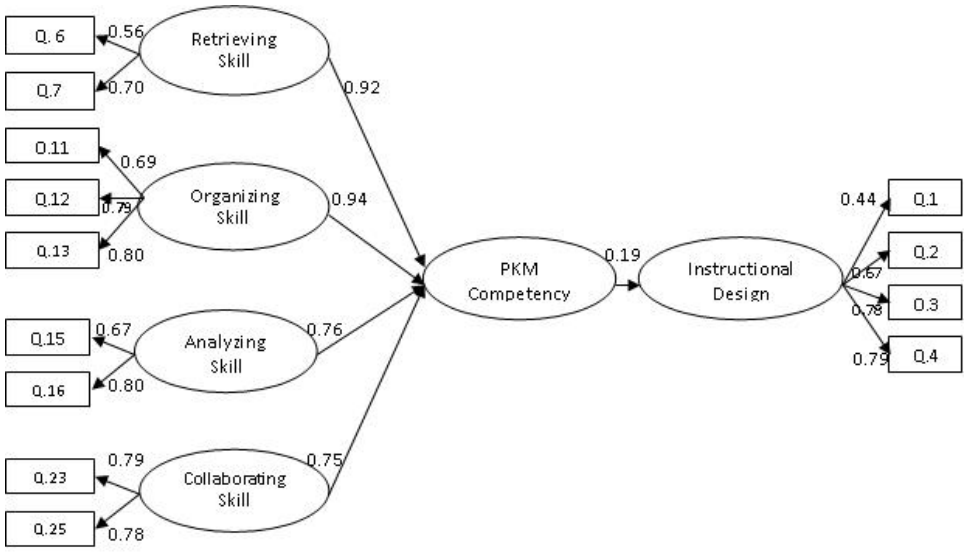

Figure 2. Result for the structural model

The hypothesized model is a good fit to the data. The results of the LISREL with 225 participants showed that the chi square value was not significant for the overall model, $\chi 2$ (N=225) = 70.6, P = 0.1433. As an absolute fit index, the chi square assesses the discrepancy between the sample covariance matrix and the implied covariance matrix based on the hypothesized model. A non-significant chi-square suggests that the model may be a reasonable representation of the data. However, the assessment of fit using the chi square test is confounded by sample size. When the sample size is large, the small difference between the sample covariance matrix and the reproduction covariance may be found to be significant.

Relative-fit index and residual-based indexes are two types of additional fit indexes widely used to complement chi-square. Relative-fit indexes include comparative fit index (CFI), non-normed fit index (NNFI), and incremental fit index (IFI). These indexes measure the relative improvement in fit by comparing a hypothesized model with a base-line model. The base-line model is an independent model in which all variables are expected to be uncorrelated. These indexes range from zero to one, with larger values indicating a better fit. They should be at least larger than 0.9 for a reasonable goodness of fit. In the present study, the indexes are: CFI = 0.99, NNFI = 0.98, and IFI = 0.99, indicating a reasonable fit between the data and the hypothesized model.

In addition to relative-fit indexes, residual-based indexes can also be used. Standardized root means square (SRMS) measures the average value across all standardized residuals between the elements of the observed and implied covariance matrices. Root mean square error of approximation (RMSEA) assesses the absence of fit because of model misspecification and provides a measure of discrepancy per degree of freedom (Browne & Cudeck, 1993). SRMR range from zero to one and there is no upper limit for RMSEA, with smaller values indicating a better model fit. A value of 0.08 or less for SRMR and a value of 0.06 or less for RMSEA indicate an adequate fit (Hu & Bentler, 1999). In this study, SRMR = 0.044, while RMSEA = 0.031 (90% CI. 0.0; 0.053). Given that this is a very stringent model in which the correlations among all measurement errors were not set free, these fit statistics indexes show that the model fit the data fairly well.

Analysis

Regarding the first research question, the empirical model clearly shows that retrieving, organizing, analyzing and collaborating skills are all involved in PKM competency. Participants in this study tend to slightly agree that they are able to retrieve teaching materials via the internet (mean = 4.45, sd = 0.64), organize the information themselves by using ordering and connecting principles that relate new information to old information (mean =

4.27, sd = 0.66), extract meaning from data and convert information into knowledge (mean = 4.49, sd = 0.61) and understand others' ideas, develop and follow through on shared practices (mean = 4.35, sd = 0.648).

Surprisingly, the model does not include the skills of evaluating, presenting and securing information. This finding may reflect the possibility that the pre-service teachers in this study were not aware of exercising these skills when acquiring knowledge or that the use of these skills is actually outside the knowledge acquisition process. Evaluation of information can take place as part of the information retrieval process (Frand & Hixon, 1999); therefore evaluating skills may be embedded in the retrieving skills, especially during the information search process. Conceptually, presentation skills and information securing skills could be applied theoretically for managing information, but they are closely related to the aspects of knowledge dissemination and knowledge protection respectively, both of which skills are commonly applied after the information and knowledge conversion process. Therefore, presenting skills and securing skills should arguably be part of the knowledge creation process.

Regarding the second research question, the results show that there is a predictive relationship between PKM competency and knowledge acquisition for instructional design ($\gamma = 0.19$). The results reflect participants' ability to exercise their retrieving, organizing, analyzing and collaborating skills for instructional design (mean = 4.33, sd = 0.691). They can order and connect retrieved information for analysis, and convert the information to knowledge via individual or collective analysis. This finding is consistent with the studies of Wright, 2005, Tsui, 2002 and Grundspenkis, 2007, in which learners can apply PKM competency to support their day-to-day learning activities. The findings of this study suggest that enhancing the PKM competency of pre-service teachers can enhance their knowledge acquisition for instructional design.

Another interesting finding emerges when comparing the knowledge acquisition process using retrieving, organizing, analyzing and collaborating skills with Nonanka and Takeuchi's (1995) knowledge creation model. Nonanka and Takeuchi describe how knowledge conversion takes place through an iterative and spiral process of socialization, externalization, combination and internalization as an effective means of making individual knowledge available to the broader organization in order to create new knowledge. The empirical PKM model of the study focuses on manipulation of an intertwined macro-competency for knowledge acquisition at individual level in which the individual learner organizes retrieved information for conversion into knowledge and then shares it with others (see figure 3). It is similar to the knowledge creation process in Nonanka and Takeuchi's (1995) model, in which a learner retrieves information from knowledge sharing, then combines it with existing information and internalizes it as his own knowledge.

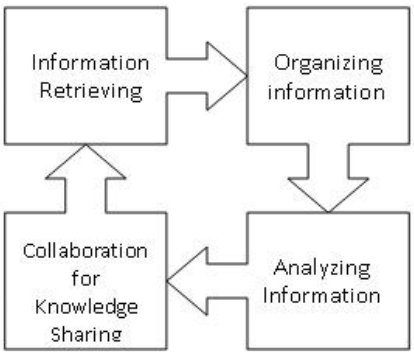

Figure 3. Knowledge acquisition process of this study

Discussion

A set of learning outcomes for planning the PKM curriculum could be articulated from the extracted items of the four PKM elements. For example, pre-service teachers should be able to access databases and websites for information retrieval; operate electronic tools for information integration; use spreadsheet and statistical software for data and information analysis; use collaborative PKM tools for collaboration to support both synchronous and asynchronous communication for the purpose of learning; and construct knowledge that is based on an appropriate understanding of the nature of data, sound inference, and an understanding of potentially meaningful relationships within a data set. To develop pre-service teachers on the basis of the above derived learning outcomes, competency training including the four interrelated skills of cognitive and metacognitive, information, social and learning should be provided (Wright, 2005). If teacher education institutions really want to fully engage pre-service teachers with a professional and lifelong learning process, they should develop pre-service teachers' PKM competency by making PKM tools available (Tsui, 2002), providing training through e-learning activities (Pettenati and Cigognini, 2009) and conducting collaborative action research (Zuber-Skerritt, 2005; Cheng, 2009).

Tsui (2002) takes a technology-centric view of PKM and looks at the challenges and problems associated with the use of PKM tools. He considers PKM as a set of information skills and describes several categories of tools for developing PKM skills. These PKM tools are search/index tools, meta-search tools, information capture and sharing tools, associative link tools and concept/mind mapping tools, email management, voice recognition, collaboration and synchronization and learning tools. Garner (2010) proposes using wikis to support and develop PKM skill. A wiki is a web application whose content is collaboratively added to, updated, and organized by its users (Mitchell, 2009), and which can be utilized in knowledge management within education to support analysis and collaboration around information. Learners can acquire relevant new knowledge by internalizing information from a wiki.

Besides efficient use of PKM tools, e-learning activities also involve sharing and intelligent practices that guide the use of tools. e-learning is a means of learning that uses wireless mobile communications network technology and wireless mobile communication systems, individual digital assistants, etc. to access information and resources. Pettenati and Cigognini (2009) devised a conceptual model on e-learning activities to develop adult learner PKM skills. These activities involve using internet tools for teaching PKM skills. The training is built around learning purposes and activity tasks, and requires learners to respond to, comment on and evaluate others' learning. This training model involves the development of cognitive, metacognitive and information skills.

E-learning activities should be delivered by action research approach. Action research is a form of self-reflective enquiry undertaken by participants in educational situations in order to improve the rationality and justice of their own educational practices, their understanding of these practices and the situations in which the practices are carried out (Kemmis, 1988). Studies involving teachers in collaborative action research into their own practices can be traced back to John Elliott's research work (1976). As part of the action research process, teachers are expected to learn cooperatively and become reflective practitioners (Schon, 1983) by practising theories postulated from others. Research shows that incorporating action research approaches into initial teacher education programmes could educate reflective teachers to deal with the complexity of practice, but that adequate resources and support need to be provided for the programme implementation (Gore & Zeichner, 1991; Price, 2001; Cochran-Smith, 2004; Mills, 2007).

Zuber-Skerritt (2005) proposes a model of action research and action learning to help knowledge workers access, communicate and manage personal knowledge. This soft approach could help develop people's PKM competency. Pre-service teachers appreciate collaborative action learning and value opportunities for deliberation and reflection on experience (Eisner, 2002) as long as they feel confident speaking about their experiences of knowledge acquisition. Cheng (2009) adopted a CoP framework to help a group of five in-service teachers create pedagogical content knowledge for mathematics teaching. He applied an action research approach titled Learning Study to cultivate and facilitate a community of practice for studying the knowledge sharing and creation process. He discovered that the collaborative action research approach can develop teachers' learning competency for knowledge creation.

To support the sustainable development of teachers as professionals in the knowledge society, teacher education institutions should integrate PKM tools, e-learning activities and collaborative action research into the pre-service teacher education curriculum. This could be of significant assistance to pre-service teachers in retrieving, organizing, analyzing and collaborating around information across all disciplines. If PKM skills are taught, acquired and utilized in each discipline across the curriculum, teachers can organize and integrate information to provide strategies for transforming what might be random pieces of information into something that can be systematically applied and that expands their personal knowledge. Nurturing pre-service teachers with PKM competency can help to sustain a competitive human capital in the knowledge economy.

Limitations Of The Study

Several limitations of this study should be noted. One important issue is the generalizability of this study. Although the questionnaire appears to have constructive content and validity in addition to relatively high reliability, the fact that all the pre-service teachers were from a single institution means that, the findings of this study may have limitations in terms of general application to other populations. As far as the predictive validity of the findings is concerned, although the data was collected from self-response questionnaires posited as evidence of the four PKM skills, the researcher is not certain whether the participants perceived the competencies found in this study as actual long-lasting competencies that can be transferred to other instructional situations.

Implications For Future Research

It is evident from the study's findings and conclusions that additional research is necessary. Firstly, in-depth qualitative research is needed to triangulate the findings of this study. This could provide a better understanding of why and how pre-service teachers' PKM competency skills can enhance their knowledge acquisition. It would explore how PKM skills support the process of converting information into knowledge. It might also explore the learning process experienced by pre-service teachers exercising their PKM skills. Secondly, this study was restricted to a single Hong Kong teacher education institution. Future studies should also focus on a comparison between teacher education in different institutions and universities in Hong Kong and other countries. Finally, further research should be conducted to examine the effectiveness of e-learning activities, collaborative action research and an integrative approach in the pre-service teacher education curriculum to develop PKM competency.

Conclusion

This study constructs an empirical model for articulating the personal knowledge management competency of pre-service teachers. The PKM competency model for pre-service teachers is identified as a four-factor structure which consists of retrieving, organizing, analyzing and collaborating skills. Enhancing pre-service teacher PKM competency can improve their knowledge acquisition in teaching. It contributes to existing PKM literature by providing an empirical pre-service teacher PKM model, and to existing teacher education by providing a PKM curriculum framework. It is in the interests of teacher education institutions to inject PKM elements into their teacher education curriculum, if they are serious about the competency of future teachers to develop primary and secondary school students' learn to learn skills to help them cope with the demands of recent curriculum reform. Teacher education institutions should consider facilitating pre-service teachers' cognitive, metacognitive, learning, information and social competency by providing e-learning activities on the use of PKM tools and collaborative action research throughout their training programme. This PKM model may enhance the ability of pre-service teachers to learn how to learn and to adapt to change and provide a framework to support lifelong learning and the sustainable development of teachers as professionals.

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