International Journal of Information Science and Management
Vol. 16, No. 1, 2018, 89-103

PKM Tools for Developing Personal Knowledge Management Skills among University Students

Rezvan Hosseingholizadeh
Associate Prof. Department of Education
Ferdowsi University of Mashhad, Iran
Corresponding Author
r.h.gholizadeh@gmail.com

Atefeh Sharif
Assistant Prof. Department of Management
Tarbiat Modares University, Iran
atefeh.sharif@modares.ac.ir

Masoumeh Kouhsari
M.A. Student in Educational Administration
Ferdowsi University of Mashhad, Iran
m.kouhsari85@gmail.com

Abstract

This study aims to investigate how PKM tools support university students for developing personal knowledge management skills. It has been done based on the PKM Skill model developed by Avery, Brooks, Brown, Dorsey and O'Conner (2001) and Sharif and Hosseingholizadeh's (2016) PKM tools taxonomy. This research focuses on how PKM tools can support PKM skills in an academic environment. Data was collected from master's and PhD students of Ferdowsi University of Mashhad (FUM) (n=362). Results showed there is significant relationship between seven PKM skills and the use of PKM tools. The strength of the correlation is between the use of PKM tools and the securing, and analyzing skills. Also, the PKM skills play different and important role in awareness, being skilled in use of PKM tools and also the rate of usage. Some of PKM tools can be used by students to support their PKM skills. Moreover, results revealed that there is no significant relationship between usefulness and perceived ease of using and use of PKM tools. This necessity is felt more in the academic environments and among graduate students, since the nature of student's educational activities and research as knowledge worker, require skills of search, collect, transfer and sharing of information and knowledge.

Keywords: Personal Knowledge Management, PKM Tools, PKM Skills, Academic Environment, Graduate Students.

Introduction

The main concern of studies focused on personal knowledge management (PKM) is how to deal with information overload problem (Farhoomand & Drury, 2002; Razmerita, Kirchner, & Sudzina, 2009; Garner, 2011; Zhen, Song, & He, 2012). Information overload affects knowledge workers' productivity and decision-making (Farhoomand & Drury, 2002). According to Zhen, Song and He (2012), the main concern in designing the personal knowledge sharing system is how to avoid information (knowledge) overload. So, in the knowledge-centered society discourse, it is more important than ever that student as knowledge worker is able to manage knowledge that he/she construct and this can be supported by PKM skills and systems (Garner, 2011). Most of the authors agree that PKM supports individuals to manage their knowledge process better, collaborate around

information and exchange their knowledge with others (Fathizargaran, 2012).

In building and maintaining personal knowledge base *attention* must be *paid* on two issues; first, it is necessary "to understand what knowledge one needs to gain and maintain, where to find it, and how to develop the skills to use it effectively" and second, "to make best use of some of the knowledge-tools that are becoming available" (Truch, 2001 cited in Agnihotri and Troutt, 2009). The optimal utilization of technology tools will depend on how well knowledge workers and other users assimilate the PKM skills and technology in their KM behaviors (Fathizargaran, 2012). To achieve these goals, PKMS have been built to facilitate the PKM process using information technology (Doong & Wang, 2009).

According to Barth (2001c cited in Tsui, 2002), "Knowledge Management cannot succeed unless every knowledge worker takes personal responsibility for what he/she knows and doesn't know". In this regard, several scholars, for example Frand and Hixon (1999), Avery et al. (2001) Berman and Annexstein (2003), Efimova (2005), Wright (2005), Zuber-Skerritt (2005), Agnihotri and Troutt (2009), and Jarche (2010a) have developed models to describe PKM. All of these models shared the same assumption that PKM is important and both individuals and organizations would benefit from it (cited in Cheong & Tsui, 2011).

Cheong and Tsui (2011) believe that the development of PKM is divided into two clusters: skills/activities-centric and technology-centric. The skills/activities-centric mainly focused on the skills of an individual to manage their knowledge activities. In this regard, he reviewed and evaluated eight different PKM models. Based on the Cheong and Tsui's (2011) evaluation, the Avery, Brooks, Brown, Dorsey and O'Conner (2001)'s model is a comprehensive and generic PKM model which covers all four generic knowledge management processes (locate /capture, share /transfer, create and apply) as proposed by others. Moreover, Avery et al. (2001) viewed PKM as a set of skills necessary for better problem solving, decision making and other knowledge works, and highlighted the significance of the appropriate practice of each skill as well as the importance of technology integration. These skills include (1) retrieving information; (2) evaluating/assessing information; (3) organizing information; (4) analyzing information; (5) presenting information; (6) securing information; and (7) collaborating around information. These skills are required for successful problem solving in daily knowledge work tasks (Razmerita et al., 2009). *These seven PKM skills* have been applied to student learning (Garner, 2011). On the other hand, according to Pauleen (2009, P. 222), "Individuals need to know how to decide on and seek out new and relevant information, knowledge, experiences and "learnings" ". Therefore, teaching students to become effective self-regulated learners may help them acquire basic and complex PKM skills (Kitsantas & Dabbagh, 2011). In this context, *the primary* concern of this research is to examine how PKM tools support university students for developing their personal knowledge management skills.

Review of the literature

Research in the field of personal knowledge management can be categorized in four categories include roles and values of PKM, identification and classification of the PKM tools, benefits and challenges of using PKM tools and skills in general, and use of PKM tools and skills in an academic community. In the first category, the roles of PKM were investigated in the KM process cycle and the values were assessed for improving the competences of both individuals and organizations by Cheong and Tsui (2010). In this study a

total of 206 valid samples were examined. The results indicated that for example retrieving skill plays a very important role in locating / capturing knowledge. Ismail, Yusof, Zulkifli and Ahmad (2013) focused on understanding how adult learners manage their personal knowledge via social networking tools. Findings showed that the four main variables describing the PKM processes in learning – Get, Understand, Share and Connect – are positively related to the Effective PKM in learning. Also, Tsui (2002), Barth (2004), Agnihotri and Troutt (2009) and Sharif and Hosseingholizadeh (2016) are the samples in the second category. Tsui (2002) has provided a unique and in depth coverage of a bottom up approach to understand technologies that support PKM. He presented a holistic view and concluded with a list of the critical issues that underpin the adoption and success of PKM and P2PKM systems. Barth (2004) took a personal approach to KM and tried to show different tools related to the seven basic PKM skills. He believed that there are hundreds of available tools for PKM and there are all kinds of communication and collaboration tools that make it easier to work together. According to Agnihotri and Troutt (2009) the impact of effective PKM will depend increasingly on skills-tools fit. Sharif & Hosseingholizadeh (2016) tried to identify and cluster the PKM tools. To achieve this objective, survey research method was used. In the first phase, 47 tools were identified based on the literature. Then, in the second phase, tools intentionally selected thirty experts from computer science and information and knowledge science, clustered the identified tools into seven clusters including knowledge retrieving, knowledge evaluating, knowledge organizing, knowledge analyzing, knowledge collaborating, knowledge presenting, and knowledge securing.

Third category of papers focused on the benefits and challenges of using PKM tools and skills in general and wasn't restricted to any populations. In this category, three studies have been focused on Web 2.0 technologies and their impact on PKM skills and strategies. First, Razmerita, et al., (2009) studied the role of Web 2.0 tools for managing knowledge at individual and organizational levels. It demonstrated that Web 2.0 plays a multifaceted role in communicating, collaborating, sharing and managing knowledge. Moreover, Web 2.0 enables a new model of PKM that includes formal and informal communication, collaboration and social networking tools. Požgaj, and Vukšić (2011) examined the implication of Web 2.0 services on learning process. They found that the implementation of Web 2.0 services into learning process strongly influences the organizational aspects of e-learning. PKM supports individuals in the processes of cooperation, collaboration, and connection among the people of the same interests in carrying out the activities of data and information collecting, analyzing, sharing, retrieving and transforming it into knowledge. Also, Roß (2011) examined the use of web 2.0 in PKM. Interviews with six involved professionals were conducted and the results of the interviews were analyzed using qualitative content analysis. Findings showed that PKM 2.0 offers great potential. Likewise, through a qualitative research method, semi-structured interviews with three middle level managers and three software developers from four multinational software engineering companies have been studied by Fathizargaran (2012) to show the benefits and challenges of using Web 2.0 technologies (Wikis, Blogs, Facebook, Twitter, etc.) for PKM. He stated that Ease of use of technologies and ease of organizing information were found to be enablers of the technologies for effective management of personal knowledge.

The last category belongs to researchers who are interested in use of PKM tools and skills in an academic community. In recent years, several papers have been published with the

almost same approach (e.g. Liu, 2011; Swigon, 2013a; Benitez, Pauleen & Hooper, 2013; Safar & Alkhezzi, 2014; Çavuşoğlu, Uzunboylu, 2014). Liu (2011) tried to examine how Chinese college students use Web 2.0 technologies for PKM using a questionnaire. A total of 200 students were surveyed. This empirical research demonstrates that the college students have been aware of the importance of the PKM and the Web as a channel to acquire knowledge. However, the data also reflects limitations in terms of knowledge sharing and exchanging, knowledge application and creation, and using Web 2.0 tools to manage personal knowledge among college students in China.

The reaction of KU's students regarding the utilization of some PKM tools in their academic studies and its influence on managing their knowledge has been assessed by Safar and Alkhezzi (2014). According to the research objectives, Students' feelings, perceptions, and attitudes were measured by a questionnaire. A total of 100 undergraduate students from the College of Education participated in this research, regardless of students being not aware at all of KM, PKM, and PKM tools. Yet, the fact is that the results showed a significantly positive, affirmative, and encouraging feelings, attitudes, and perceptions with respect to using PKM tools for academia and personal life as well (i.e. yielded an agreement ratio about 95 percent).

With a different perspective, Swigon (2013b) proposed Personal knowledge and information management (PKIM) in a theoretical paper as an integrated approach of three concepts – personal knowledge management (PKM), personal information management (PIM) and information literacy (IL) – as an appropriate and comprehensive approach to these issues with overlapping and supplementary areas of interests. Then, he tried to highlight the humanistic perspective by focusing on students' activities and attitudes regarding K&I management in the context of learning and studying (Swigon, 2013a). The respondents' group consisted of 510 Information Science and Library study students from nine universities throughout Poland. The study demonstrated that students saw K&I management as the possession and development of specific skills and abilities useful in academic and private life. In general, students of Information Science and Library Studies (ISLS) were self-confident in the area of information skills or information literacy, in particular in K&I gathering, searching and organizing. However, selecting and evaluating of information was problematic for the surveyed students.

Çavuşoğlu, Uzunboylu (2014) aimed to find out the approaches of academic staff towards PKM in a developing university in Northern Cyprus by focusing on the four PKM strategies and techniques, i.e. obtaining, saving, using, and sharing knowledge. All the 381 academic staff was taken as participants. The findings suggested that in this developing university, general attitudes of the staff towards PKM strategies are positive. However, while strategies for effectively using and saving knowledge were widely used, strategies for obtaining new information and sharing it with colleagues were not so popular. However, the above-mentioned studies were quantitative. Benitez, Pauleen and Hooper (2013) had different approach and studied a post-graduate student evolved from an information gatherer to a knowledge creator during a two-year period of post-graduate studies. They provided background findings used to develop the conceptual model followed by a supporting case study.

In general, Studies highlight the importance of PKM in improving individual performance (Fathizargaran, 2012), helping individuals to be more effective in personal, organizational and social environments (Razmerita et al., 2009), and developing a self-awareness of their limits and abilities (Avery et al., 2001). There are also researchers who

have examined the roles and values of PKM (Cheong & Tsui, 2010). While, most investigations have focused on technology and examined the benefits and challenges of using Web 2.0 technologies (Fathizargaran, 2012), students' PKM and use of web 2.0 (Liu, 2011), the effective utilization of technology in PKM practices (Agnihotri and Troutt, 2008), technologies for Personal and Peer-to-Peer (P2P) Knowledge Management (Tsui, 2002), implication of Web 2.0 services on learning process (Požgaj, & Vukšić 2011), and analysis of benefits and challenges of using Web 2.0 technologies at the individual level (Fathizargaran, 2012). There is limited research on integrated taxonomy of PKM tools and their usage for PKM skills.

While there is increasing attention paid to the use of PKM skills and PKM tools, there has been relatively little discussion about using PKM skills and tools in the learning process of students. To fill in this gap, this study by applying the taxonomy of PKM tools (Sharif and Hosseingholizadeh, 2016) aims to examine the relationship between PKM skills and PKM tools and the influence of perceived usefulness and perceived ease of use on them. It is also important to know that the conceptual model in our study is the same as in Avery et al. (2001). Accordingly, two research questions are formulated:

1. What is the relationship between PKM skills and PKM tools?
2. What is the impact of perceived usefulness and perceived ease of use of PKM tools on use of them?

Method

Participants and procedure

This study was conducted at a Ferdowsi University of Mashhad (FUM) using Quantitative Methodology along with a survey instrument. Participants of this study were master's and PhD students (N=7758). Based on Krejcie & Morgan's table a sample of 370 students was drawn through random sampling. 362 questionnaires were completed and analyzed (female= 63.6 percent and male= 36.1 percent). 249 subjects were master's students (68.6 percent) 112 subjects were Ph.D. students (30.9 percent). Participants were distributed as following: human sciences (39.4 percent), engineering (19.8 percent), Farming (20.1 percent) and Science (20.1 percent). Basic information of participants is depicted in Table 1.

Table 1
Basic information of Participants

Participants Characteristics	Frequency	Percent
Gender		
Male	131	36.1
Female	231	63.6
Degree		
M.A.	249	68.6
Ph.D.	112	30.9
Discipline		
Human Sciences	143	39.4
Engineering	72	19.8
Farming	73	20.1
Science	73	20.1
Note*:* n= 362		

Measures

Personal Knowledge Management Skills

This was measured with 70 items of PKM Self-Assessment developed by Laura Larsson with suggestions from colleagues, including Dorsey. The seven main skills have been adopted for this self-assessment from work of Dorsey (2000). These PKM skills include accessing information and ideas, evaluating information and ideas, organizing information and ideas, analyzing information and ideas, conveying information and ideas, collaborating around information and ideas, and securing information and ideas. Example items for Accessing Information and Ideas are "*I can ask focused questions to inform my search for information … I know the difference between an online search engine, a directory of sites, and a meta-search engine … I know when to use primary sources of information and when to use secondary sources… I understand the basics of evidence-based public health practice … I have successfully classified, organized and stored documents into folders for later retrieval… I can ask relevant questions of my data… I can extract and manipulate data and information in a variety of formats … my password protects sensitive personal data and I do not share my password with colleagues*" (α= .9487; 1=strongly disagree to 5 = strongly agree).

Personal Knowledge Management Tools

This was measured with 31 items of PKM tools taxonomy of Sharif and Hosseingholizadeh (2016). According to this taxonomy, PKM tools include "*Personalized search tools, Search engine, Digital repository, Desktop search, Meta search engine, Bookmarks or favorites, File system, Workflow, Visualization tools, Indexer, Reference Managers, Spreadsheets, Summarizes, Recommender systems, Tags and folksonomy, Social bookmarking, Newsgroup, Shared drive, Social networks, Wikis, Video conferencing and teleconferencing, Weblog, podcasts video casts, multimedia archives/Video & photo sharing, RSS, e-mail, Chat, Access control tools, Passwords and Encryption keys, Virus filters and firewalls, Pocket diaries, Discussion forum, and Personal portals*" (α= .9772; = strongly disagree to 5 = strongly agree).

Perceived Ease of Use and Perceived Usefulness of PKM Tools

Perceived ease of use of PKM tools was measured with 7 items and perceived usefulness of PKM tools was measured with 7 items of scale developed by Davis, Bagozzi and Warshaw (1989). Example items are "*using PKM tools in my learning would enable me to accomplish tasks more quickly,… using PKM tools would make it easier to do my learning,….it was easy to become skillful using PKM tools,…I would find PKM tools easy to use*"(α= .9211; 1=strongly disagree to 5 = strongly agree).

Results

The results are presented first in terms of descriptive analysis. Then we analyze the data in order to address the research questions.

Data from the PKM self-assessment presented in Table 2 indicate that PKM skills are above average (M> 3). As analyzing skill with an average of 3.79 and collaborating with an average of 3.66 are the highest. On the other hand, Retrieving skill with an average of 3.39 and Organizing with an average of 3.43 are the lowest one. Results of the correlation among each of skills showed that in general, there is a significant correlation between the seven skills of PKM (r= 0.66, p <.01). The strength correlation was observed between the skills of Analyzing and Organizing (r= 0.88, p <.01) and also among the skills of Retrieving, Organizing and Evaluating (r= 0.86, p <.01).

Table 2
Means, standard deviations and correlations

Variable	*M*	*SD*	1	2	3	4	5	6	7
1. Retrieving	3.39	0.73	1						
2. Evaluating	3.49	0.73	0.84**	1					
3. Organizing	3.43	0.78	0.86**	0.86**	1				
4. Analyzing	3.79	0.76	0.81**	0.85**	0.88**	1			
5. Collaborating	3.66	0.75	0.67**	0.68**	0.72**	0.76**	1		
6. Presenting	3.63	0.85	0.72**	0.69**	0.79**	0.84**	0.74**	1	
7. Securing	3.47	0.84	0.67**	0.66**	0.72**	0.71**	0.74**	0.66**	1

Note: *p<.05; **p<.01

More ever, results revealed that the amount of awareness, skills and use of PKM tools among graduate students at FUM is less than average (M <3). As such, the lowest average, respectively, was related to 0the use of tools (M = 2.60), then skills of usage (M = 2.73) and awareness of PKM tools (M = 2.96). The correlation results showed that the strength correlation is between the skills and the use of tools (0.94, p <.01). Means, standard deviations of correlations of the variables (PKM skills) are summarized in Table 3 and 4.

Table 3
Means, standard deviations and correlations

Variable	*M*	*SD*	1	2	3
1. awareness of PKM Tools	2.96	0.75	-		
2. skill in use of PKM Tools	2.73	0.72	0.70**	-	
3. use of PKM Tools	2.60	0.71	0.66**	0.94**	-

Note: *p<.05; **p<.01

Table 4
Means, standard deviations

PKM Tools	Awareness		Skill		Use	
	Mean	SD	Mean	SD	Mean	SD
Personalized search tools (T1)	2.69	1.30	2.80	1.25	2.73	1.31
Search engine (T2)	3.52	1.33	3.45	1.18	3.58	1.29
Digital repository (T3)	2.34	1.21	2.32	1.14	2.25	1.15
Desktop search (T4)	2.41	1.32	2.45	1.32	2.34	1.32
Meta search engine (T5)	2.11	1.15	2.11	1.17	2.00	1.14
Bookmarks or favorites(T6)	3.01	1.48	2.84	1.38	2.69	1.35
File system (T7)	2.61	1.41	2.50	1.31	2.44	1.33
Workflow (T8)	1.99	1.14	1.93	1.09	1.87	1.05
Visualization tools (T9)	2.52	1.33	2.32	1.18	2.22	1.18
Indexer (T10)	2.13	1.22	1.99	1.08	1.94	1.08
Reference Managers (T11)	2.48	1.38	2.34	1.22	2.27	1.25
Spreadsheets (T12)	2.38	1.30	2.25	1.22	2.12	1.20

PKM Tools	Awareness		Skill		Use	
	Mean	SD	Mean	SD	Mean	SD
Summarizes (T13)	2.02	1.16	1.97	1.10	1.91	1.09
Recommender systems (T14)	1.75	1.00	1.75	0.98	1.71	0.95
Tags and folksonomy, Social bookmarking (T15)	2.25	1.27	2.17	1.22	2.08	1.15
Newsgroup (T16)	3.12	1.26	2.82	1.17	2.66	1.16
Shared drive (T17)	2.64	1.32	2.32	1.21	2.25	2.11
Social networks (T18)	4.02	1.00	3.42	1.15	3.15	1.29
Wikis (T19)	3.46	1.36	3.02	1.30	2.92	1.29
Video conferencing and teleconferencing (T20)	3.37	1.28	2.55	1.11	2.30	1.14
Weblog , podcasts video casts (T21)	3.53	1.16	2.72	1.14	2.43	1.18
multimedia archives / Video & photo sharing (T22)	3.51	1.19	2.89	1.21	2.74	1.23
RSS (T23)	2.05	1.29	1.77	1.09	1.67	1.01
e-mail (T24)	4.55	0.88	4.41	0.84	4.40	0.89
Chat (T25)	4.24	0.93	3.38	1.34	2.98	1.46
Access control tools (T26)	2.70	1.29	2.39	1.16	2.29	1.14
Passwords and Encryption keys (T27)	3.98	1.10	3.55	1.19	3.44	1.22
Virus filters and firewalls (T28)	3.92	1.00	3.46	1.12	3.45	1.16
Pocket diaries (T29)	3.10	1.40	2.45	1.25	2.22	1.17
Discussion forum (T30)	3.19	1.34	2.52	1.19	2.18	1.14
Personal portals (T31)	4.02	1.04	3.51	1.10	3.38	1.16

Table 4 shows the analysis of the results of awareness, skill and use of any PKM tools. Accordingly, the highest awareness is related to the tools of Social networks (M= 4.02), e-mail (M= 4.552), Chat (M= 4.24) and Personal portals (M = 4.02) and the lowest ones are Workflow (M= 1.99) and Recommender systems (M= 1.75). The majority of graduate students' skills in FUM are in using tools of Search engine (M = 3.45), Social networks (M= 3.42), Passwords and Encryption keys (M= 3.55), e-mail (M = 4.41) and Personal portals (M= 3.51). Indeed, the lowest skills are in using tools of Workflow (M = 1.93), Indexer (M= 1.99), Summarizes (M=1.97), Recommender systems (M= 1.75) and RSS (M= 1.77). The practical use of these students from tools such as Search engine (M= 3.58), Social networks (M= 3.15), e-mail (M= 4.40) and Virus filters and firewalls (M= 3.45) is higher than average, and the use of tools Indexer (M=1.94), Summarizes (M= 1.91), Recommender systems (M= 1.71) and RSS (M= 1.67) is less than average.

As shown in table 5, an independent samples *t* test was performed comparing the mean consistency scores of master's and PhD students. There is a significant difference in the scores for Ph.D students in awareness (M=3, SD=1.3), skill (M=3.2, SD=1.2) and use of PKM Tools (M=3.1, SD=1.2) and for master's students in awareness (M=2.51, SD=1.5), skill (M=2.59, SD=1.5) and use of PKM Tools (M=2.5, SD=1.2).These results suggest that degree really does have an effect on awareness, skill and use of PKM Tools. Table 5. *t* test results comparing master's and PhD students on Awareness, Skill and use of PKM tools.

Table 5
t test results comparing master's and PhD students on Awareness, Skill and use of PKM tools

		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Awareness	Equal variances assumed	.005	.945	-3.551	305	.000	-.56125
	Equal variances not assumed			-3.476	166.804	.001	-.56125
Skill	Equal variances assumed	.708	.401	-4.040	308	.000	-.60503
	Equal variances not assumed			-4.054	190.453	.000	-.60503
Use	Equal variances assumed	.234	.629	-4.028	301	.000	-.63066
	Equal variances not assumed			-4.012	189.269	.000	-.63066

As predicted, results from an independent samples *t* test indicated that there is no statistically significant difference between master's and PhD students in how to Retrieve, Evaluate, Organize, Analyze, Present, Collaborate and Secure personal knowledge.

Table 6
t test results comparing master's and PhD students on PKM Skills

		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Retrieving	Equal variances assumed	.014	.905	.740	351	.460	.06307
	Equal variances not assumed			.743	215.214	.458	.06307
Evaluating	Equal variances assumed	1.033	.310	1.300	351	.194	.11026
	Equal variances not assumed			1.342	230.706	.181	.11026
Organizing	Equal variances assumed	.261	.610	1.474	352	.141	.13254
	Equal variances not assumed			1.490	218.798	.138	.13254
Analyzing	Equal variances assumed	.170	.680	1.233	352	.218	.10951
	Equal variances not assumed			1.254	222.166	.211	.10951
Presenting	Equal variances assumed	.008	.928	1.595	346	.112	.15841
	Equal variances not assumed			1.652	231.593	.100	.15841
Collaborating	Equal variances assumed	.058	.809	.587	343	.557	.05179
	Equal variances not assumed			.589	215.057	.556	.05179
Securing	Equal variances assumed	1.419	.234	.753	343	.452	.07334
	Equal variances not assumed			.769	225.428	.442	.07334

According to table 7, the results showed that there is a significant relationship between seven skills of PKM tools and use of tools. The strength correlation is between the use of PKM tools with the skill of securing (p = 0.262) and analyzing (p = 0192).

Table 7
Correlations

Variable	Retrieving	Evaluating	Organizing	Analyzing	Collaborating	Presenting	Securing
Use of PKM Tools	0.174**	*0.171***	0.170**	0.192**	0.162**	0.129*	0.262**

Note: *p<.05; **p<.01

Hierarchical linear modeling to examine the main influence of PKM on use of PKM tools was used. Model 1 (table 8) shows that control variables include Degree (b= 0.112, SE= 0.00, p<0.05) and academic study (b= 0.116, SE= 0.00, p<0.05) directly and significantly associated with PKM tools. Thus, in final model (table 5) after controlling of the direct effects of control variables, PKM skills were entered. Model 2 shows that all of PKM skills will not explain significantly variance of using PKM tools, except analyzing skill (b= 0.299, SE= 0.00, p<0.05) and securing skill (b= 0.335, SE= 0.00, p<0.05) that have prediction power on PKM tools.

Table 8
Estimates of the direct and interactive effects of PKM skills on use of PKM tools

	Model 1	Model 2
Control variables		
Gender	0.079	0.051
Degree	0.112*	0.124*
Academic study	0.116*	0.105*
Independent variables		
Retrieving		0.046
Evaluating		-0.019
Organizing		-0.134
Analyzing		0.299*
Collaborating		-0.141
Presenting		-0.135
Securing		0.335*
R^2	0.040	0.134
Adjusted R^2	0.031	0.108
ΔR^2	0.040	0.095
F	4.597	5.090

The results of table 9 shows the students perceived use of PKMT (M = 3.92) and usefulness of PKMT (M = 3.98). Also, significant correlations were observed between perceived ease of use of PKMT and perceived usefulness of PKMT (0.81, p <.01). Based on these results, in spite of the perceived usefulness and ease of use of tools and at the same time

awareness and the low-skilled students, the actual use of the tools is less than average. Moreover, the results revealed there is no significant relationship between usefulness (0.08, p> .01) and perceived ease of use (0.05, p> .01) in applying PKM tools.

Table 9
Means, standard deviations, and correlations

Variable	*M*	*SD*	1	2	3
1. Perceived ease of use PKMT	3.92	0.71	-		
2. Perceived usefulness PKMT	3.98	0.69	0.81**	-	
3. Use PKMT	2.60	0.71	0.05	0.08	-

Note: *p<.05; **p<.01

Conclusion

The central aim of this current study was to investigate the level of protection of PKM tools of PKM skills. This necessity is felt more in academic environments among graduate students, because the nature of student's research and educational activities as knowledge worker requires skills of search, collect, transfer and sharing of information and knowledge (Garner, 2011). The results of this study support the view of Avery et al. (2001) and Cheong and Tsui (2010) suggest that effective PKM is related to the use of technology. Despite the diversity of PKM frameworks, Avery's et al. (2001) perspective was considered as an overall PKM framework with seven skills. the skills include retrieving information; evaluating information; organizing information; collaborating around information; analyzing information; presenting information and securing information. In addition, previous studies indicated a variety of tools used in PKM. In order to classify the most widely used tools in each of these skills, the results of Sharif's and Hosseingholizadeh's (2016) classification model was used, which involved 31 PKM tools for this study.

The use of these tools and skills by university students within learning environments have been the subject of previous research (e.g. Liu, 2011; Požgaj and Vukšić, 2011; Swigon, 2013a; Benitez, Pauleen & Hooper, 2013; Safar & Alkhezzi, 2014; Çavuşoğlu, Uzunboylu, 2014). Roß (2011) argued that the use of PKM can improve the productivity of knowledge worker. Thus, students as knowledge workers can improve their academic and personal lives through development of related skills and PKM capabilities (Swigon, 2013a). Therefore, it is essential that students transform into a knowledge creator and not only be an information gatherer (Benitez, Pauleen & Hooper, 2013). The perceived ease of use and perceived usefulness of PKM tools were found to be enablers for effective management of personal knowledge (Fathizargaran, 2012).

The results showed that students with PKM skills have better than average skillsets. Students with PKM skills have greater skills in analyzing and collaborating. They have a better awareness level and proficiency of tools like; Social networks, E-mail, Chat, Personal portals, Virus filters and firewalls, Passwords and Encryption keys and Search engine capabilities. According to Liu (2011) sharing, creating and application skills among students are low. Safar & Alkhezzi (2014) also indicated that students are significantly unaware of KM, PKM, and PKM tools. However, their research also showed that students applying KM tools also have positive feelings, attitudes, and perceptions with respect to using PKM tools for academia and personal life. Furthermore, Çavuşoğlu, Uzunboylu (2014) reported that the

general attitudes of academic staff towards PKM strategies are positive. According to Sharif and Hosseingholizadeh (2016), knowledge management tools are effective in supporting one or more of the aforementioned skills. In addition, the tools having the highest usage based on Table 3 have been identified.

The use of PKM tools and their relevant skills development play different and important roles in awareness for university students (Avery et al, 2001). Using PKM tools can significantly increase the students' related PKM skills . For example, web 2 tools (Social networks, E-Mail, Chat) can support collaborative and presentation abilities. In addition, virus filters, firewalls, passwords, and encryption tools can support knowledge regarding security and information as well as the development of those skill sets.

Students often use tools that that pertain to knowledge retrieval, presentation, security, and collaborative information (table 10). Less attention is given to tools that support evaluation, organization, and analyzation skills; nonetheless, students self- report having good knowledge analyzation skillsets. The results of this study show that of the seven PKM skills, only two; (a) securing, and (b) analyzing, have the most predictive power of using PKM tools.

Table 10
Matrix of PKM skills and tools

PKM Tools / PKM Skills	Social networks	e-mail	chat	Personal portals	Virus filters and firewalls	Passwords and Encryption keys	Search engine
Retrieving							*
Evaluating							
Organizing							
Analyzing							
Collaborating	*	*	*				
Presenting	*	*		*			*
Securing					*	*	

A significant contributing goal of the current study is to help develop the theoretical basis of PKM in terms of PKM tool performance and skillsets developed related to students' learning activities. Students with acquired PKM skillsets will be able to develop and improve the quality of learning. Practical contribution of this current study is to introduce the most important tools that provide PKM capabilities for students in university environments. A significant limitation of this study includes the lack of classification criteria of PKM tools. Due to the multiple use of many tools and technologies, diagnosis and classification under any of the PKM skills is difficult. Moreover, consideration of the application of these tools is not only an individual choice but also its applicability to team-based usage and the organizational applicability. Sharif and Hosseingholizadeh's (2016) classification model was used for this current study.

This research study revealed that the amount of awareness, skills and use of PKM tools among graduate students at FUM is less than average (M <3). Even though, Ph.D. students have a significant rigorous learning and research curricula, all students would benefit from PKM tools and skillsets if made available through different workshops and tutorials. The

University library can also provide a segment of PKM training courses on demand. A multitude of programs designed to increase PKM awareness, knowledge, and practice would benefit a student's performance.

Acknowledgments

The authors gratefully acknowledge support from Ferdowsi University of Mashhad. This study was supported in part by vice president for research and technology at Ferdowsi University of Mashhad. We gratefully acknowledge this support. We are thankful for the insightful comments by the editors and reviewers of this article.

References

Agnihotri, R., & Troutt, M. D. (2009). The effective use of technology in personal knowledge management: A framework of skills, tools and user context. *Online Information Review*, 33(2), 329-342. doi: 10.1108/14684520910951249

Avery S., Brooks, R., Brown, J., Dorsey, P., and O'Conner, M. (2001). Personal knowledge management: framework for integration and partnerships. In *Proceedings of the 2001 ASCUE Summer Conference, P. Smith (ed.)*, (ed. P. Smith), North Myrtle Beach, South Carolina, 10-14, 39-43.

Barth, S. (2004). Self-organization: taking a personal approach to KM. in M. Rao (Ed.), *Knowledge Management Tools and Techniques: Practitioners and Experts evaluate KM solutions*. Butterworth-Heinemann. Retrieved from http://www.knowledgeboard.com/download/3285/ pkm-chapter-stevebarth.pdf

Benitez, E., Pauleen, D., & Hooper, T. (2013). From Information Gatherers to Knowledge Creators: The Evolution of the Post-Graduate Student. *Electronic Journal of Knowledge Management*, 11(2). Retrieved from http://www.ejkm. com/issue/download.html?idArticle=415

Berman, K. A., & Annexstein, F. S. (2003). *Actualizing Context for Personal Knowledge Management*. Department of ECECS, University of Cincinnati: Cincinnati, OH, 1-8.

Çavuşoğlu, Ç., & Uzunboylu, H. (2014). Academic knowledge and personal knowledge management in a developing university: a case study. *Eylül*, 22 (3), 1229-1242. doi: 10.1108/13673270910942718

Cheong, R. K., & Tsui, E. (2010). The roles and values of personal knowledge management: an exploratory study. *Vine*, 40(2), 204-227. 10.1108/03055721011050686

Cheong, R. K., & Tsui, E. (2011). From Skills and Competencies to Outcome-based Collaborative Work: Tracking a Decade's Development of Personal Knowledge Management (PKM) Models. *Knowledge and Process Management*, 18(3), 175-193. doi: 10.1002/kpm.380

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: a comparison of two theoretical models. *Management science*, 35(8), 982-1003. doi: 10.1287/mnsc.35.8.982

Doong, H. S., & Wang, H. C. (2009). Predictors of diverse usage behavior towards personal knowledge management systems. *Online Information Review*, 33(2), 316-328. doi: 10.1108/14684520910951230

Dorsey, P. A. (2000). *What is PKM? Overview of personal knowledge management*. Retrieved from www.millikin.edu/webmaster/seminar/pkm.html.

Farhoomand, A. F., & Drury, D. H. (2002). Managerial information overload. *Communications of the ACM*, 45(10), 127-131. doi: 10.1145/570907.570909

Fathizargaran, R. (2012). *Personal Knowledge Management: An Analysis of Benefits and Challenges of Using Web 2.0 Technologies at the Individual Level*. MA thesis, Victoria University of Wellington, New Zealand Retrieved from http://hdl.handle.net/10063/2620

Garner, S. (2011). Small Group Knowledge Management and the Support of Student Learning. In: *19th International Conference on Computers in Education* (ed T Hirashima et al.) Chiang Mai, Thailand., November 28, 2011 to December 2. Retrieved from http://www.nectec.or.th/icce2011/program/proceedings/pdf/C6_S3_15S.pdf

Ismail, S., Yusof, N. W. M., Zulkifli, M. Z., & Ahmad, M. S. (2013). Personal Knowledge Management among Adult Learners: Behind the Scene of Social Network. *World Academy of Science, Engineering and Technology* (WASET), 74, 273-279

Kitsantas, A., & Dabbagh, N. (2011). The role of Web 2.0 technologies in self-regulated learning. *New Directions for Teaching and Learning*, 2011(126), 99-106. doi: 10.1002/tl.448

Liu, X. (2011). Investigation on students' personal knowledge management and uses of web 2.0 technologies in Chinese higher education. *In Proceeding of the Southern Association for Information System Conference,* Retrieved from Atlanta. https://aisel.aisnet.org/ sais2011/6

Pauleen, D. (2009). Personal knowledge management: putting the "person" back into the knowledge equation. *Online Information Review,* 33 (2), 221-224. doi: 10.1108/ 14684520910951177

Požgaj, Ž. & Vukšić, V. B. (2011). Personal knowledge management: The implication of Web 2.0 services on learning process. *In MIPRO, 2011 Proceedings of the 34th International Convention* (pp. 1213-1217). IEEE.

Razmerita, L., Kirchner, K., & Sudzina, F. (2009). Personal knowledge management: The role of Web 2.0 tools for managing knowledge at individual and organizational levels. *Online Information Review*, 33(6), 1021-1039. doi: 10.1108/14684520911010981

Roß, D. (2011). *Personal Knowledge Management 2.0: Use of Web 2.0, in Personal Knowledge Management.* Master Thesis. Available at FH Burgenland Digital Repository Retrieved from http://opac.fh-burgenland.at/alipac/-/find-simple?F1=VID& V1= AC08575393

Safar, A. H., & Alkhezzi, F. A. (2014). PKM tools for academia: Ingredients for success in the global knowledge society. *TOJET: The Turkish Online Journal of Educational Technology*, 13(3). ERIC Number: EJ1034231

Sharif A., & Hosseingolizadeh, R. (2016). Identifying and clustering the Personal Knowledge Management (PKM) systems. *Journal of Information Processing and Management*. 31(4), 1009-1029. (In Persion)

Świgoń, M. (2013a). Knowledge and Information Management Behavior—in the Light of Empirical Studies among Students. In *Proceedings of ISIC, the Information Behavior Conference,* Leeds, 2-5 September, 2014: Part 1, (paper isic17). Retrieved from http://InformationR.net/ir /19-4/isic/isic17.html (Archived by WebCite® at http://www. webcitation.org/...)

Świgoń, M. (2013b). Personal knowledge and information management–conception and exemplification. *Journal of information science*, 39(6), 832-845. doi: 10.1177/ 0165551513501435

Tsui, E. (2002). Technologies for personal and peer-to-peer (p2p) knowledge management. In *CSC Leading Edge Forum Technology Grant Report*. Retrieved from http://citeseerx.ist. psu.edu/ viewdoc/summary?doi=10.1.1.84.9689

Wright, K. (2005). Personal knowledge management: supporting individual knowledge worker performance. *Knowledge management research and practice,* 3(3), 156-165. doi: 10.1057/palgrave.kmrp.8500061

Zhen, L., Song, H. T., & He, J. T. (2012). Recommender systems for personal knowledge management in collaborative environments. *Expert Systems with Applications*, 39 (16), 12536-12542. doi:10.1016/j.eswa.2012.04.060