

A Case Study on Research Assistant System – From Knowledge Management Perspective

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Abstract: The purpose of this study is to develop a web-based Research Assistant System (RAS), a Knowledge Management System by community of practice, to improve the group performance of Research Assistants (RAs). Knowledge management is concerned with effective and efficient access to internal and external knowledge that enable an organization to be informed of its environment. The methodology of this study consists of system analysis/design. This study focuses on the implementation of such a system, a system based on free software—PhpBB that allows people to add special features to meet RAS's requirements. The testing phase in this study was also obtained from RAs' feedbacks. Two contributions of RAS are: (a). With shared memory, the RAS exposes to an interest in how research performance being not merely a function of an individual's achievement, but in a way that tasks and problems are being shared; the organization memory implies an emphasis on how individual insights are combined in a group, and how the structure and dynamics of such group thought processes;(b). The RAS plays as an organizational learning support system that individual problem solving is inspired by how groups of experts can come together and solve problems in a way that the individuals could not do on their own. Finally, the implications of RAS in terms of Knowledge Management are also discussed.

1. Introduction

The recognition that knowledge is one of an organization's most important assets, decisively influencing its competitiveness, has fueled interests in comprehensive approaches to the basic activities of knowledge

management: identification, acquisition, development, dissemination, use, and preservation of organization's knowledge[14][4][2]. Traditionally, higher educations have addressed knowledge management (KM) from either a management or a technological point of view. Advisors at university understand that the knowledge of their research assistants is one of the most valuable assets. They are concerned with the effective use of individuals' knowledge and the qualitative and quantitative adaptation of this knowledge toward a changing environment. The technological approach, by contrast, deals with questions about what information technology should be provided to support knowledge management.

Another motivation why we set up Research Assistant System (RAS) is that those Research Assistants (RAs), attaining financial support from National Science Council (NSC) of Taiwan are distributed around southern Taiwan. Due to geographical separation, all members of RAs are asked to join an online meeting for three-hour every week and post their research results or insights on RAS. However, literature survey shows that effective knowledge management requires a hybrid solution, one that involves both people and technology. Our long-term vision is that organizational memory is the core of a learning organization to support knowledge sharing and reuse of individual and organizational knowledge.

Arranged around such an Organization Memory (OM), "IT-supported knowledge management services" actively provide the user working on a knowledge-intensive operational task with all the information necessary and useful for fulfilling the research task. Furthermore, the biggest advantage from an OM's support will likely come in tasks that are complex, difficult, and important by nature. To perform these tasks such as a research or project, the human experts need considerable skill and knowledge. Such knowledge tasks can deal with the acquisition, creation, packaging, and application of knowledge, and can be increasingly identified inside the core competencies of modern research.

Given research characteristics, a complete automation of knowledge management, or even a very detailed partition into subtasks—is usually not feasible because there is no predetermined task sequence that, if executed, guarantees the desired outcome. In fact, what we call knowledge tasks, or knowledge-intensive tasks, essentially amount to the notion of no guide or support during work processes; whereas the progress of each research assistant is invisible and hidden from each other, the RAS can be used to encode OM for professional group growth. If memory lost in an organization, not stored in OM, or is simply forgotten for learners directly without being recorded, then it represents a waste of resources, as future problem solvers will have to resolve old problems.

IT-supported computer-mediated communication systems, including email and bulletin boards, facilitate information sharing at both the organizational and the group levels. However, they are not intended to enable group collaboration or shared knowledge accumulation. Groupware

is a relatively new class of IT for collaborative working environments. Lotus Notes from IBM is a representative and highly popular application of commercial groupware, allowing users to transform unstructured textual documents such as email messages, and import them into databases [3].

Summarily, any knowledge management system is different from information system in terms of technique issues. The former requires participatory design such as networks of people, practices, and technology embedded in particular organizational contexts; the latter is operated by mechanisms instead. This study aims at developing a web-based RAS as community of practice of Knowledge Management System (KMS) for improving research performance.

2. Literature review

In this section, knowledge management, community of practice, and organizational learning supporting system will be reviewed as a foundation of this study.

2.1 Knowledge Management

Recently, knowledge management, organization learning, and situated learning are new focuses of learning. Organization learning becomes a hot research issue in industry and academic fields. On the one hand, knowledge management can be a tool for organizational innovation. On the other hand, the paradigm shift of learning perspective is from objective to subjective construction. New research orientation of learning has beyond individual's cognition to social cognition. Today, community of practice is identified as "having the same goal by participating process to reach organizational consensus". Therefore, learning is not an individual's journey, but a portfolio of participating, learning by doing, and recognition of development as time goes by.

Two main streams related to KM research are hardware and software facets. The former causes many KMSs to have been developed as cooperative tools for facilitating information sharing at both the organizational and group levels. The latter, Nonaka & Takeuchi [13] proposes KM as spiral movements in Figure 2-1. "Knowledge Management caters to the critical issues of organizational adaptation, survival and competence in face of increasingly discontinuous environmental change. Essentially, it embodies organizational processes that seek synergistic combination of data and information processing, capacity of information technologies, and the creative and innovative capacity of human beings"[13].

In this study, we address “How do system developers ensure active RAs’ participation RAS and improve research performance?” In order to resolve these questions, we create a model of the communication among members of RAS. The model highlights important factors and relates them to one another. The factors are: the results of RA processes (including intermediate results); RA’s emails, and task ontologies of system description and resource discovery.

In terms of classification systems for knowledge management practices, the most widely cited is Nonaka’s model (in Figure 2-1) as Socialization-Externalization-Combination-Internalization processes. That model proposes four classes of knowledge creation based on the conversion of knowledge between tacit and explicit forms.

Those types of knowledge can be extended for sharing at different aspects from inside to outside such as personal, group, organization, and inter-organizational aspects. The spiral structure of knowledge shifting makes knowledge being shared by fostering innovation, or refinement in community of practice continuously.

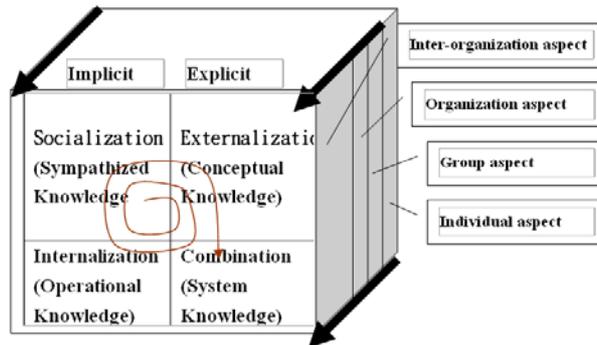


Fig. 1: Knowledge sharing and shifting (Data source : Nonaksa & Takeuchi, 1995)

According to Gray & Chan [5], knowledge management practices are categorized by members’ contributions to problem solving efforts. Problem solving is a mechanism for learning; individuals and organizations develop a better understanding of their environment by recognizing and resolving problems and opportunities. The Knowledge Management Framework (Figure 2-2), therefore, provides an important conceptual link between the emerging body of knowledge management literature and the established literature on decision making and problem solving.

Two facets are identified by vertical and horizontal axes: Class of problem and process supported. In this framework, four categories are identified as below,

- New problem in (1) is identified or discovered.
- Problems have been resolved in (2).
- Knowledge is shared by a group or organizational level (3).

- Knowledge is distributed as personalized knowledge by interpretation (4).

The process from (1) to (2) is called “Identification”. Similarly, new personalized knowledge stored as organizational memory from (2) to (3) is called “preservation”. The process from (3) to (4) is called “Distribution” while individuals attain OM by distribution. Thus, (2) and (3) belong to OM level whereas (1) and (4) belong to individual levels. It is worthwhile to mention that the process from (4) to (2) is called “Re-inventing the wheel” and the process from (2) to (4) is called “Memory loss”. Both of them are organizational loss in terms of problem solving.

		Class of Problem	
		New or Unique	Previously Solved
Process Supported	Problem Recognition	Encouraging Serendipity(1)	Raising Awareness(4)
	Problem Solving	Knowledge Creation(2)	Knowledge Acquisition(3)

Fig. 2: The knowledge management framework (Data Source : Gray and Chan, 2000)

Summarily, the model adopted in RAS is based on two distinctions—dealing with four categories of discourse and two levels of knowledge. The four categories of discourse are based on projects from National Science Council of Taiwan. Each member of RAS is assigned to one of the four NSC projects. Therefore, if a RA is intending to locate some information or expertise, then he/she can track to right appropriate folders by individuals’ project attributes. As for two levels of knowledge, it consists of detailed documents such as intermediate results in individual folders and formal documents in public folders like papers to be put at public areas.

2.2 Community of practice

As organizations grow in size, geographical scope, and complexity, it is increasingly apparent that sponsorship and support of communities of practice—groups whose members regularly engage in sharing and learning, based on common interests—can improve organizational performance[20]. To build an understanding of how communities of practice create organizational value is very important for members who located at different places. As part of our research, communities of practice influence research outcomes. Although many of these are tied to

the specific research environment that each of the communities operated within, our intention highlights four areas of organizational performance that are impacted by ongoing activities of communities of practice. These include:

- Decreasing the learning curve of new RA.
- Responding more rapidly to RA members' needs and inquiries.
- Reducing rework and preventing "reinvention of the wheel".
- Spawning new ideas for research group.

Summarily, we adopt that communities of practice lead to positively influence research performance in this study. These dimensions include connections among RA members who may or may not have built a sense of trust, mutual obligation, and context that can be shared by RA members. Interactions among communities of practice in RAS might be useful tools to turn an organization into higher group performance.

2.3 Organizational Learning Support System (OLSS)

Organizational learning is as important as positive cash flow for an organization's survival in today's business, administration, or education field. With the range of information technology available today, the potential roles of IT in organizational learning are increasingly evident and important. The definition of a learning organization, adopted in this study, is "skilled at creating, acquiring, and transferring knowledge, and at modifying its behavior to reflect new knowledge and insights." [1].

For one hand, organizational knowledge creation and distribution demands a disciplined approach. Organizational knowledge is the accumulation of synthesized individual knowledge accepted by an organization's members for its validity and utility [1]. To become a kind of shared knowledge, individual knowledge must undergo several steps: presentation of a problem; elicitation of opposing views and critiques from peers; and synthesis of the different views. An OLSS must be designed to facilitate this process by providing a platform for individuals to share and improve their knowledge and understanding of their problems.

On the other hand, ontology can be used by such a group to express the common ground and to annotate their information documents. A broker can make use of these annotations to provide intelligent information access. The ontology describes the competence of the information broker, i.e. the area in which it can provide meaningful query response. In consequence, several information brokers will arise while an online meeting is held and discussed among research assistants, each covering different areas or different points of views on related areas. Facilitators such as advisor or senior members guide each member through this knowledgeable network superimposed on the web. Therefore, work on relating and integrating ontology can be helpful to evolve on the Web from a Document Repository to a Knowledge Base.

Summarily, OLSS provides a hierarchical categorization scheme based on topics and a network of ontological space for creating a shared understanding of research problems and decisions. The OLSS plays a role to change OM by Document Repository to OM by a Knowledge Base. A study of the effect of groupware, however, points out there is no evidence of changes in the degree of collaboration among organization members unless facilitators guide each member of OLSS through this knowledgeable network.

3. System analysis / Design

Organizational memory includes goals, plans, handbooks, manuals, and standard operating procedures. The reason why we set up RAS as a tool to enhance research performance is that a professor must guide over 10 graduate students during academic years. Advisor and his/her graduate students form a star-like structure in Figure 3-1.

To reduce advisor's overloading and promote research performance, peer-to-peer communications are often ignored while some techniques in programming language or research change rapidly during recent years. Thus, new network-like structure in Figure 3-2 is designed as organization memory. All members can share OM via Internet. A graduate student can call for help by posting his/her question. Later on, he/she might attain others opinions or comments. In this section, IT-supported tools and portfolio are examined below.

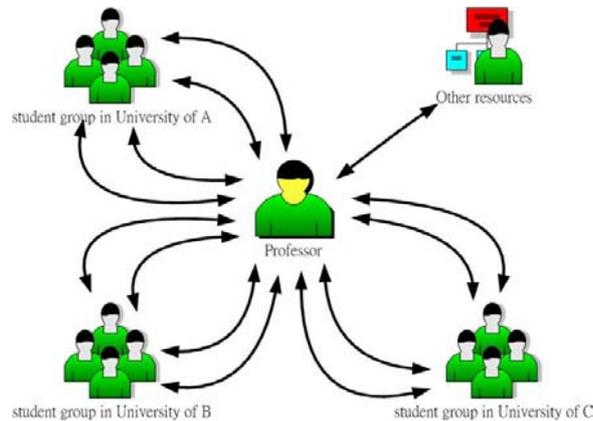


Fig. 3: Advisor as center of consultant

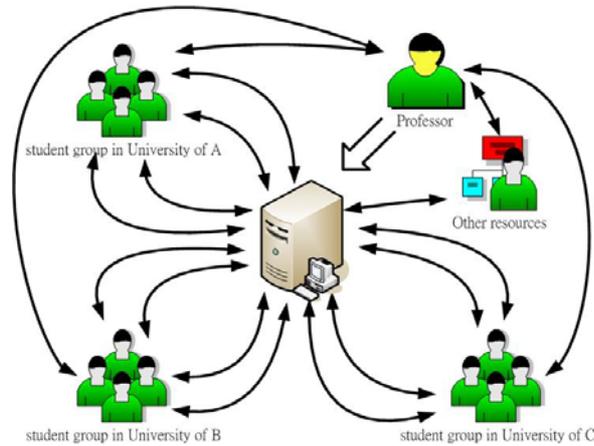


Fig.4: A network structure of RAS

3.1 IT-Supported Tools at RAS

Our objective is to examine organizational learning from an IT-support perspective, analyze requirements for organizational learning support system, and discuss current developments on RAS. RAS adopts two IT-supported tools: RAS as asynchronous tool and JoinNet at K12 for 3-hour online discussion every week as synchronous tool. The former is designed for repository such as informal or formal documents. The sense of community in asynchronous learning of RAS can be conducted and shared by RAS by discussion forums as cooperative activities. The latter is group online discussion. Digital School (DS), an e-learning environment with tools for learning community, is developed at National Sun-Yet-Sen University of Taiwan. Those tools, which emulate a virtual classroom, are primarily designed for synchronous/asynchronous sharing of resources and sense of community. It enables those RA members to share whiteboard synchronously and also allows the advisor to dynamically manage the e-learning session. Thus, teachers or students can access to these resources by joint browsing while it is necessary to share these resources synchronously. Figure 3-3 shows a snapshot of online discussion.

In this study, we believe that organizational learning typically ignore the role of individual learning by treating organizational learning as a simplistic extension of individual learning. Therefore, we argue that each member of RAS should open their mind to “give and take” from this OM of RAS.

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Fig.5: Online discussions with whiteboard on Join Net at Digital School

Summarily, RAS supports individual learning and shared results. The former includes operational vs. conceptual learning. The completed records of problem solving have potential impact for group learning and provide advisor to track research progress of individuals. The latter is designed for reducing exploration time while a question occurs at individuals.

3.2. RAS as portfolios

RAS has been used to record new problems raised to be resolved or advisor's new requests at meeting every Friday night. In the meeting time, all RA members are scheduled to report an article or show his/her progress by Join Net. Figure 3-4 shows that detailed work-flow processes in RAS. The meeting records will be refined by RAS members and attain finer quality of papers for publication finally. If the inter-mediated problems are still un-resolved, then the advisor will keep track on what the RA has done at meeting held next week. Therefore, the completed processes will be recorded like a health system to keep patients' records. Those records will be a part of OM for later references.

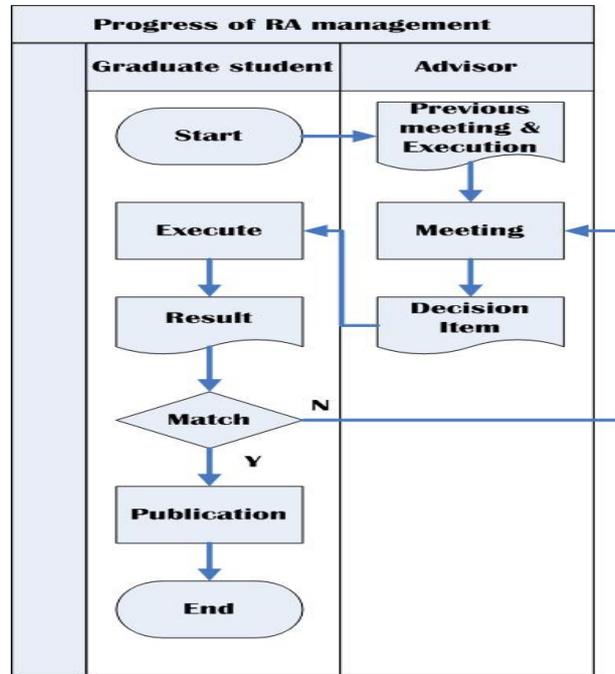


Fig.6: Flowchart of Tracking Progress of RAS management

4. Research results

In this section, we present three preliminary results while RAs just began four months ago. Those are: RAS portal, technical issues in RAS, tools at RAS.

4.1 RAS framework and portal.

As information system represented in special context in terms of domain knowledge, RAS consists of three layers from abstract to concrete structure. Those layers include "application" such as user's interface, "description" of context, content, and structure access, and "object" levels shown in Figure 4-1.

At the lowest level, it includes structured documents, informal documents, database, and members' email in "contacts to RAs". Similarly, knowledge description by ontological supporting is well-designed for information processing and retrieval at the mid-level. Basically, ontology is defined as "a specification of a conceptualization". In this study, those names of RAS folders are represented as knowledge conceptualization such as the objects, concepts, and other entities that are assumed to exist in our research area of interest, and the relationships that hold among

them. As for application level, members can get RAS on the web by a variety of devices such as PDA, mobile phone, or desktop computer.

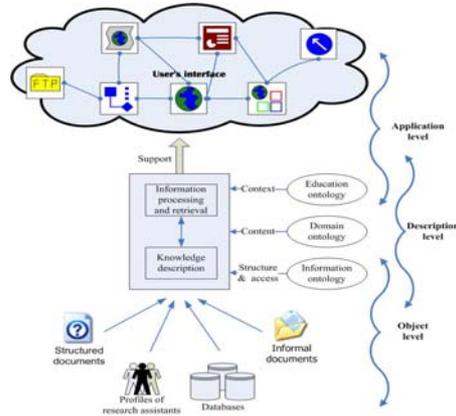


Fig.7 : Ontology-supported description at RAS

The layer classification focuses on acquiring weakly structured on-line information sources:

- Acquiring: Each RA has his/her own research topic and specialist. RAS forms syntax and semantics of semi-structured information sources by three layers notation. Those terms enable automatic acquiring and view definitions of RAS.

For acquiring tasks, ontologies are the key asset in achieving the described functionality. Ontologies are used to annotate unstructured information with structural and semantic information. Ontologies are used to integrate information from various sources and to formulate constraints over their content. Finally, ontologies help to improve each RA access to the information. Users can define their own personalized view, their user profile, and their information in terms of ontology.

Based on ontology-supported principle, public forum, progress of research assistant folders, paper publications, and technical forum are classified in Figure 4-2. The classification is helpful for RAS' members to locate information quickly. If a RA has trouble in programming on ontology, then he/she might go to technical forum first.

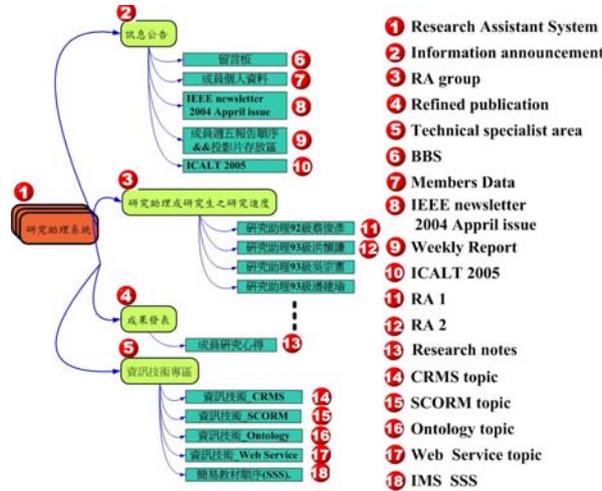


Fig.8: The structure of RAS

Like regular portal, RAS members are required to register at initial phase since it is a closed system. It is, however, an open-minded system for all members after they are permitted as members of RAS. The portal of RAS is shown in Figure 4-3

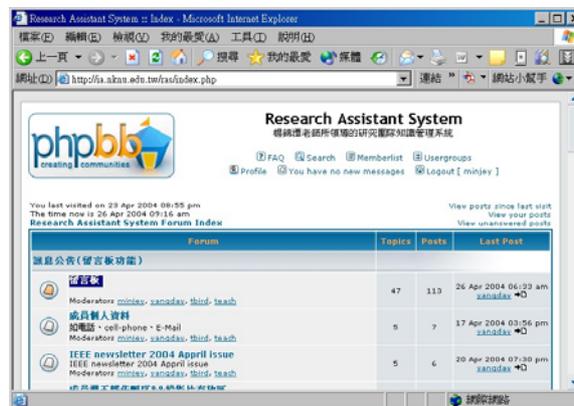


Fig. 9: RAS Home page

4-2 Community of practice and problem solving in RAS

The scenario is presented by a discourse on the programming areas. The interactions of problem solving among three RAs, Dannie, Tbird, and Minjey, are described below:

- Dannie asked for help while he was stuck at programming on how to save Chinese characters at server side.
- Tbird offered what his experience was in the similar case.

- Minjeay also proposed his opinions to this issue.
- A solution for the issue was resolved by Dannie finally.

Therefore, RAS plays as a bridge that individual problem solving is inspired by the way the groups of experts coming together and solving problems that the individuals could not make it on their own. The issue raised and showed the power of community of practice. As processes are supported asynchronously while different classes of problem are occurred. These processes had been recorded as OM for later use by similar cases. It also reduces the overloading of advisee while similar questions happen again.

4.3 Technical issues in RAS

To some extent, RAS is a legal repository or an important asset for each RAS member. Each member can retrieve/upload any documents or insights while one feels appropriate at anytime and at anywhere. However, it also causes some troubles while the power supply system fails sometimes. Therefore, we upgrade hardware by RAID array-disk for mirror and UPS for maintaining system reliability.

4.4 Tools at RAS

Two tools are developed for administration. One is global search and evaluation. The former might be helpful while a RA wants to find particular subject without any guidance. Figure 4-4 shows some criteria in RAS query tool and Figure 4-5 displays the results that respond to query from Figure 4-4.

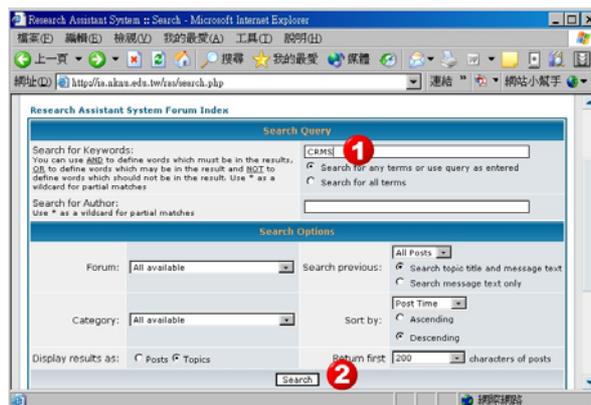


Fig.10: A snapshot of query

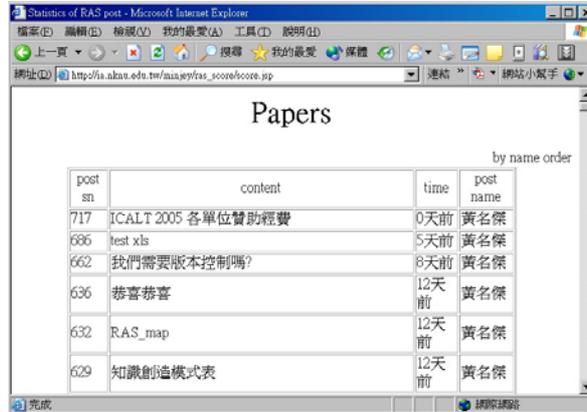
As we know, evaluation is always used to enhance performance in any system. For example, teachers host a mid-examination during a semester.

The evaluation results give insightful clues for both teachers and students. Three evaluation styles in RAS are: diagnostic, formative, and summary evaluation. The diagnostic evaluation gives members of RAS critics while the advisor or peers might join the online meeting or be content reviewers of RAS. As for formative and summary evaluations, the differences between them are that one is for short-term evaluation, such as midterm examinations; the other for long-term evaluation such as final examinations.



Fig.11: Query results responding to Figure 4-4

Three performance evaluations are: product evaluation such as paper published at international conferences or journals, performance evaluation such as demonstration or oral report on specific articles, process-focused evaluation such as learning logs or questioning in online meeting. Through peers' reviews, the group performance has shown better than that of past four months. Thus, RAS plays as an organizational learning support system that individual problem solving is inspired by the way the groups of experts coming together and solving problems that the individuals could not make it on their own.



The screenshot shows a web browser window titled 'Statistics of RAS post - Microsoft Internet Explorer'. The address bar shows the URL 'http://fa.akas.edu.tw/mis/efas_score/score.sp'. The main content area is titled 'Papers' and includes a sub-header 'by name order'. Below this is a table with the following data:

post sn	content	time	post name
717	ICALT 2005 各單位贊助經費	0天前	黃名傑
606	test xls	5天前	黃名傑
662	我們需要版本控制嗎?	8天前	黃名傑
636	恭喜恭喜	12天前	黃名傑
632	RAS_map	12天前	黃名傑
629	知識創造模式表	12天前	黃名傑

Fig.12: RAS summarizes the posted papers.

Figure 4-6 shows a summary of posted papers by a member of RAS. In terms of statistics report, the advisor will ask some RA members, who are inactive in RAS, to make more efforts on RAS, which help make RAS members more active on the platform.

5. Conclusions and Discussions

Organizational learning is as important as positive cash flow for an organization's survival in today's global market. With the range of information technology available today, the potential roles of IT in organizational learning are increasingly evident and important. Organizational memory is broadly defined as consisting of everything retrievable within an organization. Organization memory is more specifically defined as "The means by which knowledge from the past is brought to bear on present activities and may result in higher or lower levels of organizational effectiveness" [13].

As Malhotra points out that knowledge management system (KMS) has two different models [19]: Model 1 and Model 2 KMS. The former aims at routine and structured information processing, whereas the latter focuses on non-routine and unstructured sense making. The RAS is dynamic as it is based upon ongoing reinterpretation of data, information, and, assumptions while pro-actively sensing how decision-making process should adjust to future possibilities. From a pragmatic perspective, the dynamic representation of knowledge provides a more realistic construct where human and social interactions are present while situating this construct more proximal to performance outcomes. This is a typical model for combing the technology and learners' endeavors to make research performance in a better shape via collective intelligence.

This study is to design RAS in educational practices. Two modes of learning, including synchronous and asynchronous e-learning

environment, have been explored, and how RAS as OM environment in terms of knowledge management perspective has been fully discussed. In addition, the community setting for asynchronous RAS has been designed based on research practice and distributed locations of graduate students at southern Taiwan. While research is to explore the unknown world, each member of RAS should be based upon mutual trust in terms of achieving commitments. Through RAS's open space to dynamic and constructed sense-making and self-control for creativity, the RAS can increase returns as days go by. Whereas the RAS model is different from traditional information system in terms of pre-definition of outcomes, it also shows that human must work together with tools to explore the potential in research.

We have successfully deployed and tested RAS in shared sessions in both synchronous and asynchronous ways. Based on our experience, the most interesting thing in RAS is IT-supported professional growth. This enables members of RAS to carry out research with minimum interruptions. The ability to dynamically bring any resource or documents into RAS is a key feature enjoyed and emphasized at RAS, and those objects become OM.

We believe that RAS can be used under different educational research teams. These tools can be further enhanced in using metadata to give each member of RAS different perspectives of the same problem. Furthermore, all systems must evolve with the turning of time. Consequently, we would like to go further in the coming years. Three key issues for future research are summarized as follows,

(a).The RAS team will develop and keep on shifting current system into “intelligent system”, which means that some tedious tasks will be replaced by intelligent agents. For instance, personalized information will be dealt by cooperative filtering, or information recommendation being dealt by data mining techniques

(b).RAS has a collection of content, learners' profiles, and discussion forums. Those sources might be analyzed or mined to identify the best recommendations once a question occurs within individuals. He/she might fill in specified forms, and intelligent agents will propose their recommendations. The rules discovered through data mining can be applied to such kind of recommendations. Then, “push services” and “intelligent agent” technology will support users in accessing this knowledge

(c).Members of RAS cannot make decisions on “how to do next” unless they are emotionally involved in terms of meaning, consensus norm, or responsibility in such a society. In other words, technology can only serve as auxiliary tool, and a project leader needs to learn how to use RAS to support collaborative work. Future researchers might explore such a social network or collaborative work rather than technical issues.

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