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A STUDY ON THE EFFECT OF USING A KNOWLEDGE MANAGEMENT SYSTEM ON DESIGN EDUCATION

Po-Ying Chu[1], Li-Chieh Chen[1] and Wan-Li Wei[2]

[1]Department of Industrial Design, Tatung University, Taipei, Taiwan, juby@ms1.hinet.net, lcchen@ttu.edu.tw.

[2]Department of Product Design, Ming Chuan University, Taoyuan, Taiwan, wanliwei@mcu.edu.tw

ABSTRACT:

The importance of peer learning in design education has been recognized recently. To facilitate the peer learning among students, a Design Knowledge Management System (DKMS) was constructed. This system provided a web-based platform for students to share their knowledge and perform peer-to-peer recommendation among good works. In addition, an experiment was conducted in different courses within three universities. Students in these courses were asked to submit their homework through this system for the duration of experiments. Their performances of learning were then evaluated by the instructors. Furthermore, after the experiment, a questionnaire survey was conducted to study their

satisfaction levels of using this system. The result showed that the function of sharing and recommendation in the proposed DKMS contributed to high learning performance and great satisfaction.

Keywords: Design Education, Knowledge Management, Peer Learning, Recommendation

1. INTRODUCTION

It was recognized that peer learning is unique to the art and design disciplines (Maldonado et al., 2006). To facilitate the peer learning, some research groups attempted to construct web-based platform for students and instructors to share their knowledge (Boghetich et al., 2002). Although some available systems provided user interfaces for participants to upload and share information, most of them did not provide the function of peer-to-peer recommendation. To address this issue, a Design Knowledge Management System (DKMS) was built in this research. The proposed system fully provided a web-based platform for students to share their knowledge and perform the peer-to-peer recommendation among those good works. The architecture and evaluation of this system n will be addressed in the following sections.

2. LITERATURE REVIEW

An increasing number of recent publications and empirical studies have reassessed the positive contribution that Knowledge Management (KM) can make for learning, problem-solving, and creating core competencies (Wu and Lee, 2007). With the advent of Knowledge Management technologies, some researchers reported that colleges and universities have significant opportunities to apply knowledge management practices to support every part of their mission (Kidwell et al., 2000). Although Knowledge Management has been proved to be an effective strategy in the software engineering education (Aurum et al., 2004), the application of KM in design education has not got much attention. There are some peculiar characteristics of design knowledge. For example, the typical outputs of design process are 3D or 2D artworks, not just texts or simple graphics (Boghetich et al., 2002). From the aspect of perfection, Bangle (2001) has pointed out that engineers think perfection is

physical and measurable, but designers consider perfection as ephemeral and spiritual. In other words, design knowledge is not like explicit knowledge which can be expressed in words and numbers. On the contrary, design knowledge is mostly tacit and based on practice and experience (Johannessen and Olsen, 2003). Based on similar points of views, the research group from Italy, the Dept. INDACO, Politecnico di Milano, also identified the unique characteristics in industrial design education, and therefore developed a Knowledge Gateway for sharing expertise and learning experiences (Boghetich et al., 2002). Furthermore, it was recognized that the reflection of students and instructors is an essential factor for effective learning and teaching in design education (Agouridas and Race, 2007). The practice of reflection could be strengthened by active peer learning. However, there were few research projects discussing the development of KM systems to facilitate peer learning for college students majored in art and design disciplines.

3. RESEARCH METHOD

3.1. SYSTEM ARCHITECTURE

The DKMS kernel consists of five modules and two databases (Fig. 1). The paradigm upload module allows the instructors to assign homework and provides representative paradigms. These paradigms are stored in the database. Students use homework upload module to submit their homework. In addition, students can view the work from peers and provide their recommendation ratings through the rating module. Based on the frequency of clicking and the result of recommendation, the recommendation module calculates the priority ratings and then recommends peers' works according to these ratings through the notification and sharing module. The system is web-based and constructed with a database management system using SQL Server, and the ASP.NET programming tool.

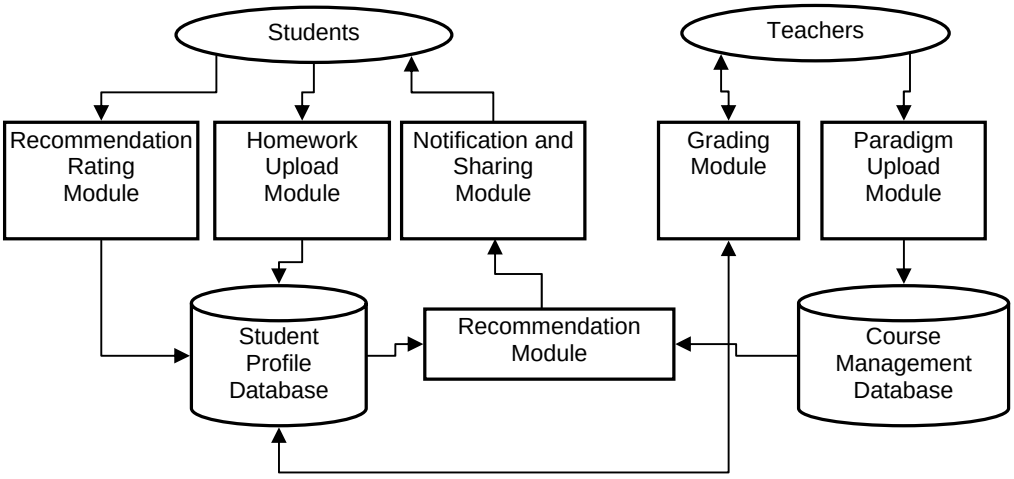

Figure 1: Architecture of the DKMS

Through the user interface, instructors can assign homework, upload the specification, and benchmark the best practices as references for students. If the homework deadline or some conditions occurred in this course, the system will remind instructors by e-mail automatically, and show “alarm” or flash “red-light” signal simultaneously when they login into DKMS. In addition, teachers monitor the progress and administrate their courses via this system. For example, they can verify who has not submitted assignment yet, and check the student’s grade distribution and sorting these grades (Fig. 2). After the appointed dates of submission, the DKMS will synchronize all students’ works from the server. Thus teachers can review and grade student’s homework, and then release the results to students (Fig. 3).

Figure 2: Teachers can monitor and administrate their course while the system provides alarms.

Figure 3: Teacher can review and grade student's homework after the DKMS synchronizes all students' works from the server.

On the other hand, students can be notified about their assignments by e-mail from DKMS immediately. Then, they can login and download the paradigm or click to browse other students' works which are recommended by the DKMS automatically. Before the deadline of assignments, students are encouraged to submit the progress of their homework by uploading graphic files, animation files, or other format at their convenience. The history of their submission will be recorded in the database. Therefore, they can browse the history of peers' works. Besides, they can recommend other students' homework which will affect the recommendation list derived by DKMS (Fig. 4). In other words, DKMS facilitates peer learning, and learners can browse, learn, or query in order to improve the quality of their homework or shorten their learning time.

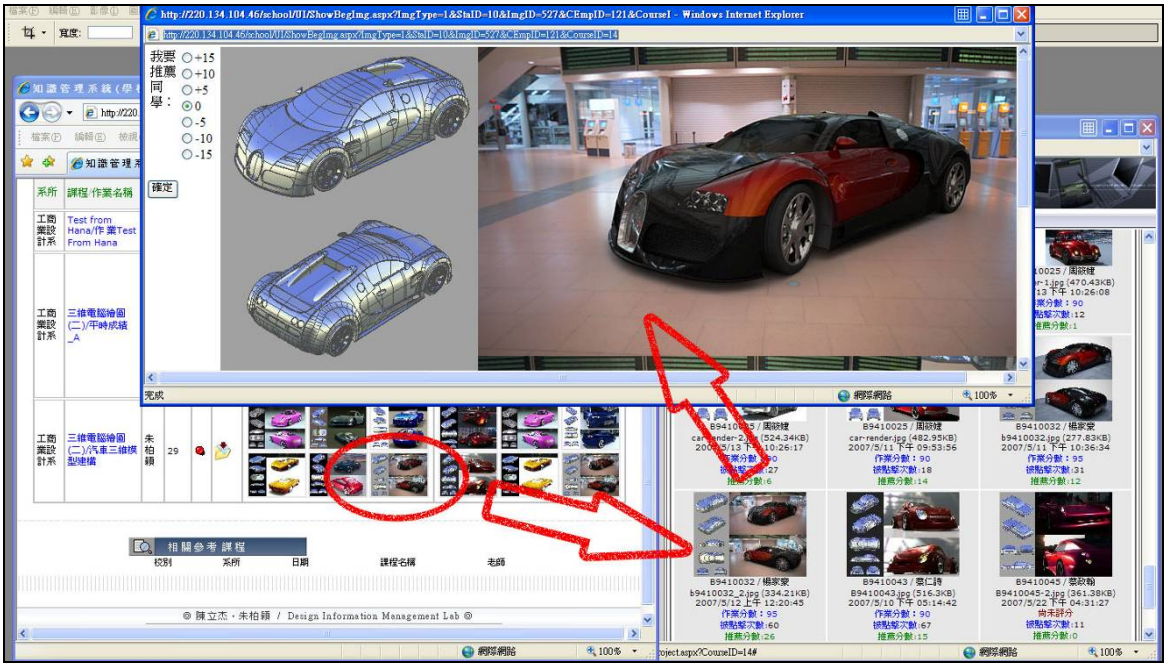

Figure 4: Students can search, download, and browse paradigm and peers' work which were recommended by DKMS.

3.2. SYSTEM EVALUATION

In order to investigate the influence of this system, a two-phase study was designed to explore the effectiveness of DKMS, including both of the students' grading and satisfaction. There were 75 students from 3 universities, denoted as NE, NT and CY, participating in the experiment. In university NE, 17 students took the course entitled "Form Design and Modeling." In university NT, 22 students took "Advance 3D Computer Graphics." In university CY, 38 subjects took "Image Processing and Design." These courses include the pedagogy to help students understand the method of designing product forms and effective tools to present their design concepts through visual communication. In the first phase, during a period of two month, teachers assigned homework, asked students to submit their works by the appointed dates, and then grade them. Instructors and students use this system as the platform to assist knowledge sharing. The teaching and learning activities progress as regular courses. Students submitted their homework through the user interface in Figure 5. They were also encouraged to search and download the related learning paradigm, browse other students' work which was recommended by the DKMS to help them complete their homework through the user interface shown in Figure 6.

Figure 5: The user interface to submit students' homework

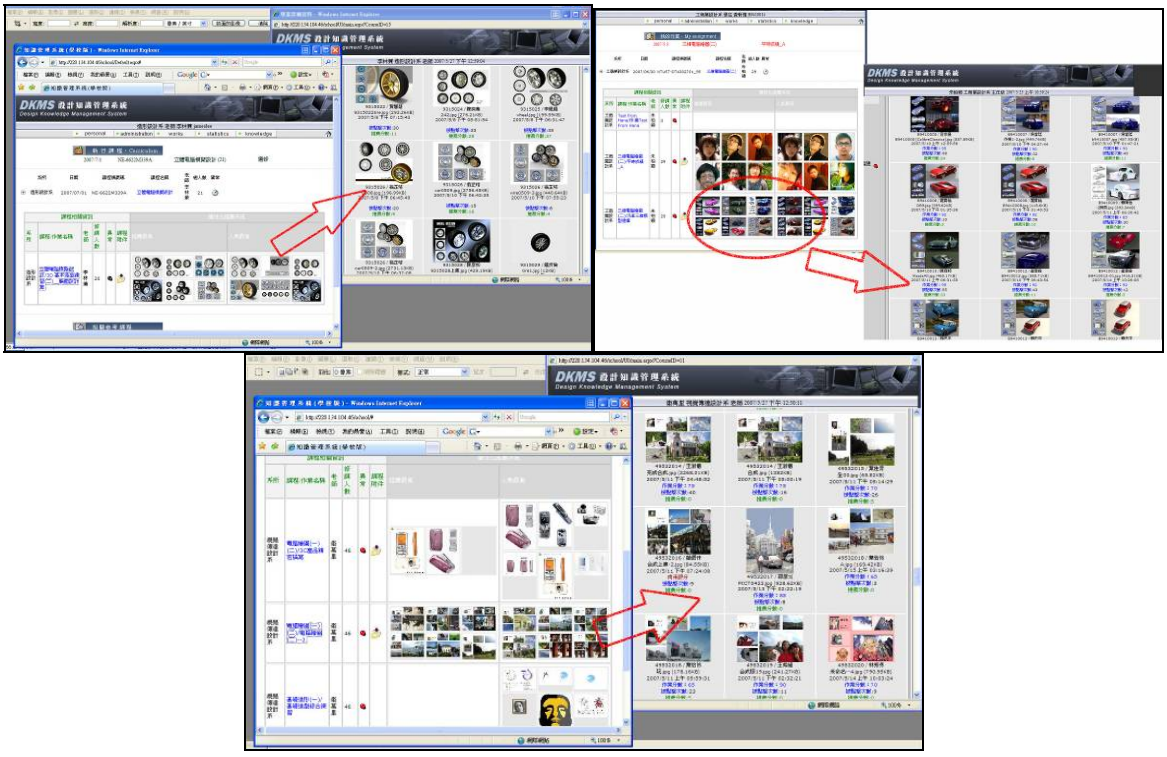

Figure 6: Snapshot of knowledge sharing function in university NE (Form Design and Modeling), university NT (Advance 3D Computer Graphics), and university CY (Image Processing and Design).

In the second phase, a questionnaire survey was conducted to identify the factors that support or impede the acceptance of the DKMS as an assistive tool for design education. Participants were invited to fill out a questionnaire which consists 18 detailed items that belonged to five categories, including acceptance of using the DKMS system, usability of user-interface, e-mail and deadline reminder, browse other students' homework, and recommend other students' homework. Students indicated their degree of satisfactions with respect to each item through a 5-point Likert scale, in which, 5 indicating very high degree and 1 indicating very low degree of satisfaction.

4. RESULT AND DISCUSSION

4.1. THE EFFECT OF DKMS ON LEARNING PERFORMANCE (GRADING)

In order to clarify the effect of sharing and recommendation module in DKMS on learning performance, grading of assignments from three universities were analyzed after the experiment. Based on the click-through frequency of viewing peers' works during the experiment period, students were divided into 2 groups each university. Students in group A have low click-through frequency, while students in group B have high click-through frequency. The mean and standard deviation of grading for all subject groups are shown in Table 1. These assignments were graded separately by several instructors in three universities. Furthermore, the results showed that students with high click-through frequency (group B) were significantly superior to those with low click-through frequency (group A) across three courses in different universities (University NE $t_{(15)}$= 2.353; p=.033 <.05; University NT $t_{(20)}$= 2.579; p=.018 <.05; University CY $t_{(36)}$= 2.783; p=.009 <.05). This indicates that viewing and recommending peer's works has positive effect on the performance of learning.

Universities	Number of Students	Group	Students in Group	Mean	Std. Deviation
NE	17	A	8	79.4375	4.82136
		B	9	83.6667	2.30489
NT	22	A	9	87.6667	2.44949
		B	13	90.6154	2.75495
CY	38	A	17	60.8824	12.02020
		B	21	71.6667	11.76152

Table 1: Group statistics

4.2. DKMS SATISFACTION

In order to study the differences between groups A and B in DKMS satisfaction, the mean and standard deviation for five aspects were calculated across three universities (Table 2). Based on the result of t-test, students in group A and B had no difference in their degree of acceptance of using DKMS ($t_{(75)}$= -1.871, p =.065 >.05). Participants in two groups agreed or strongly agreed with the usability of DKMS user-interface ($t_{(75)}$= 1.228, p =.223 >.05) and the function of e-mail or alarm reminder for their assignments ($t_{(75)}$= -1.718, p =.090 >.05). Finally, students in both groups reported high satisfaction on browsing peer's homework and recommendation function ($t_{(75)}$= -1.240, p=.219 >.05; $t_{(75)}$= -.345, p=.731 >.05). Overall, the result of t-test indicates that there is no significant difference between groups in their satisfactions. Since the means are all greater than 3 within five-point scale, the findings reflect a highly positive attitude towards the DKMS.

DKMS satisfaction in Five Aspects	Group	N	Mean	Std. Deviation
Acceptance of using DKMS	A	34	3.7353	.89811
	B	43	4.1163	.87856
	Total	77	3.9481	.90170
The usability of user-interface	A	34	4.1765	.83378
	B	43	3.9070	1.04229
	Total	77	4.0260	.95936
e-mail and alarm reminder	A	34	3.2353	1.30405
	B	43	3.6977	1.05864
	Total	77	3.4935	1.18791
Browse other students homework	A	34	4.2941	.83591
	B	43	4.5116	.70279
	Total	77	4.4156	.76693
Recommend other students homework	A	34	3.9706	.86988
	B	43	4.0465	1.02245
	Total	77	4.0130	.95275

Table 2: Group descriptive statistics

4.3. THE RELATIONSHIP BETWEEN THE CLICK-THROUGH FREQUENCY AND THE RECOMMENDATION FREQUENCY

After the experiment, the relationship between the click-through frequency and the recommendation frequency was studied. However, there is no correlation between these statistics. It indicates that students may have interests in clicking and viewing peers' works, but unwilling to recommend them. There may be numbers of possible explanations for such a result. For example, there is no good work for them to recommend, or some of them have tendency to browse the work from limited students who used to have good performance. Furthermore, oriental students may not get used to criticizing and expressing their judgment on peers' works.

5. CONCLUSION AND SUGGESTION FOR FURTHER RESEARCH

This research has demonstrated the effectiveness of proposed Design Knowledge Management System. The module of sharing and recommending peer's works have a great of contribution contribute to learning. In addition, students in three courses from different universities were satisfied with the current system.

Although the current system was helpful, the paradigms provided for instructors were not sorted based on individual differences. Besides, the algorithm of recommendation list was not able to adapt for individual need. Moreover, the incentive of uploading the progress of homework and recommending peers' works needs to be carefully designed to enhance the participation of students when the system is widely deployed. These issues could be addressed in further research to strengthen the system.

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