Key factors affecting knowledge transfer success in CDIO project designation

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ABSTRACT

Through the intensive involvement of implication CDIO in teaching procedure, more specific projects are designed to fulfill specific training purpose including knowledge transferring, team-working, practical application etc. used in engineering class.

Based on theory of knowledge transfer, different impact factors measure students' achieving level corresponding, including knowledge context, teaching context, recipient context and activity context. Questionnaire survey and Zero-order correlation coefficients are used to analyze the data from collected survey questionnaire of 400 engineering students in computer science class. The factors are:

1. Whether theoretical analysis project is better than practical application project for knowledge transferring?
2. Whether project for small group rather than project for single student is better for knowledge transferring?

Key word

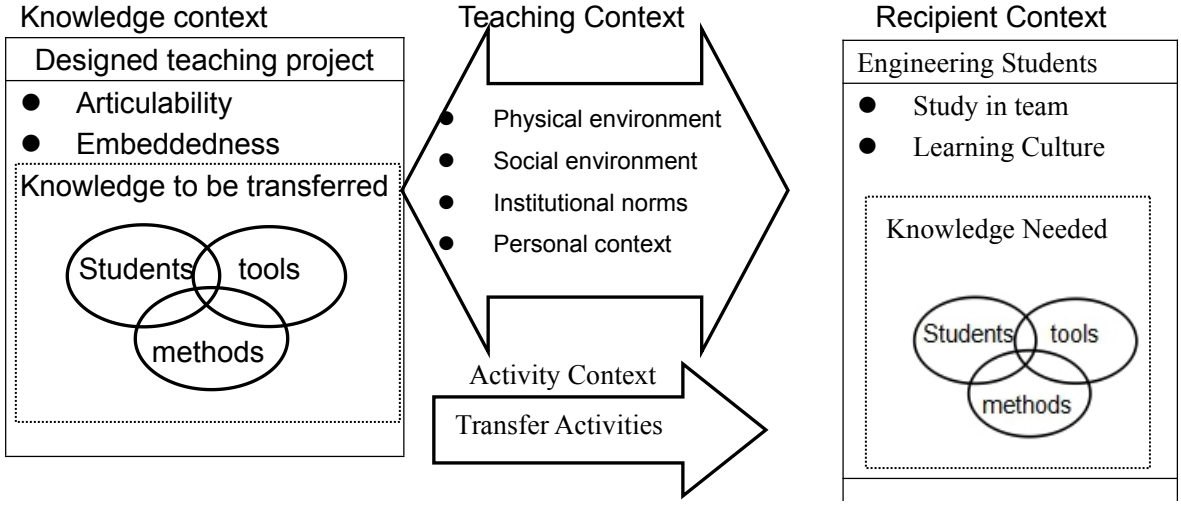
Knowledge transfer, CDIO Project designation, Questionnaire survey

1. Introduction

Knowledge transfer is a major concern in improving educational practice (Huberman 1990). Although, new teaching and communication technologies have made teaching process easier for students to access teaching content, there is still a large gap between teaching project designed by class designers and the engineering students learner used in practice. Anderson(1992) attributes the reasons for this gap mainly to project designers who offer contribute much more interest, time and effort to the production of new teaching project than to the dissemination of their teaching results. This then turns into a major barrier to the diffusion of designed teaching project to students. For other opinion, the reasons of this gap are attributed to students. So, the resistance of practitioners to adopt new knowledge of project designation and student's limited competencies and skills are some of the main handicaps for the appropriation and application of knowledge acceptance results. Whether the level of knowledge transfer is on the project designer or students, it is largely admitted that knowledge transfer between project designer and students should be further encouraged and promoted since it represents the only viable way to significantly reduce the gap between project designer and knowledge use.

This paper begins with a brief overview of knowledge transfer research from the engineering

teaching class with application CDIO method. Based on these research streams, Fig.1 presents a model of knowledge transfer success that includes four broad contextual domains, including knowledge context, relational context, recipient context and activity context.



Drawing on a delineation of the model, Zero-order correlation coefficients is used to analyze the data from the collected survey questionnaire of 400 engineering students in Digital Image Processing class. This paper aims to advance knowledge transfer in education by investigating the CDIO teaching process and the main affecting factors of knowledge transfer. The research findings should provide a better understanding of the knowledge transfer process in teaching, and suggests a number of key factors that can affect knowledge transfer success, with implications for actual CDIO engineering teaching environment.

2.Research variables

2.1 Knowledge context

As indicated in Fig1. Nine factors affecting knowledge transfer are grouped within four broader contexts. Knowledge context includes the transferred knowledge's articulability and embeddedness.

2.1.1 Knowledge articulability

Knowledge articulability is one of the importance factors affecting knowledge transfer success, which means knowledge can be verbalized, written, drawn or articulated(Bresman et al., 1999). Actually, people know more than they can explain, that is formed into non-verbalized, intuitive, and unarticulated.

Lippman and Rumelt (1982) argued that the replication of knowledge is more difficult to the extent that there is ambiguity about what factors, skills, or in the language of this study, what knowledge elements and sub networks, interactively define the function of interest. The greater the causal ambiguity, the more difficult is to identify the related knowledge elements. Causal ambiguity is often singled out as an important factor affecting knowledge transfer.

(Spender, 1996; Nonaka, 1994; Grant, 1996) Moreover, “poorly articulated knowledge is difficult to teach and learn”, such knowledge can be more difficult to transfer from teacher to students. (Hakanson and Nobel, 1998, p.13)

2.1.2knowledge’s embeddedness

Embeddedness is a recognized characteristic of knowledge. Knowledge can be embedded in students, teaching tools, and teaching methods under engineering teaching environment.(see Fig.1)It was found that when there were no personal transfers accompanying knowledge transfers, students often failed to learn who had expertise with different teaching tools and teaching methods.(Moreland et al.,2006)
Knowledge can also be embedded in certain kinds of class; knowledge that is in a more fluid than specific stage of its life cycle can be much harder to transfer, as identification of the appropriate knowledge elements to be shared is difficult (Abernathy and Utterback, 1978; Utterback, 2001)
Knowledge can also be embedded in multiple elements. Knowledge from designed project cannot be moved into an organization without the transfer of individuals with established patterns of team working together. Then, the transfer of more highly embedded knowledge, therefore, is expected to be more difficult than the transfer of less embedded knowledge.

2.2 Teaching context
The context of teaching includes anything in the surrounding environment: physical, social, institutional and personal, that influences teaching and learning.

2.2.1 Physical environment

The physical environment includes the classroom where teaching/learning occurs. For instance, the arrangement of the desks encourages some kinds of interactions and discourages others. Other factors such as lighting (enough to read by but not so much as to glare or be uncomfortable), heat (too warm makes people tired, too cold makes them uncomfortable and focusing on their physical feelings), time of day, and even the day of the week can make a difference.

2.2.2 Social environment

The social environment including the relationship between teacher and students and the cultural norms play a significant role in what can and does occur in the classroom. How friendly/approachable an instructor seems to be determines how outgoing students will be and the kind of communication that will characterize classroom interaction. The cultural norms: what is expected of a teacher and a student also have to be considered. This includes norms and attitudes regarding gender, age, class and ethnic roles.

2.2.3 Institutional norms

The institutional norms play a similar role as cultural norms but perhaps more strongly affect what behaviors the teacher and students see as acceptable. Is the teaching method being promulgated as the only acceptable teaching practice? Is teaching "outside the lines" an acceptable custom? Are teachers encouraged to take risks? Are students encouraged to take an active role in their own education? The culture of the institution determines what is valued/ rewarded/recognized in the context. Is teaching rewarded or does research have higher esteem and, thus, more currency. How is teaching evaluated? All of these are affected by the larger culture, but specifically designated by the institution's culture and the norms of the department within which the course is offered.

2.2.4 Personal context

The personal context which each instructor (and every student, for that matter) brings to the classroom includes stressors instructors may be dealing with in their daily lives. More importantly, personal context contains teachers' attitudes about learning, teaching, students, their own ability, and their subject matter. For instance, teachers who believe their students can learn the content and communicate that belief to students can create a self-fulfilling prophecy in much the same way as teachers who do not believe in their students' abilities can create failure, regardless of actual student abilities. More importantly, is teachers' ability to teach from who they are. Teachers, to succeed, must believe in themselves, their students and the importance and awesomeness of their subject.

2.3 Recipient Context

2.3.1 Study in team

Teamwork could strengthen the responsibility and friendship of the members in the group. In the group, it is less likely that someone will give up in the task casually, because it will spoil others ‘efforts and it is a kind of lacking responsibility that he may be scorned by others as well as lose recognition and expectation from others. In brief, many factors will stimulate everyone to take responsibilities in the group. Furthermore, teamwork brings us into communication with other like-minded people we do not know previously. We stick to each other through thick and thin that we will generate reliance on each other. With the help of others, we can get rid of loneliness and feel like there is someone we can turn to.

2.3.2 Learning culture

The need for a culture of learning process in class to facilitate students’ learning in general, and knowledge transfer specifically has been emphasized by many researchers (Aubrey and Cohen, 1995). Even when knowledge is transferred to a willing recipient, the transfer will only be effective when the knowledge is retained, while the knowledge may not be nurtured and further developed if learning is not considered as importance, because the slack required to enable people to think and discuss, and for learning groups to emerge, may be sacrificed in the name of efficiency (Stewart,1996). Recipients, here we mean students, with an extensive set of learning routines and learning competencies designed to retain and nurture transferred

knowledge, with a learning culture, may achieve greater knowledge transfer success.

3.4 Activity context

The knowledge transfer literature identifies three interdependent types of knowledge transfer activities, including those focused on assessing the form and embeddedness of the knowledge; those focused on establishing and managing an administrative structure through which differences and issues between the students can be accommodated and reduced. During the implement of CDIO teaching method, we point activity context as knowledge transferred into practice.

4. Methods

4.1 Questionnaire survey

This research used the total design method mail survey questionnaire approach to sample students of computer department from second year to fourth year; the total number is 400 students. This target sample was selected because the transfer of knowledge occurred in CDIO model of engineering teaching class.

Twenty-five usable responses collected over 6-week period were obtained from a final sample of 362, for a response rate of 81%. The respondents were predominately male students (cause there is more male students than female students in computer science department). 25% of the respondents were sophomore students, 34% were junior students, and 41% were senior students.

4.2 Construct measurement

The fundamental theme of the research model of this study is nine knowledge commitment related items from Pierce et al. (2001) ,to provide a robust measure of transfer success.(Alpha=0.76);

For knowledge context, how easy it was to locate and extract the information needed to understand the knowledge (alpha=0.74); How quick and easy it is and how much experience it takes for students to become capable in using the knowledge (alpha=0.61)

For teaching context, four perceptual questions were used where respondents were asked to assess the extent to which the designed teaching project and students has the knowledge based necessary to easily understand how transfer knowledge, and the extent to which the overlap of knowledge bases was cause for difficulties in communication. (Alpha=0.63); the social environment in the teaching class involved in designed project is measured with Alpha=0.83.

For recipient context, index of the testament for study in team and learning culture will be alpha=0.73 and alpha=0.76.

The final activity context examined in this study will be showed in their means and standard deviations are reported in the Appendix A.

5. Results and discussion

Table 1. Zero-order correlation coefficients (n=162)

S.no.	variable	mean	S.D	1	2	3	4	5	6	7	8	9
1	Articulability	20.9	4.87	1.0								
2	Embeddedness	8.67	3.33	0.264	1.0							
3	physical environment	1433	2303	-0.243	-0.039	1.0						
4	social environment	8.59	2.6	0.04	0.229	0.116	1.0					
5	institutional norms	4.98	2.04	0.034	0.243	-0.067	-0.004	1.0				
6	personal context	2.52	1.71	-0.21	-0.128	0.123	-0.121	-0.512	1.0			
7	study in team	5.22	1.74	-1.11	0.09	-0.094	-0.021	-0.006	0.25	1.0		
8	learning culture	10.58	2.71	-0.21	-0.127	0.126	-0.181	-0.265	-0.856	0.352	1.0	
9	transfer activity	3.12	1.08	0.004	0.119	-0.221	-0.006	0.327	0.12	-0.21	-0.265	1.0
10	transfer success	63.1	10.5	-0.489	-0.482	0.081	-0.315	-0.345	0.231	-0.013	0.312	0.036

Table 1 calculated zero-order, bi-vibrate correlations between all the variables. We set up the value as $p<0.001$; $p<0.01$; $p<0.1$.

Knowledge transfer is critical to improve teaching methods and project designation in education. Our findings suggest that institutional norms, “study in team” ,”personal context”,”transfer sucess”and “transfer activity” are highly correlated with knowledge transfer. In many cases, the complexity of the knowledge instructed in project could make it difficult for students to understand and adopt it. Hence, the intervention of those factors in teaching process in order to adapt the knowledge.

Along with the researched factors affecting the knowledge transfer, the effectiveness of knowledge transfer in education also depends on other factors. Our findings suggest that, in education, practical application project is better than theoretical analysis project for knowledge transferring; project for group learning rather than project for single student is better for knowledge transferring.

According to the specific teaching situation of CUIT implemented with CDIO teaching philosophy, there are some teaching reform based on the research results.

Firstly, we try to use the modern teaching method from the network of MOOC to open more courses related with engineering in English.The research on the design of MOOC study system is on the way trying to make the class more active and let every student in the class to take the part of the discussion and learn from each other.

Secondly, we adapt the “learning and practice”method in the class, connecting every thoery of the knowledge with the practical project.Only with practice and experiment, students can truely understand the knowledge, that is the best way to make knowledge to be transferred.

Thirdly, Students are divided into several practical group, they will discuss the knowlege they learnt and design the specific task assigned by their professor.This way can raise the ablility of their personal context during the knowledge transfer. The knowledge activities will be proposed by the teaching office of the department, students can choose the interesting

activities to join, set up a research team and make invistigation of specific subject to raise the ability of team work spirit.

Appendix A

APPENDIX A		Items in Questionnaire	Mean	S.D
Embeddedness	To what extent do the following statements characterize how well the transfer project proceeded?			
	1	It was easy for the students to identify new knowledge through instructor's help.	2.4	0.87
(Alpha=0.74)	2	It was easy for the students to identify new knowledge through learning the tools, equipment and technologies related to this know-how.	2.03	0.72
Item=4	3	it was easy for students to identify teaching tools to understand certain knowledge.	2.19	0.83
	4	it was easy for students to locate and extract the information needed to understand this know-how.	2.05	0.91
Articulability	5	New project knowledge can easily learn this know-how by listening teachers explanation	1.87	0.86
(Alpha=0.61)	6	new project knowledge can easily learn this know-how by consulting with teachers	2.13	0.78
items=3	7	acceptation of new knowledge is an easier process under teachers explanation	16.9	3.23
physical environment	8	it is more pleasure to study in the prepared and comfort learning environment	1443.67	2302.53
social environment	9	it is easier to accept new knowledge when the instructor has good communication relationship with students	2.45	3.56
(Alpha=0.83)	10	The same ethic of students and instructors is good for knowledge transfer.	3.69	1.34
institutional norms	11	Is the teaching method being promulgated as the only acceptable teaching practice?	2.46	1.15
(Alpha=0.63)	12	Are students encouraged to take an active role in their own education?	8.7	0.89
items=3	13	Is teaching "outside the lines" an acceptable custom?	2.3	0.96
personal context	14	Teachers' attitudes about learning, teaching, students, their own ability, and their subject matter are affecting students?	2.68	1.02
(Alpha=0.83)	15	Is teachers' ability to teach from who they are?	3.00	0.81
items=3	16	Are students encouraged to take an active role in their own education?	2.11	1.15

study in team	17	Teamwork strengthens the responsibility and friendship of the members in the group	2.46	3.15
alpha=0.73	18	Teamwork brings into communication with other like-minded people not know previously.	2.35	2.98
items=3	19	With the help of others, we can get rid of loneliness and feel like there is someone we can turn to	2.25	0.79
learning culture	20	With an extensive set of learning routines and learning competencies and a learning culture, may achieve greater knowledge transfer success.	1.23	0.8
alpha=0.76	21	the knowledge may not be nurtured and further developed if learning is not considered as importance	2.61	0.67
items=3	22	Even when knowledge is transferred to a willing recipient, the transfer will only be effective	2.46	0.79
transfer activity	24	establishing and managing an administrative structure through which differences and issues between the students can be accommodated and reduced	2.98	0.88
alpha=0.76	25	CDIO teaching method, we point activity context as knowledge transferred into practice	2.11	0.9
items=2				

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BIOGRAPHICAL INFORMATION

WuXiang **is a Professor in Chengdu University of Information Technology, as well as being vice president of CUIT, mainly in research of CDIO teaching mode for many years.**

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Qiuyan Gai, is associate researcher, dedicated in the research of CDIO teaching method, following many professors to do research in the reform of teaching method in University.

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