Assessing Students' Learning in MIS using Concept Mapping

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ABSTRACT

The work described here draws on the emerging need to internationalize the curriculum in higher education. The focus of the study is on the evaluation of a Management Information Systems (MIS) Module, and the specification of appropriate course of action that would support its internationalization. To realize this goal it is essential to identify the possible learning needs of the two dominant cultural groups that compose the university student population in Britain, specifically European and Asian (UUK, 2005). Identification of knowledge patterns among these cultural groups is achieved through the application of a concept mapping technique. The main research questions addressed are: (1) How to internationalize the MIS module's content and teaching methods to provide for students from different cultural backgrounds? (2) What are the main gaps in knowledge of students in MIS? The paper presents the results of this study and proposes actions needed to streamline the current teaching methods towards improving the quality of the students' learning experience.

Keywords: MIS Internationalization, Concept Mapping, Learning Assessment, Knowledge Gaps.

1. INTRODUCTION

Increased diversity of students from different cultural backgrounds is pushing universities to internationalize their curriculum to better reflect the global perspective of students' experience. This nurtures graduates to develop the skills and knowledge to operate effectively in the global workplace environment. To this end, the teaching material and methods should integrate aspects from a range of different cultures and ethnic backgrounds to promote cross-cultural awareness. With regards to the MIS module at the School of Management, there are two dominant communities in the student population: Asian and European. In particular, for the academic years 2005 to 2008 the average percentage of Asian and European students in the MIS module was 17% and 72% respectively. A challenge addressed in this research study is the evaluation of students' level of learning and the identification of commonalities and gaps in knowledge among the two groups. Accordingly, these highlight their learning needs. For this purpose, we employ a technique popular for assessing students' level of learning, namely, concept mapping. It should be noted however, that the sample in our case is limited to British and Chinese students. British students are mainly influenced by Western/European teaching and learning styles while the Chinese by Asian teaching and learning styles. Therefore, the two groups are considered as representative classes for European and Asian students respectively.

A contributing factor for the increasing need to internationalize the curriculum stems from evidence that stresses the differences in learning styles among Asian and Western students. According to Gow et al. (1996) Chinese students' learning style is greatly based on memorizing concepts which constitutes rote learning. Moreover, Marton et al. (1993) identified two types of memorizing in which Chinese participants engaged: mechanical memorizing and memorizing with understanding. However, the passive learning through memorization in Asian cultures can be linked to their complex writing systems, composed of large sets of linguistic units. These systems require the memorization of a large number of symbols and their mapping to natural language units (William, 2003). Having to memorize these symbols as part of their language, possibly affects their learning style.

Western students on the other hand, tend to employ a reflective approach to learning with less passive memorization. Considering the difference in learning styles among Western and Asian students it is imperative that for the successful internationalization of curriculum, these issues need to be adequately addressed. The driving force behind this work is the identification of knowledge gaps or misunderstandings among both groups with regards to the MIS module. The literature varies in terms of evidence that supports the differences/similarities among Asian and European students (Kwang, 2001; Holsinger, 2003). Some authors argue that Asian students are less creative than Western students (Kwang, 2004), while others provide evidence of no difference (Martin, 2007; Nisbett, 2004). Moreover, when it comes to creativity and MIS, students are expected throughout the course to create models that describe the functionality of Information systems (IS); therefore, creativity becomes an important aspect to the MIS module.

In terms of content, the MIS module includes learning outcomes that address core IS theory, key business applications of IS, fundamental aspects of data and information modeling and basic techniques for reengineering enterprises using information technology. In principle, IS technologies are the backbone of any modern business and organization worldwide. Therefore, they constitute an important parameter for gaining a strategic advantage in an increasingly competitive business environment. This property makes the MIS module an essential component of any management course. The MIS module aims to provide an overview of the main aspects of modern information systems along with the main methods and technologies that enable their successful realization. The module emphasizes the fundamental concepts of contemporary information systems and the way they support the operational and management processes of modern businesses and organizations. In addition, it presents modern and traditional techniques for developing the systems, and addresses aspects essential in this process, such as, the definition of business requirements, business needs and business value. Information systems are developed with the intention to improve organization's competitive advantage through improved performance, reduced cost and better quality products and services. This intention is translated into an activity that aims towards the streamlining of the principal components of businesses and organizations, their business processes. Therefore, the presentation of contemporary IS development strategies for the realization of systems that improve organizations' business processes is of core importance to the MIS module. However, the complexities inherent in any IS solutions, require extensive "process" and "data" modeling activities prior to implementation. Model development is a creative process that requires students to first assimilate the theory prior to applying it to implement efficient IS solutions. The MIS module is designed with this in mind, exposing the students to the main constructs of the most popular data and process modeling techniques used in industry prior to engaging them in practical applications.

The paper is organized as follows. First an overview of the method is provided. This is followed by a description of concept mapping as the main research instrument supporting this study. Subsequently, the concept map assessment method is explained in the context of its application of identifying knowledge gaps and different learning needs among students. Results are presented and explained and their implications for the MIS module internationalization are presented.

2. THE METHOD

The methodology used to assess the level of learning in the MIS module is composed of four steps. First, students were introduced to the theory of concept mapping and its practical applications through several examples during class sessions. Subsequently, a questions-answers session followed to verify that the technique was understood. Next, the students were asked to prepare a concept map of their understanding of MIS module. For their assistance with the task, students were asked to use a variety of questions, for example: What is an MIS? Where are they used? How they are developed? Why are they important? How organization gain competitive advantage with IS? The students were given 30 minutes to construct their models on paper. The constructed concept maps were then collected and categorized according to students' origin and level of prior IS/IT experience. The exercise was conducted during the last lecture of the module, four lectures after the students completed a multiple choice test on all aspects of the module. Results from the test were used as a preliminary record of students' performance in the module.

2.1. The subjects

The study was performed with second year undergraduate (level 2 in UK terms) students of similar academic performance. This was achieved by matching the students based on their 1st year academic results. The screening process was performed based on three criteria: academic performance, origin and prior knowledge of IT/IS. After collecting all the concept maps, these were classified into groups based on the students' academic performance during the previous year. The students who achieved an average mark between 60% and 70% (2:1 in UK terminology) in Year 1 were selected. Students' prior IS/IT experience was also recorded. This information was elicited using a questionnaire prior to the experiment and helped to improve the validity of the research. Therefore, students with prior experience in IT/IS were eliminated from the study. The questionnaire also elicited information regarding students' country origin, course details and university ID, enabling the researchers to identify their previous year's performance. Since the selected students were of similar academic performance with no prior training in IT/IS, it provided a normalized sample for the analysis. Among the 51 students that had similar academic performance, 8 had an A-level in IT/IS, thus their concept maps were removed. From the remaining 43 concept maps 8 were developed by Chinese students and the other 35 by British. Each of these 43 concept maps was evaluated based on a set of rules as described in a subsequent section. Patterns identified in the students' concept maps helped to identify which aspects of the module were received well by the students and which were not.

2.2. Theoretical background for the research instrument

Concept mapping is a technique used for representing knowledge in the form of graphs which are composed of nodes and arcs/links. Nodes represent concepts and arcs represent relations between these concepts. Concepts are labeled depending on an underlying idea/notion that they represent. Links can be non-directional, uni-directional or bi-directional. The direction indicates cause-effect or specialization-generalization relationships. Concept mapping may serve several purposes, such as: to generate ideas as part of brain storming sessions, to design complex structures (i.e. large web sites), to communicate complex ideas, to aid learning by explicitly integrating new and old knowledge, to assess understanding or diagnose misunderstandings in students' learning. In this study, concept maps were used to assess the level of learning/understanding among the Chinese and British students of the MIS module. This falls under the last category of applications of concept mapping. The concept mapping technique was developed by Novak (1977) at Cornell University. His work was based on the theories of David Ausubel (1968), who stressed the importance of prior knowledge in the process of learning new concepts. Ausubel also states that "meaningful learning involves the assimilation of new concepts and propositions into existing cognitive structures". In education, concept maps have been used as a way to represent the knowledge of a learner and as a method of assessing learner progress and understanding (Hay, 2007; Novak, 1991, 1993). Concept maps have also been used as a way to visually represent course structure and content, and to develop and organize program objectives and outcomes (Novak, 1998).

Because of their visual language, concept maps have been widely used in many different disciplines. They are particularly useful in organizing information related to a problem or subject. The construction of concept maps helps to pull together information already known about a subject and thus is related to factual knowledge. On the other hand, interrelationships among concepts correspond to procedural knowledge. Hammond (1994) describes concept mapping as a tool that supports the learner with key schematic scaffolding. The underlying principle of concept maps is the schematic representation of meaningful relationships between concepts which are in the form of propositions. A concept map is a schematic device for representing a set of conceptual meanings embedded in a framework of propositions.

Concept mapping can contribute in both learning and teaching. However, its greatest advantage is its power to assess students' learning and it is for this purpose that concept mapping was employed in this study. According to Martin (1994) concept hierarchy can be used to identify meaningful learning. Therefore, new perceptions are added under broader concepts to form a concept hierarchy. More general or more inclusive concepts should be at the top of the map, with progressively more specific, less inclusive concepts arranged below. Although this is the original method of concept mapping, students should be allowed to be innovative in their design approaches, and therefore they should be assisted to create richer concepts maps without being constrained by the graphical notation. This is the approach that we followed in this research.

Concept maps are effective tools for making the structure of knowledge explicit. The usefulness of concept mapping for assessment is linked to the complexity of the information that can be encapsulated. This distinguishes them from more conventional evaluation techniques such as multiple-choice tests that could be described as linear. Markham et al. (1994) suggest that these traditional uni-dimensional assessment measures represent a failure to recognize that knowledge is based on an understanding of the interrelationships among concepts. Researchers have found concept map-based evaluations to yield equally comprehensive and accurate overviews of knowledge as compared to well-planned structured personal interviews (Edwards et al., 1983) and assessment through writing (Osmundson et al., 1999). However, concept mapping allows for more efficient data collection than interviews, and presents an advantage over writing-based assessments in that it is inherently non-linear.

Even though there are still a number of important unanswered questions about the role of concept maps in measuring knowledge, there is substantial evidence supporting the reliability and validity of concept maps for assessment (McClure et al., 1990; Ruiz-Primo, 2001a, 2001b). Therefore, concept maps are ideal for measuring the growth of students' learning (Hay, 2007). They enable students to reiterate ideas using their own words, and as a result they can help inaccuracies or misunderstandings to come to the surface. To assess the growth of students' learning, concept maps are created before and after a learning task and are compared after the task has been completed. This provides a schematic summary of what has been learned. Comparison of the two provides an assessment outcome of level of learning acquired (Shavelson et al., 1994). In this study, since we were interested in the

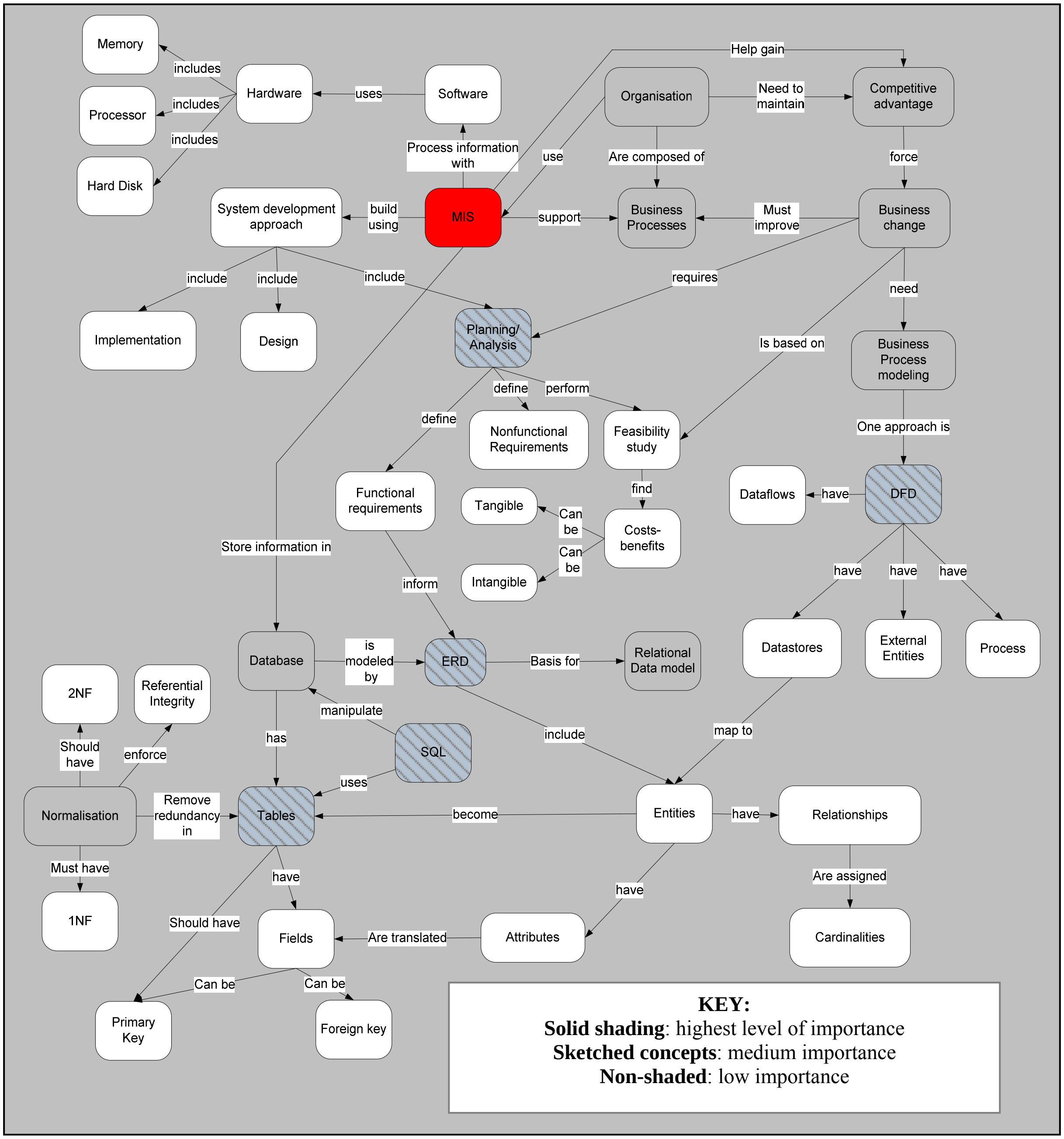

Figure 1. The master concept map

identification of the learning needs of the two cultural groups, we limited the implementation of this methodology to only one application, hence we adopted a slightly different perspective than 'before and after' experiments.

When it comes to developing concept maps, there is a range of directedness that defines the information provided to the students during the exercise and this range is spanning from high-directed to low-directed (Ruiz-Primo, 2001b). High-directed concept map tasks provide students with the concepts, connecting lines, linking phrases, and the map structure. In contrast, in a low-directed concept map task, students are free to decide which and how many concepts to include in their maps, which concepts are related, and which words to use to explain a relationship. In this study low-directed concept mapping was used. This was necessary in order to identify patterns among British and Chinese students learning needs.

2.3. Concept map assessment

For the assessment of students' models a master concept map was developed by the instructor and used as a point of comparison. The map addresses the learning outcomes of the module and modeled both its theoretical and practical aspects. The former include: background in information systems and its role in organizations, information systems development approaches, strategic role of information systems, business change and business process redesign. While the latter include aspects that relate to the development of business process models using data flow diagrams (DFD), development of database models using entity-relationship diagrams (ERD), normalization of data models for the elimination of data redundancy and finally the realization of relational database using Microsoft Access.

Concepts in the master map were categorized into three groups depending on their level of importance with regards to the module's learning outcomes. Highlighted concepts in Figure 1 designate strong links to the learning outcomes of the module and are assigned higher weightings during assessment. Each of the 43 concept maps was scored based on three scoring methods: (a) holistic, (b) relational (c) existential with master map.

With the holistic concept map scoring we examined each model and assessed the students' overall understanding of the module. Based on this judgment, each map was assigned a score on a scale between 1 and 10.

The relational scoring method was adapted from a technique developed by McClure et al. (1990) which assesses student maps based on the quality and number of propositions specified in the model. A proposition is defined when two concepts are connected by a labeled arrow indicating the relationship between the two concepts. Each proposition was assigned a correctness score between zero and three. The highest score implies that the proposition is specified in a very similar way to the master. Specifically, for each proposition in each concept map, three properties were evaluated: the relationship, the link label and the direction of the link (if specified). The first examines the correctness of the association among the two linked concepts. The second examines the description of the link and the third its direction. For assessment of the association, each proposition was assigned a value of 1 if the relationship between the two concepts was valid and 0 otherwise. Subsequently, if the relationship between the two concepts was valid, the description of the link was given the score of 1 if the naming was correct and 0 otherwise. Finally, if both of the previous conditions held and the link's direction was correct an additional point was given to the proposition. The maximum score assigned for each proposition is then 3. However, since some propositions are considered as more important than others the above scores were adjusted by a weighting factor.

The three levels of importance that were used in the relational assessment of the maps are low, medium and high and each was assigned a value of 1, 2 and 3, respectively. Specifically, the shaded concepts in the master map (Figure 1) were assigned a higher level of importance than the non-shaded. Hence, propositions were multiplied by their corresponding weighting factor and subsequently summed before reaching the final relational score of each map. Therefore, the relational assessment of each concept map was calculated using the following formula:

$$\mathrm{Re}lational = \sum_{c=1}^{n}\left[(R+D+T)\cdot R\ \right]\cdot W$$

Where R=concepts relationship, D=link description, T=link direction, W=weighting

Based on this formulae, if R=0 then relational score=0. This means that, if the two concepts that are linked are irrelevant the proposition gets a zero score.

Using the above formulae, the maximum relational score for the master concept map is 282. This is calculated by multiplying the total number of relationships (56) that exist in the model by the corresponding correctness and importance factor. Among the total number of propositions, 12 are assigned a weighting factor of 3, due to their high importance to the module's learning outcome and 14 the weighting factor of 2 due to medium importance. The rest were assigned a weighting factor of 1. Therefore, the maximum score for the relational assessment of the master model is calculated as follows: Master Concept Map Relational score = (56-12-14)*3*1 +12*3*3+14*3*2=282.

Finally, the existential concept map assessment examined the existence of concepts in the map with regards to the master model. Inclusion of a correct concept in the map was assigned the score of 1, and zero otherwise. Concept names that were not specified exactly as in the master model but were referring to the same notion were given full marks. For instance, the acronym SDLC that refers to system development life cycle, is highly related to the "System Development Approach" concept in the master map and hence received full points if specified in either way. In addition, concepts were assigned a weighting score between 1 to 3, depending on their level of importance. The formula for the assessment of the existential score is shown below:

$$Existentia\ l = \sum_{c=1}^{n} C \cdot W\ ,$$

Where c= a correct concept from the master map, C= concept importance {High, Med, Low} and W its corresponding weighting factor =[1-3]

Based on the formulae, the maximum score for the existential assessment is equal to the total number of high importance concepts*weighting + total number of medium importance concepts*weighting +total number of low importance concepts*weighting. In the master map of Figure 1, there are 28 concepts of low importance, 5 of medium and 7 of high importance. This gives a total score for the existential assessment of 59 i.e. 28*1+5*2+7*3=59.

Students' concept maps were assessed based on the above three measures and subsequently transformed to a score in the rage of 0-10. This was achieved by dividing the product of each map's assessment*10 by the maximum score of that assessment. Therefore, for the existential metric, the first cell of the first row of Table 1 is calculated as follows: Existential Score = existential assessment*10/59. A similar procedure was followed for the relational assessment where the maximum score is 282. The average value from all three assessment types defined the overall concept map's score.

The scores of all students' concept maps were assessed using the described method. Table 1 presents a subset of these scores. The first column indicates the cultural background of the student. Letter "B" indicates that the student is of British origin, and letter "C" indicates a Chinese origin. The values of each of the three assessments are transformed to scores with 10 as maximum score, using the initial maximum value that they can take (as described before).

ORIGIN	Existential	Relational	Holistic	Overall
B	3.55	1.70	3.0	2.75
B	2.20	1.49	2.0	1.89
B	0.67	1.14	1.0	0.93
B	3.22	1.63	3.0	2.61
B	3.38	1.70	4.0	3.03
B	4.91	1.99	3.0	3.30
B	8.81	4.51	8.0	7.10
C	3.38	1.67	3.0	2.68
C	1.35	1.21	1.0	1.18
C	3.72	1.88	1.0	2.20
B	7.96	4.72	7.0	6.56
C	3.38	1.78	3.0	2.72
C	3.05	1.88	3.0	2.64
C	3.22	1.78	2.0	2.33
C	4.23	2.38	5.0	3.87
B	2.37	2.06	3.0	2.47
B	5.08	2.41	5.0	4.16
B	4.91	1.70	3.0	3.20

Table 1. A Subset of the assessed concept maps

An illustration of the method in assessing two concept maps is provided in Figures 2 and 3. The former presents a representative map of a Chinese and the latter of a British student. The points obtained in each scoring technique are provided in circles on the students' concept map. Therefore E1 corresponds to existential score of 1. Values next to concept's links represent relational scores. The overall score of each model is assessed by accumulating the existential, relational and holistic scores. The model of Figure 2 incorporates a relatively sufficient number of concepts with regards to the master concept map; however, the relationships between concepts are not adequately specified and, hence, gained a lower mark. In contrast, the map of Figure 3 illustrates a more extensive list of relevant concepts. Moreover, the relationships among the concepts demonstrate a higher level of understanding. Consequently, the two representative concept maps of the Chinese and British students, as shown in Figures 2 and 3, gained the overall marks of 4.2 and 6.2 respectively. The maps' scores, as will be illustrated in the following section are used to specify the corresponding level of student learning.

3. ANALYSIS AND RESULTS

The general descriptive results presented here are based on information from 43 students of whom we could match their concept maps and course information. From these students 8 are Chinese and 35 of British origin.

3.1. Descriptive Analysis

A summary of the descriptive statistics (maximum, minimum, mean and Standard deviation) for the three assessed dimensions as well as the overall score of the students is presented in Table 2.

	Min	Max	Mean	Std. Deviation
Existential	1.68	8.81	3.71	1.76
Relational	1.14	5.72	2.98	0.89
Holistic	1.00	8.00	4.60	1.63
Overall	1.27	7.51	3.76	1.35

Table 2. Summary Descriptive Statistics of students' scores

As can be seen from Table 2, students' scores are low overall, with the lowest score corresponding to the relational aspect of the concept maps. This is especially evident from the maximum score on this dimension which is only 5.72 (out of a possible maximum 10). This is due to the quality and number of propositions specified between concepts in the students' models compared to the master map. Low performance is attributed to the difficulty in identifying relevant relationships among concepts and specifying them with correct propositions, which is a first indication of surface learning (Biggs, 2003).

Table 3 shows analytically the scores achieved by the two groups of students (i.e. Chinese and British) in each assessment. It can be seen that British students scored higher than the Chinese students in the existential, holistic and aggregate assessments of their concept maps, whereas the Chinese students on the relational dimension performed slightly better. These results highlight the strength and weaknesses of each group. However, the small sample size of Chinese students prevents us from making strong conclusions regarding the differences among the two groups.

	Group	N	Mean	Std. Deviation
Existential	British	35	3.8111	1.88351
	Chinese	8	3.3051	1.14239
Relational	British	35	2.9696	0.89994
	Chinese	8	3.0638	0.90468
Holistic	British	35	4.6571	1.66173
	Chinese	8	4.3750	1.59799

Table 3. Collated view of the scores achieve in all assessment by the two student groups

It should also be noted that for both groups of students, the performance in relational analysis was much poorer compared to the other two aspects. This result can be attributed to memorization of the concepts by students and the low understanding of their meaning (Biggs, 2003). This could be due to the low level of student's practical experience with the module's material. This is attributed to the sheer number of students that were registered in this module (N=250).

3.2. Further analysis

The assessment of students' learning level employed in this study, is based on Bloom's taxonomy (1956). According to this taxonomy, learning is categorized into six distinct levels that span from surface to deep learning. These levels include:

- Knowledge of facts, terminology, etc.
- Comprehension of meaning
- Application of previously learned information
- Analysis that includes the skill to make inferences
- Synthesis that includes creative skills
- Evaluation which includes the ability to critique, defend, and reframe

An updated model of "Bloom's Taxonomy", described by Lorin et al. (2001) organizes knowledge into four levels, namely factual, conceptual, procedural and metacognitive. The assessment method employed here is highly related to this taxonomy. Specifically, existential assessment aims at factual knowledge, while relational assessment is linked to conceptual knowledge. Procedural and Metacognitive levels are assessed approximately by the holistic assessment.

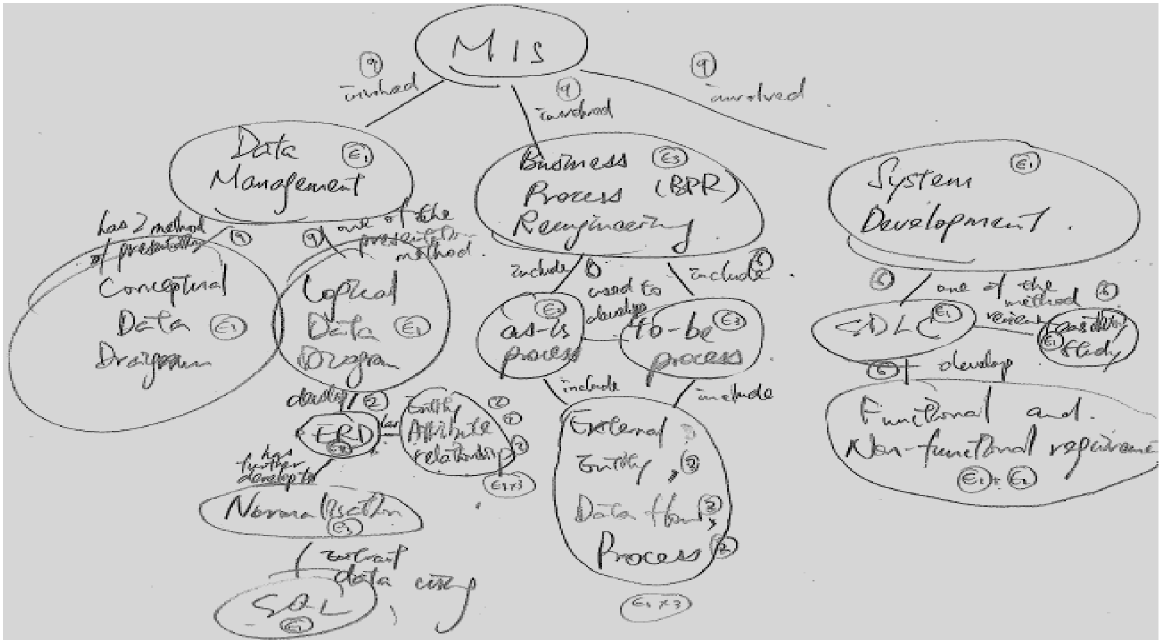

Figure 2. A concept map of a Chinese student

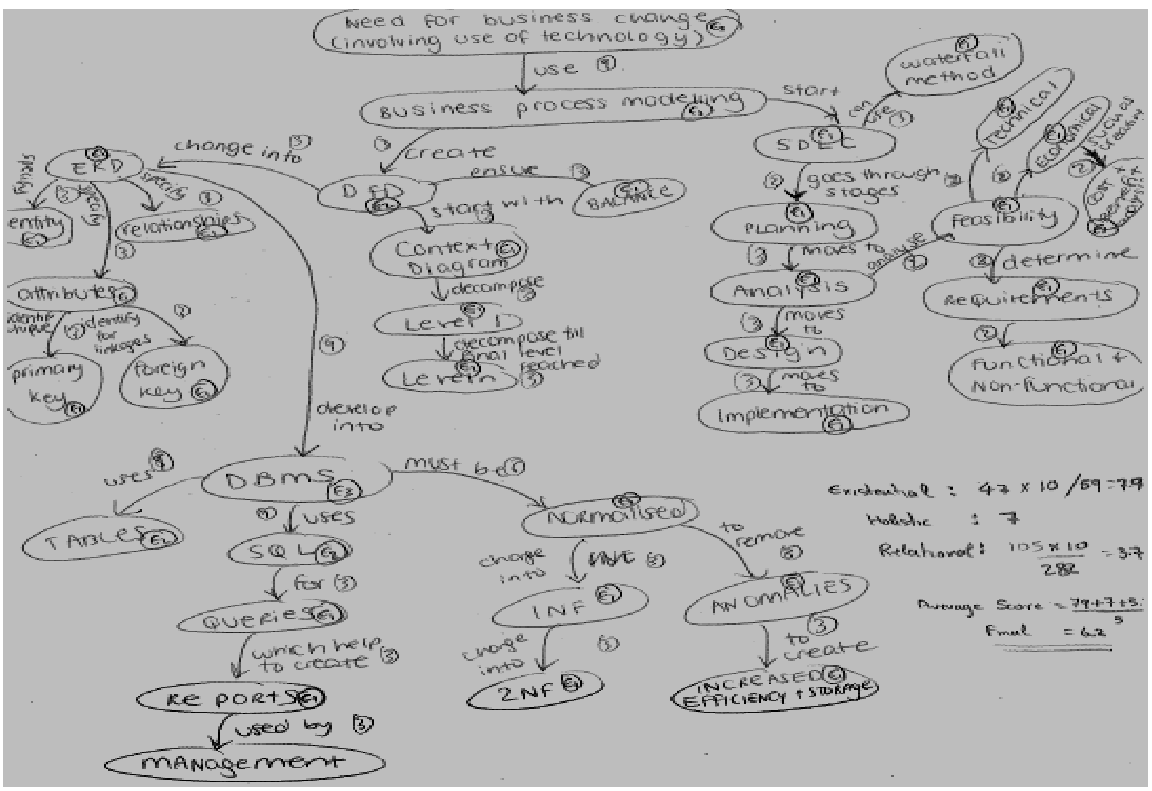

Figure 3. A concept map of a British student

Depending on the scores obtained from the assessment, students are classified in one of the four categories. The classification rules based on which this categorization is performed are as follows: Factual level of knowledge is assigned to students whose concept map scores between 1 and 2.5. The minimum value for this is 1, since the range between 0 and 1 does not provide sufficient evidence of factual learning. Conceptual level of learning is assigned to students with concept maps scoring between 2.5 and 5. Similarly, the range between 5 to 7.5 and 7.5 to 10 corresponds to the remaining two categories of learning, namely, procedural and metacognitive.

The distribution of the students according to this classification is shown in Figure 4.

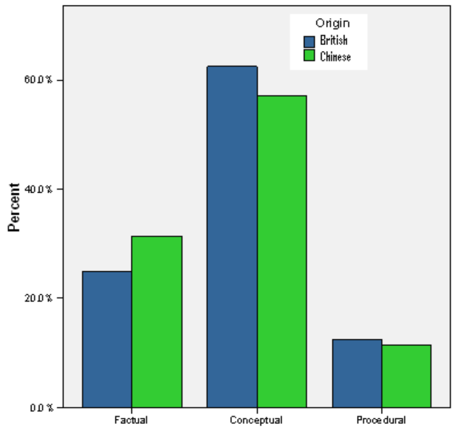

Figure 4. Application of Lorin's classification in students' level of learning

It is evident from this categorization that both groups of students did not manage to achieve an adequate level of deep learning. This, as mentioned earlier, is attributed to the low level of hands-on experience in the laboratory. The sheer number of students (250) made the practical engagement of the students with the material difficult.

3.3. Final observations

Pattern analysis (Chen-Chung et al, 2005; Hay, 2007) on the models topology showed that references to practical aspects of the module, such as the conceptual modeling constructs of "dataflow diagramming" and "entity relationship diagrams", was marginally better for Chinese students. This is an interesting observation that if possible to extend and generalize with more data, could be used to argue that Chinese students are better in diagrammatic techniques. The literature has not reached a consensus on this; however, the difference can be attributed to the cognitively complex language semantics of the Asian cultures (William, 2003). On the other hand, despite this difference, both groups demonstrated significantly low level understanding of the use of the "process" and "data modeling" DFD constructs. This is attributed to the small exposure of the students to these practical aspects of the module, an area that needs to be addressed in the future.

Figures 5 and 6 visualize the identified patterns among the two groups. These were generated based on the frequency that concepts from the master model were included in the students' maps. The color coding of the two master maps of Figures 5 and 6 show the results obtained from the pattern analysis. These overlays help to pin-point the areas that were mostly covered by each student group and, hence, indicated the achieved level of understanding of each group on the particular module's aspect. Specifically, red dashed overplayed areas on the master indicate high inclusion frequency of concepts in the students' maps, orange - medium frequency and green low frequency. The visualizations demonstrated that British students included more concepts in their concept maps than those in the master. This is evident from the total area covered by the overlaid color coding.

In addition, British students used more concepts from the more practical aspects of the module such as the use of DFD and ER modeling constructs. This is evident from the frequency of occurrence of these concepts in their models and is indicated with the red overlaid areas on both master maps of Figures 5 and 6. These findings demonstrate that the British students (of our sample) possessed a wider knowledge of the subject and in particular they have a better understanding of the practical usage of information modeling constructs. This final observation is aligned with other research findings in literature that argues that European students are more equipped with better problem solving and critical thinking skills (Wong, 2004; Niehoff et al., 2001).

Another interesting observation from the Chinese students' concept maps is the inclusion of concepts in students' maps that were drawn from a case study presented in the lectures regarding the Hong Kong International Airport. This observation is aligned with the constructivism model of learning that states that students learn better when the teaching supporting material and techniques are directly linked with their prior knowledge. Therefore, the MIS module should incorporate case studies from the global business scene to stimulate students from diverse cultural backgrounds.

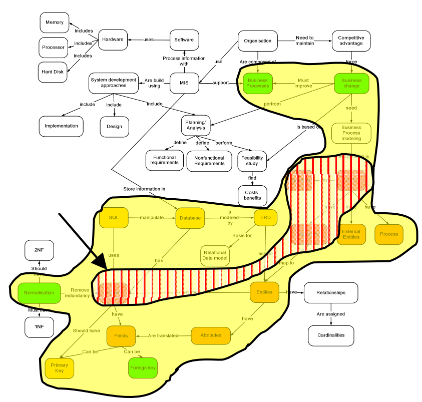

Figure 5. Pattern of concepts usage of Chinese students

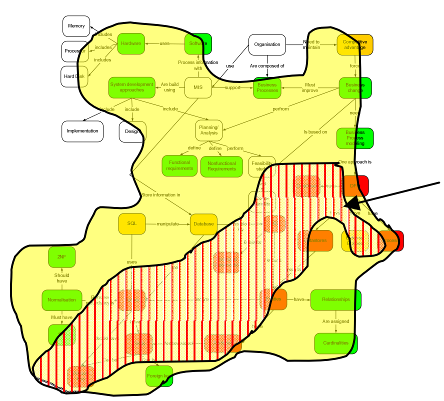

Figure 6. Pattern of concepts usage of British Students [Note: Arrows point to highly used concepts in students' maps]

4. PROPOSED ACTIONS TO INTERNATIONALIZE THE MIS MODULE

The increased exposure of international students in British universities impacts on teaching practices, assessment methods and content of the curriculum. There are many dimensions to the problem of internationalizing the curriculum in higher education. At the forefront of this endeavor are issues regarding students' culture and language which affect learning style and learning pace. With regards to language, increasingly it becomes evident that many of the international students have language difficulties regardless of their English language entry score. As a result, they struggle to comprehend the material (Bradley, 2000). In the MIS module, this problem became evident with the Chinese students. In particular, the majority of nodes in the Chinese students' concept maps were related to the practical aspects of the module. These relate to model development using DFD and ERDs. Plus, the use of notions from the theoretical parts of the module was limited, and in their majority erroneously specified. This observation became apparent from the pattern analysis. Generally, theoretical parts of the module require good language comprehension. As a mean to tackle this problem, we propose the incorporation of assessment approaches that are not solidly language dependent. Therefore, we recommend the adoption of problem-based learning and assessment approaches in which students will be able to select their own real-life projects. This will ease non native English speaking students from the burden of learning the terminology of an unknown problem domain by selecting scenarios from domains that they are familiar with.

Generally, students in IS courses show difficulties in applying what they have learned in a practical setting. In essence there is a large gap between knowing and doing. With regards to the MIS, this problem became evident through the existential and relational analyses. Specifically, the majority of the students demonstrated satisfactory levels of familiarity with the terminology of ERD and DFD diagrams as was picked up by the existential analysis. However, the students demonstrated considerable difficulty in explicitly showing the relationships among concepts of these diagramming techniques, and this was indicated by the relational analysis. In principle, learning in IS modules occurs better in the context of engaging with a compelling problem, through interactions among students and the instructor, and even better through the engagement with outside sources. However, due to the sheer number of students, problem-based learning was not possible in this case. For this reason, we propose the adoption of group-based learning and assessment methods with members of different cultural backgrounds to aid peer learning and ease the problems with students of non-native English speaking backgrounds.

Additionally, the concept map analysis revealed that the incorporation of case studies from different contexts improved student motivation and subsequently learning. This was picked up by the existential and relational analyses that revealed an increased number of concepts and relationships in the students' models that were drawn from an international case study presented in the lectures. Therefore, we encourage the incorporation of real-life cases from the international scene which have direct link to the students' background.

Most importantly, it is essential that the teaching methods adopted by the instructor, satisfy the diverse learning needs and styles of students from culturally diverse backgrounds. According to Honey and Mumford (1992), there are four dominant learning styles in which students can be classified, namely: the Activists, Reflectors, Theorists and Pragmatists. The first refers to students who are 'hands-on' learners and prefer to have a go and learn through trial and error. Reflectors are students who are 'tell me' learners and prefer to be thoroughly briefed before proceeding. Theorists are students who are 'convince me' learners and want reassurance that a project makes sense. Finally, Pragmatists are students who are 'show me' learners and want a demonstration from an acknowledged expert. According to the literature, Asian students are more acquainted with teacher-centered approaches, specifically the "theorist learning style" (Mohamed, 1997) while Europeans prefer student centered approaches. Therefore, the combination of teacher and student centered methods would reveal the best results in a multicultural class.

To conclude, a teaching environment where diverse perspectives are fostered and appreciated will make students better critical thinkers, better communicators, better problem-solvers and better team players.

5. DISCUSSION AND CONCLUSION

Educators agree that students do not learn by memorizing facts, but instead, they learn by summarizing, relating, and organizing concepts into their minds (Ausubel, 1963). This directly relates to the constructivism model of learning which focuses on the activities that the learner does, rather than what the teacher does (Hughes & Hay, 2001). Teaching within a constructivist perspective, demands teachers to act as facilitators, where their main role would be helping students become active learners and construct knowledge based on what they already know. The work presented in this paper employs a concept mapping technique as a means to assess the level of learning acquired in the MIS module by Chinese and British students (as the two dominant cultural groups in UK according to UCAS) and accordingly propose appropriate actions to internationalize the module. Research has shown that typical students do not have a vast store of knowledge, but instead their knowledge is disjointed and not well connected (Fowler, 1987). In contrast, successful learners have well developed and interconnected knowledge structures. The concept mapping technique is highly related to the way students structure their knowledge in terms of concepts and relationships. This makes it an invaluable tool for representing students' knowledge and subsequently their level of learning.

However, the way that students learn depends on their cultural background. Therefore, the fact that the students' cultural backgrounds differ significantly in most academic institutions in the UK at least, makes this aspect critical to successful pedagogy. The core concern during the internationalization of curriculums is the inclusion of pedagogical paradigms that consider the particularities of all cultural groups (Caruana & Hanstock, 2003). According to the literature, Asian students show greater preference for content information, whereas Europeans show preference in applying course material (Niehoff et al., 2001). Moreover, students in Asia often relate very passively to their teachers and they are more likely to use rote learning (Baumgart & Halse, 1999; Pratt et al., 1999). Following this, they are more reluctant to ask questions or even engage in group discussions or debate (Pratt et al., 1999; Wong, 2004). Furthermore, Asian students are accustomed to the teacher-centered style of learning environment, which stresses reproduction of written work and factual information, with little emphasis on critical thinking and problem-solving abilities. Considering the above, it seems that the literature is converging, leading us to the conclusion that Asian students do not easily achieve deep learning due to their learning style. The study did not concentrate on learning differences among the two cultural groups as. Instead it focused on identifying problems that students of both groups had with particular aspects of the module.

The primary contribution of this study is the identification of misconceptions between and within Chinese and British students and the proposal of appropriate courses of action for improving the learning experience. The literature reached a consensus regarding the usefulness of concept mapping for evaluating students learning. On the other hand, concept mapping alone can not be used to detect the causes of learning deficit since the style of learning and teaching methods employed are not addressed by this technique. However, understanding students' learning style helps instructors adapt their teaching method to better support the students' learning (Bonham, 1989).

The study described here helped to infer the effects of the different learning styles among students with different cultural backgrounds and accordingly specified an assortment of activities to address problems identified. Other methods for identifying students' misconceptions and understandings exist (e.g. Winer & Vazquez-Abad, 1995), however, in contrast to these methods, concept mapping was employed and investigated as a method by several studies that have established its validity and utility as an evaluation tool (MaClure et al 1999; Pendley et al. 1990; Nakhleh, 1994). Similar work by Markham and Jones (1994) revealed the differences between biology majors and non-biology majors using concept maps. Moreover, work by Freeman and Urbaczewski (2001) demonstrated the use of concept maps for assessing students' knowledge in an Information Systems module. However, unlike the research reported here, these studies did not examine the learning needs of different cultural groups.

Despite its advantages, concept mapping has one major limitation. Without a systematic approach for their quantification it is difficult to deduce students' level of learning and subsequently compare between different groups. In response to this, we introduced a methodical approach in this study for evaluating concept maps using three different metrics. The assessment approach described in this paper integrates both holistic and numerical techniques and is applied on original concept maps as they have been developed by the students. In particular, since our study addresses the needs among different cultural groups it was imperative to employ a technique sensitive enough to the different learning styles among Chinese and British students. Therefore, aspects such as the richness of the propositions that described the relationships between concepts helped to identify misconceptions attributed to rote learning.

Results of this work identified common problems in both groups that assisted the redesigning of the MIS module and as contributed towards improving the level of learning. Specifically, the results demonstrated that both groups had significant misconceptions with regards to the relationship between "External entities" in DFD and "Entities" in ERD modeling. This can be attributed to their similar naming/labeling. To eliminate this problem, we aim to explicitly draw students' attention to the difference among the two concepts through specific examples that emphasize their difference. This observation may also be helpful in similar courses such as software and requirements engineering where these models are used.

The primary implication from this work emphasizes the need for increased exposure of students to theory through additional hands-on sessions. In particular, students benefit from practical group-work and the use of examples and case studies from the international scene (Lynn, 1999). Hands-on sessions will facilitate students to construct their understanding by practicing the material in the laboratory, while group work will help students to learn from each other and share their experiences. The groups must be composed of students with different cultural background and the case studies should be based on the international business scene. Both approaches could act as a catalyst to improve the engagement of international students in the learning process.

Part of our immediate future directions includes the pre and post module evaluation of students' concept maps. This will be performed by asking students to construct two models, one at the beginning of the module and one at the end. This will enable us to assess the level of learning achieved by controlling more variables in the study, such as the prior knowledge of IS. More specifically we are interested in identifying differences in the pace of learning among cultural groups in pre-specified intervals. This will help us refine the pace of the module delivery in order to improve learning in multicultural classes.

To conclude, results from this study stress the need to internationalize the MIS curriculum and to introduce techniques to facilitate deep learning. Since the MIS module necessitates the use of information modeling, the instructional methods could be based on modality learning styles to help students with a single dominant learning style to strengthen weaker learning styles. Additional, teaching approaches, such as: research-led teaching through injection of research output in the teaching process, increased reflective discussion through problem based learning, and increased student motivation through applied activities of basic research skills will lead to improved student learning. These will increase students' employability, enhance university and program reputation, and finally, increase students' enrolments.

6. REFERENCES

Ausubel, D. (1963). *The Psychology of Meaningful Verbal Learning*. New York: Grune & Stratton.

Ausubel, D. P. (1968). *Educational Psychology: A Cognitive View*. New York: Holt, Rinehart and Winston, Inc.

Baumgart, N., & Halse, C. (1999). Approaches to learning across cultures: The role of assessment. *Assessment in* Education, 6, 321–339.

Biggs, J. (2003). *Teaching for Quality Learning at University*. Buckingham: Society for Research into Higher Education & Open University Press.

Bloom, B.S., Engelhart, M. D., Furst, E. J., Hill, W. H., & Krathwohl, D. R. (1956). Taxonomy of educational objectives: Handbook I: Cognitive domain. New York: David McKay.

Bonham, L. A. (1989). Using learning style information, too. In E. Hayes (ed), *Effective teaching styles*. San Francisco: Jossey Bass.

Bradley,G. (2000). Responding effectively to the mental health needs of international students. *Higher Education,* 39, 417 – 433.

Caruana V., & Hanstock J, (2003). Internationalising the Curriculum: From Policy to Practice, Education in a Changing Environment Conference Proceedings, University of Salford, 17-18 September 2003.

Chen-Chung L. Ping-Hsing D. & Chun-Ming T. (2005). Assessment based on linkage patterns in concept maps, *Journal of information science and engineering* 21(5),873-890

Gow, L., Balla, J., Kember, D. and Hau, K.T. (1996). Learning approaches of Chinese people: A function of socialisation processes and the context of learning? In Bond, M.H. (ed.) *The handbook of Chinese psychology* (pp. 109-123). Hong Kong: Oxford University Press.

Edwards, J., & K. Fraser. (1983). Concept maps as reflectors of conceptual understanding. *Research in Science Education, 13*, 19-26.

Fowler, T. W. and Bou Jaoude, S. (1987) Using hierarchical concept/proposition maps to plan instruction that addresses existing and potential student misunderstandings in science. Proceedings of the 2nd International Seminar, 1, 182-186.

Hammond, N. (1994), Auto-monitoring; theoretical touchstone or circular catch-all? *Research in Learning Technology, 2*(1), 49-50.

Hay, D. (2007). Using concept maps to measure deep, surface and non-learning outcomes. Studies in Education, 32(1), 39-57.

Holsinger, D. (2003). Is The Quality of Education in Vietnam Declining? (BYU)

Hughes, G., & Hay, D. (2001). Use of concept mapping to integrate the different perspectives of designers and other stakeholders in the development of e-learning materials. British *Journal of Educational Technology, 32*(5), 557-569.

Kwang, N. (2001). Why Asians are less Creative than Westerners (NTUS).

Kwang, N. (2004). Liberating the Creative Spirit in Asian Students. Prentice Hall.

Freeman L & Urbaczewski A. (2001), Using Concept Maps to Assess Students' Understanding of Information Systems. *Journal of Information Systems Education, 12*(1), 3-9.

Lorin, A., & Krathwohl, D. (2001). *A Taxonomy for Learning, Teaching, and Assessing*. New York: Longman.

Lynn, L. (1999). *Teaching and Learning with Cases: A Guidebook*. New York: Chatham House Publishers.

MaClure, J.R., Sonak, B., & Suen, H.K. (1999). Concept map assessment of classroom learning: Reliability, validity, and logistical practically. *Journal of Research In Science teaching, 36*(4), 475-492.

McClure, J.R., & Bell, P.E. (1990). Effects of an environmental education related STS approach instruction on cognitive structures of pre-service science teachers. University Park, PA:Pennsylvania State University. (ERIC Document Reproduction Services No. ED 341 582)

Markham, K., Mintzes, J., & Jones, G. (1994). The concept map as a research and evaluation tool: Further evidence of validity. *Journal of Research in Science Teaching, 31*(1), 91-101.

Martin, D. (2007). Cognitive contours: recent work on cross-cultural psychology and its relevance for education. *Studies in Philosophy and Education, 26*(1), 13-42.

Martin, D. J. (1994). Concept Mapping as an aid to lesson planning: A longitudinal study. *Journal of Elementary Science Education, 6*(2), 11-30.

Marton, F., Dall'Alba, G., & Tse, L. K. (1993) The Paradox of the Chinese Learner, Occasional Paper 93.1, Educational Research and Development Unit, Royal Melbourne Institute of Technology, Victoria.

Marton, F., Dall'Alba, G., & Tse, L. K. (1996). Memorizing and understanding: The keys to the paradox. In D. A. Watkins & J. B. Biggs (Eds.), *The Chinese learner (pp. 69–83).* Hong Kong: Comparative Education Research Centre, University of Hong Kong

Mohamed, O. (1994), *Malaysian students' learning profile: Implications for teacher-counsellors' preparation*, Paper presented at the 41st International Council of Education for Teaching World Assembly, Istanbul.

Honey, P. & Mumford, A. (1992), *The manual of learning styles*, Peter Honey, Berkshire

Nakhleh, M. B. (1994). Chemical education research in the laboratory environment: how can research uncover what students are learning? *Journal of Chemical Education, 71*, 201-205.

Niehoff, B.P., Turnley, W.H., Yen, H.J.R., & Sheu, C. (2001). Exploring cultural differences in classroom expectations of students from the United States and Taiwan. *Journal of Education for Business, 76*, 289-293.

Nisbett, R. (2004), *The Geography of Thought: How Asians and Westerners Think Differently...and Why.*.Free Press.

Novak, J. D. (1977). *A theory of education*. Ithaca, NY: Cornell University Press

Novak, J.D. (1991). Clarify with concept maps: A tool for students and teachers alike. *The Science Teacher, 58*(7), 45-49.

Novak, J. D. (1993). How do we learn our lesson?: Taking students through the process. *The Science Teacher, 60*(3), 50-55.

Novak, J.D. (1998). *Learning, Creating, and Using Knowledge: Concept Maps as Facilitative Tools in*

Schools and Corporations. Lawrence Erlbaum Associates.

Osmundson, E., Chung, G.K.W.K., Herl, H.E., & Klein, D.C.D. (1999). Knowledge mapping in the classroom: A tool for examining the development of students' conceptual understandings (Centre for the Study of Evaluation Technical Report 507). Los Angeles: UCLA, Centre for Research on Evaluation, Standards, and Student Testing.

Pendley, B. D., Bretz, R. L., & Novak, J. D. (1994). Concept maps as a tool to assess learning in chemistry. *Journal of Chemical Education, 71*, 9-17.

Pratt, D. D., Kelly, M., & Wong, W. S. S. (1999). Chinese conceptions of effective teaching' in Hong Kong: Towards culturally sensitive evaluation of teaching. *International Journal of Lifelong Education, 18,* 241–258.

Ruiz-Primo, M. A., Schultz, S. E., Li, M., & Shavelson, R. J. (2001a). Comparison of the reliability and validity of scores from two concept-mapping techniques. *Journal of Research in Science Teaching, 38*(2), 260-278.

Ruiz-Primo, M. A., Shavelson, R. J., Li, M., & Schultz, S. E. (2001b). On the validity of cognitive interpretations of scores from alternative concept-mapping techniques. *Educational Assessment, 7*(2), 99-141.

UUK. (2005). Select committee evidence, Treasury Committee, Impact of China on the World & UK Economy.

UCAS. Universities and Colleges Admissions Service, http://www.ucas.ac.uk/

William C. H. (2003***). The writing on the wall: How Asian orthography curbs creativity. Encounters with Asia***. Philadelphia, PA: University of Pennsylvania Press.

Winer, L. R., & Vazquez-Abad, J. (1995). The present and the future of ID practice. *Performance Improvement Quarterly, 8*(3), 55-67.

Wong, J. K. -K. (2004). Are the learning styles of Asian international students culturally or contextually based. *International Education Journal, 4*, 154–16

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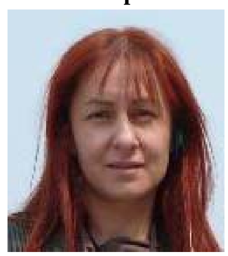

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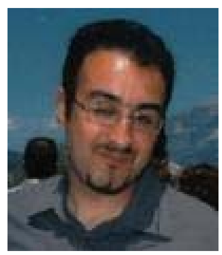

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