INTERNATIONALISING THE MANAGEMENT INFORMATION SYSTEMS MODULE

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Abstract: The work described here is drawn from the emergent need to internationalise the curriculum in higher education. The paper in particular focuses on the internationalisation of the Management Information Systems (MIS) module and the identification of learning differences among the two dominant cultural groups of higher education in the UK: Asian and European students. The identification of differences among knowledge patterns of these cultural groups is achieved through the application of a concept mapping technique. The research question addressed is: How can we internationalise the MIS module's content and teaching methods to provide for students from different cultural backgrounds?

1 INTRODUCTION

The increased diversity of students from different cultural backgrounds is pushing universities to internationalise their curriculum to better reflect the global perspective of students' experience (UUK, 2005). This will help graduates to develop the skills and knowledge to operate effectively in the global workplace environment. By definition, internationalisation of the curriculum is the process of integrating an international dimension into the teaching, research and service functions of an institution of higher education, with the aim of strengthening international education (Teekens, 2002). To that end, the teaching material and methods in higher education should integrate aspects from a range of different cultures and ethnic backgrounds to promote cross-cultural awareness. With regards to the MIS module at our university, there are two dominant communities in the student population: European and Asian. In particular, for the academic years 2005 to 2008 the average percentage of Asian and European students was 17% and 82% respectively. The focal point of this research study is the evaluation of the level of learning among these two groups, the identification of commonalities, differences or gaps in their knowledge and to use that knowledge to redesign the module.

A contributing factor for the increasing need to internationalise the curriculum is stemming from evidence that stresses the differences in learning styles among Asian and Western students. According to Beaty et al. (1996) Chinese students' leaning style is greatly based on memorising concepts which constitute rote learning. Moreover, Marton et al. (1993) identified two types of memorising in which Chinese participants: mechanical memorising and memorising with understanding. However, the passive learning through memorisation 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 memorise these symbols as part of their language, possibly affects their learning style. On the other hand, Western students 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 internationalisation of curriculum, these issues are addressed adequately. The literature varies in terms of evidence that supports the differences/similarities among Asian and European students (Kwang, 2001; Holsinger, 2003; Nisbett, 2003). Some authors argue that Asian students are less creative than Western students, while others provide evidence of no difference (e.g. Kwang, 2004). This study aims to identify possible differences/similarities among the two groups with regards to the MIS module and tailor the current teaching methods accordingly to best address the needs of both groups.

The paper is organised as follows. Firstly an overview of the method is provided. Next follows a description of concept mapping as the main research instrument supporting this study. Subsequently, the concept map assessment method used is explained and its application is demonstrated for the evaluation of the level of learning in the two groups. Results from the evaluation are presented and explained and their implications on the MIS module internationalisation are presented.

2 THE METHOD

The methodology used to assess the level of learning in the MIS module is composed of four steps. Firstly, students were introduced during class sessions to the theory of concept mapping and its practical applications through several examples. 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. To assist them with the task, students were asked to use questions such as: What is an MIS? Where are they used? How they are developed? Why are they important? The students were given 30 minutes to construct their models on paper. The constructed concept maps were then collected and categorised according to students' origin and level of prior IS/IT experience. The exercise was conducted on the last lecture of the module and 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

In order to identify the differences between European and Asian students, the study, was performed with level 2 students. Participants were of similar academic performance. This was achieved by analyzing the students' 1st year academic results. The screening process was performed based on three criteria: the academic performance, their origin and their prior knowledge in IT/IS. Therefore, after collecting all the concept maps, these were classified into groups based on the students' academic performance during the previous year. The students that achieved a 2:1 (average mark in the range of 60 to 70%) in the first year were selected. Moreover, students were also categorised according to their prior IS/IT experience. This information was elicited using a questionnaire handed to the students 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 their origin, course details and university ID, based on which previous year's performance was identified. Finally, the number of students that were selected to take part in the study was 43.

The MIS module learning outcomes address both theory and practice. Therefore, patterns identified in the students' concept maps helped to identify which aspects of the module were understood by the students and which not. The theoretical aspects of the module include: background in information systems and their role in organizations, information systems development approaches, strategic role of information systems, business change and business process redesign. The practical components of the module relate to the development of business process models using data flow diagrams (DFD), development of information models using entity-relationship diagrams (ERD), normalization of data models for the elimination of data redundancy and the finally the realization of relational database models using Microsoft access.

2.2 The Research Instrument

Concept mapping is a technique used for representing knowledge in the form of graphs, composed of nodes and arcs/links. Nodes represent concepts and arcs represent the relations between these concepts. Concepts are labelled depending on the idea/notion that they represent. Links can be non-directional, uni-directional or bi-directional. The direction indicates cause-effect or specialisation-generalisation relationships. Accordingly, concepts may be categorical, or simply associative. 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 research, concept maps were used to assess the level of learning/understanding among the Asian and European Students of the MIS module.

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 knowledge of a learner and as a method of assessing learner progress and understanding (Novak, 1991, 1998). 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 (Kitching, 2005a).

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. This 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 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 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 they can encapsulate. 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., 1999; 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 inaccuracies or misunderstandings can come to the surface. To assess the growth of students' learning, concept maps are created before and after a learning task. After a learning task has been completed, concept maps are compared. This provides a schematic summary of what has been learned. The comparison of the two gives rise to the level of learning acquired (Shavelson et al., 1994). In our study, since we were interested in differences among two cultural groups, we limited 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 spanning from high-directed to low-directed that defines the information provided to the students during the exercise (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 they 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 the two investigated groups to identify differences and similarities among Europeans and Asian students regarding their level of learning.

2.3 Concept Map Assessment

For the assessment of students' models a master concept map (Figure 1) was firstly developed to be used as a point of reference based on which all students' concepts maps were compared to.

The master concept map models all the concepts and their interrelationships as they were covered in the module. Concepts in the master were categorised into three groups depending on their level of importance with regards to the module's learning outcomes. Highlighted concepts in the master, as depicted in Figure 1, designate strong link to the learning outcomes of the module and, therefore, are assigned higher weightings during the assessment. Each of the 51 concept maps was scored based on three scoring methods: (a) holistic with master map, (b) relational with master map (c) existential with master.

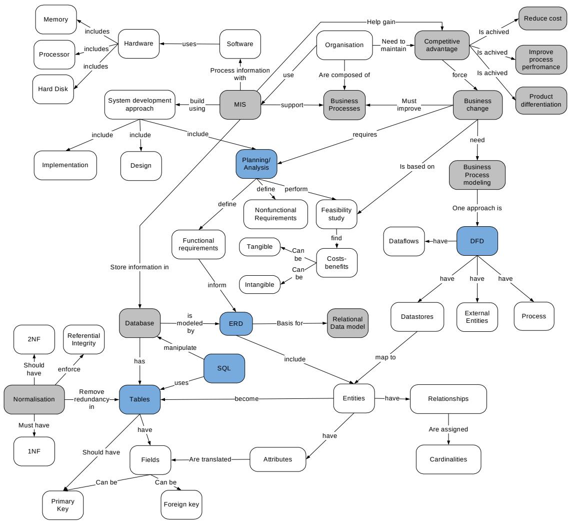


Figure 1: Master concept map.

Holistic concept map scoring examined each model and assessed the student's overall understanding of the module. Based on this judgment, each map was assigned a subjective score on a scale between 1 and 10. The relational scoring method was adapted from a technique developed by McClure et al. (1990) and 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 value between zero and three. The highest score designates that the proposition is specified in the exact or very similar way to the master. Specifically, for each proposition in each concept map, three properties were evaluated, namely: 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 examined the description of the link and the third its direction. For the assessment of the association, each proposition is assigned a value of 1 if the relationship between the two concepts is valid and 0 otherwise. Subsequently, if the relationship between the two concepts is valid, the description of the link is given the score of 1 if the named correctly and 0 otherwise. Finally, if both of the previous conditions hold and the link's direction is correct an additional point is given to the proposition. The maximum score assigned for each proposition is 3. However, since some propositions are considered as more important than others the above scores are adjusted by a weighting factor. The 3 levels of importance that were used in the relational assessment of the maps are: low, medium and high and each is assigned a value of 1, 2 and 3 respectively. Specifically, the shaded concepts in the master, (figure 1) were assigned a higher level of importance than non shaded. Hence, propositions are 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 is calculated using the following formulae:

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

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 zero score.

Using the 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. Therefore, the 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 formulae for the assessment of the existential score is shown below:

$$Existential = \sum_{c=1}^{n} C \cdot W \qquad [2]$$

where C= a correct concept from the master map,
C= {High Importance, Med Importance, Low Importance} 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.

The concept map of each student was 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.

An illustration of the method in assessing two concept maps is provided in Figure 2. The points obtained in each scoring technique are provided in circles on the students' concept map. Therefore E1 corresponds to existential score that achieved the value 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.

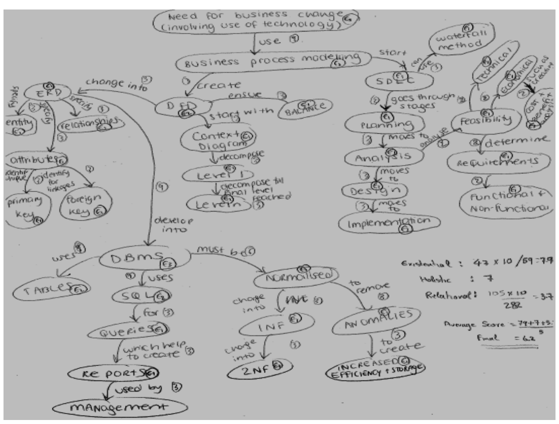


Figure 2. A concept map of a European student

3. ANALYSIS AND RESULTS

Descriptive analysis of the results of the 43 participants (8 are Asian and 35 are European) indicates that the students' overall learning is low. Particularly, the lowest score corresponds to the relational aspect of the concept maps. This is especially evident by the maximum score on this dimension that is only 4.72 out of a possible maximum 10. This result is attributed to the quality and number of propositions in the students' models. Low performance is related 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).

Moreover, the analysis revealed that scores are differentiated among the two groups of students. In particular, European students scored higher than the Asian students in the existential, holistic and aggregate assessments. Whereas on the relational dimension the Asian students performed slightly better. However, the differences between the two groups' scores were not fount to be statistically significant, according to the results of independent sample t-test (Table 1).

Table 1: Collated view of the scores achieve in all assessment by the two student groups

	Group	N	Mean	Std. Deviation	t	Sig. (p)
Existential	European	35	3.8111	1.88351	0.726	0.472
	Asian	8	3.3051	1.14239		
Relational	European	35	1.9696	.89994	0.267	0.791
	Asian	8	2.0638	.90468		
Holistic	European	35	3.6571	1.66173	0.436	0.665
	Asian	8	3.3750	1.59799		
Overall	European	35	3.1460	1.41251	0.43	0.669
	Asian	8	2.9146	1.15673		

Before getting to any conclusions with the above results a possible limitation should be acknowledged. That is the consideration of the starting ability of the students, which was captured in this occasion with a multiple choice test before the concept mapping activity. According to the results of this test, it seems that the overall sample is biased against the European group, in the sense that their mean overall score in this test was higher than the mean of the Asian students, and the difference was statistically significant [$Mean_{European}$=16,25, $Mean_{Asian}$=13,7; t=3.683, p<0.01].

If any comparison between different 'origin' groups is to be meaningful we need to 'control' for at least this variable. In order to do so we decided to create an 'experimental' condition situation for this sample of students where each of the Asian student was matched randomly with a European student who gained an equal mark on the test before the activity. A paired samples t-test (Table 2) was then run to check for the difference between the scores in each dimension.

Table 2: Paired samples statistics

Dimension	Group	Mean	Standard Deviation	t	significance
Existential	Asian	3.58	.89	-.517	.624
	European	3.99	1.61		
Relational	Asian	2.19	.90	.729	.494
	European	1.94	.29		
Holistic	Asian	3.43	1.40	.236	.821
	European	3.14	2.34		
Overall	Asian	3.07	.67	.088	.933
	European	3.03	.83		

As shown in Table 2, there is no significant statistical difference between the matched means in each dimension for the two groups of students. This may be due to the small sample size (in this case N=7). However, what should be noticed is that the pattern of the differences in the means is consistent, Hence we could claim that in this experiment/study European students performed better in the overall, existential and holistic aspects of their concept maps, and Asian students performed better at the relational dimension.

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.

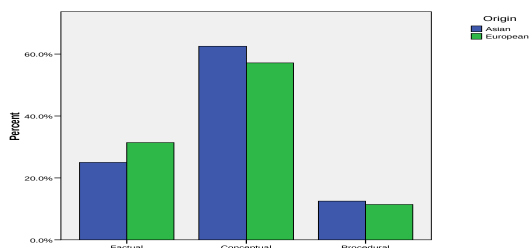
3.1. Further Analysis

The assessment of students' learning level employed in this study, is based on the taxonomy of Bloom (1956). According to this taxonomy, learning is categorized into six distinct levels that span from surface to deep learning. These levels include: (1)Knowledge of facts, terminology, (2) Comprehension of meaning (3) Application of previously learned information (4)Analysis that includes the skill to make inferences (5)Synthesis that includes creative skills (6)Evaluation which includes the ability to critique, defend, and reframe

An updated model of "Bloom's Taxomony", described by Lorin et al. (2001) organises 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 Metacognition levels are approximately assessed by the holistic assessment. Depending on the scores obtained from the assessment, students are classified in one of the four categories. The classification rules based on which this categorisation is performed are as follows: Factual level of knowledge is assigned to students with concept map score 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 map score 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 3.

Figure 3: Application of Lorin's classification in students'



level of learning

It is evident form these categorisation that both groups of students did not manage to achieve a adequate level of deep learning. This as mention earlier is attributed to the low level of hands-on experience in the laboratory. The sheer number of students (250) made practical engagement of the students with the material difficult.

4 DISCUSSION AND CONCLUSIONS

The main contribution of this study is the identification of learning differences among Asian and European students, the identification of misconceptions between and within them and the proposal of appropriate course of action for the betterment of their learning experience. The literature reached a consensus regarding the usefulness of concept mapping for student evaluation. Other methods for identifying students' misconceptions and understandings exist (e.g. Winer & Vazquez-Abad, 1995). However, in contrast to these methods, concept mapping has undergone several studies that have established its validity and utility as an evaluation tool (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 differences among cultural groups.

Despite its advantages, concept mapping however, has one major limitation. Without a systematic approach for their quantification it is difficult to infer students' level of learning and subsequently compare between different groups. To that end, in this study we introduced a systematic approach for evaluating concept maps using three different metrics. The literature refers to a wide variety of ways to assess concept maps. Work by (Shavelson et al. 1993; Liu 1994) in particular used item response theory, which takes into account the number of links, the number of hierarchies, the number of cross-links, and the number of examples to assess concept maps. Raven (1985) took a slightly different approach to concept map assessment through, employing differentiation (number of categories employed), discrimination (range of phenomena involved), and integration (efficiency of organizing method) as criteria. Moreover, Stewart (1980) employed information processing theory to evaluate concept maps that were generated from transcripts of students' interviews. On the other hand Stuart (1985) scores concept maps using a holistic approach instead of an analytic. However, neither the numerical nor the holistic/qualitative approaches alone can sufficiently capture the richness of students' concept maps. The approach introduced in this paper combines both holistic and analytic methods into one and as such constitute an improvement to previous approaches. Furthermore, the majority of the techniques in the literature assess concepts maps that have been generated by experts based on students' narratives or interview transcripts. This conversion might lead to valuable information loss during the generation of the models. Plus, it requires more effort by the experts to complete. The approach described in this paper is applied on original concept maps as they have been developed by students. In particular, since our study addressed the differences among cultural groups it was imperative to employ a technique sensitive enough to the different learning styles. Therefore, aspects such as the richness of the propositions between concepts helped to identify students' misconceptions and accordingly infer rote learning.

One limitation of our study is that it draws from the dissimilar sample size among the two groups. Specifically, the number of Asian students (8) was considerably smaller than the European (35). As a result, the conclusions that can be drawn from this research have a limited statistical significance. However, the results identified common problems in both groups that helped for the redesigning of the MIS module and as such contributed towards improving the level of learning.

The main implications from this work point to the need for increased exposure of the students to the theory through additional hands-on sessions. In particular, students will be benefited 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.

Concluding, since the MIS module necessitates the use of information modelling, the instructional methods could be based on modality learning styles to help students with a single dominant learning style 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, in conclusion, will increased students' employability, better university reputation, and finally increase students' enrolments.

Part of our immediate future directions includes the investigation of possible variations in the pace of learning among different cultural groups. This in return, will help us refine the module delivery pace to further improve the learning experience in multicultural classes.

REFERENCES

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

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.

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

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)

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.

Liu, X. (1994). *The validity and reliability of concept mapping as an alternative science assessment when item response theory is used for score*. Paper presented at the annual meeting of the American Educational Research Association (New Orleans, LA, USA), April 4-8.

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.

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

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.

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.

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)

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.

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. (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.

Raven, R. (1985). Concept analysis of correlated environmental problems. *Science Education. 69*(2), 241-245.

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.

Shavelson, R. J., Lang, H., & Lewin, B. (1993). On concept maps as potential 'authentic' assessments in science. National Center for Research on Evaluation, Standards, and Student Testing, US Department of Education.

Stewart, J., 1980. Two aspects of meaningful problem solving. *Science Solution*, pp: 66.

Stuart, H.A. (1985). Should concept maps be scored numerically? *European Journal of Science Education, 7*, 3-8.

Teekens, H. (2002), Teaching and Learning in the International Classroom, Nuffic, The Hague

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

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