# CAN ROTE LEARNERS BE TRANSFORMED INTO CRITICAL THINKERS THROUGH A CONCEPT – MAPPING INTERVENTION?

***Dr. Raisa Gul,***
Associate Professor,
Aga Khan University School of Nursing, Karachi – Pakistan

***Dr. Raisa Gul*** is currently working as an Assistant Professor at Aga Khan University School of Nursing. She obtained her basic professional education in Nursing from Lady Reading Hospital, Peshawar, followed by a Baccalaureate degree in nursing from McMaster University Canada. She has completed a Master's degree in Health Administration from of the University of New South Wales, Australia, and a doctoral degree in Nursing from the University of Alberta, Canada. Dr. Gul has worked in several administrative positions at Shifa International Hospital, Aga Khan University Hospital and the Aga Khan University School of Nursing. Her area of research interests are Nursing education, particularly, critical thinking, professional competence, and program evaluation. She presented and published her papers at national and international level. In recognition of her services and academic performance, Dr. Gul has received several awards including the dissertation fellowship award from the University of Alberta. In her present capacity, she teaches in the graduate programme at Aga Khan University School of Nursing. In addition, she has been serving on various professional forums at national and international level.

# CAN ROTE LEARNERS BE TRANSFORMED INTO CRITICAL THINKERS THROUGH A CONCEPT – MAPPING INTERVENTION?

***Dr. Raisa Gul, **Ms. Shanaz Cassum, ***Ms. Khairulnissa Ajani,**
*Associate Professor, **Senior Instructor, ***Senior Instructor,
Aga Khan University School of Nursing, Karachi – Pakistan

## ABSTRACT

Critical thinking is an important outcome of higher education in any discipline. International literature reveals that teaching strategies—such as reflections, self-directed learning, questioning, and concept mapping—which ask for active engagement of students in their learning, foster critical thinking. Social context of the learning environment, and the instructor's competence and approach to teaching also influence students' critical thinking abilities. Contrary to the required teaching practices, didactic teaching and rote learning are still prevalent in most teaching institutions and disciplines in Pakistan. The focus of this paper is to report on the process and findings of a quasi-experimental study in which students at Aga Khan University School of nursing were taught and encouraged to use concept mapping as a way for knowledge acquisition. A total of 97 nursing students in their first year of the programme were enrolled in the study. In the pre-intervention phase all students were assessed for their level of self-directed learning and ways of knowing, using two instruments, named- SDLRS (Self-Directed Learning Readiness Scale) and WOKAT (Ways of Knowing Assessment Tool). The students were allocated to experimental and controlled groups based on their score on WOKAT. Those in the experimental group were taught to develop concept-maps. In the post-intervention phase, all students were reassessed on SDLRD, WOKAT, and GPA and their scores were compared between the groups. Findings of the study showed significant difference between the controlled and experimental groups in terms of students GPA but no substantial change was noted in their scores on SDLRS and WOKAT.

## INTRODUCTION

Critical thinking is an important outcome of higher education in any discipline including Nursing (Boland, 2005; Boychuk Duchscher, 1999; Brookfield, 1987). International literature reveals that teaching strategies, such as reflective journaling, questioning, and concept mapping, requiring active engagement of students in their learning, foster critical thinking (Daley et al., 1999; Gul and Boman, 2006; Simpson and Courtney, 2002; Wheeler and Collins, 2003). However, contrary to the required teaching practices to develop students' critical thinking, didactic teaching and rote learning—memorization of material through repetition are prevalent in most teaching institutions in Pakistan (Davies and Iqbal, 1997; Khalid and Khan, 2006), and nursing education is no exception (Kamal, 1999).

Over the past years, there has been a general concern by faculty that nursing students have difficulty applying theoretical concepts learnt in their introductory courses, such as anatomy and physiology, microbiology, pharmacology and fundamentals of nursing. Students entering into a nursing programme initially need to learn new terminology, foundational knowledge and basic skills to care for patients, which may be readily absorbed through

memorization of information. However, content learnt through memorization could be easily forgotten (Castledine, 2001). Consequently, rote learning is significantly challenged when students encounter difficulties in applying memorized knowledge to real situations.

Given the above situation it is important to determine how to assess those students who use memorization as their preferred approach to learning and then assist those students to modify their ways of knowing and learning. It is not necessary that students who use rote learning to acquire knowledge are of low intelligence but it is how they are taught to think and learn in their educational experience which determines their learning style. As the complexity and amount of nursing knowledge continues to increase, nurse educators are confronted to develop strategies that help students how to learn instead of what to learn. Daley (1996) accurately pointed out that teaching adult learners to broaden their thinking and to utilise strategies that foster a constructivist approach to learning is possible but challenging. To introduce students to meaningful learning strategies, nursing faculty can play a key role in assisting them to abolish rote learning. Ausubel et al. (1986) explained that contrary to the process of rote learning, meaningful learning occurs when a learner is able to connect new knowledge to relevant concepts already known. Drawing from Ausubel et al.'s (1986) work, Daley and her colleagues (1999) explicate how meaningful learning occurs through the development of concept maps. Since the concept mapping learning strategy rests on active engagement of students and their understanding of concepts, it becomes easier for learners to integrate theory into practice (Hicks-Moore, 2005).

This study aims to assist students for learning through concept mapping in order to enhance their critical thinking capacity instead of rote learning.

## LITERATURE REVIEW

Fundamentally concept maps are considered cognitive metaphor that acts like a window to the brain of the learner. They are constructed from selected concepts and linking words or symbols. The concepts are arranged in a hierarchy and relationships are illustrated. Thus concept mapping strategy utilises constructivist approach to learning by allowing student to be in control of their learning and to be more confident in their ways of knowing (All and Havens, 1997; Daley et al., 1999; Novak, 1992; Novak and Gowin, 1984). These scholars also explicate that concept mapping is a creative technique that actively engages learner in cognitive, effective and psychomotor learning. Since concept mapping involves a visual representation of student's interpretations of ideas and concepts, it becomes easier for them to see the gaps in their thinking and understanding, which becomes an inspiration for further learning (Wheeler and Collins, 2003). Hence, concept maps facilitate the acquisition of new knowledge by integrating it with previously learnt concepts resulting into a continuous meaningful learning.

Adoption of concept mapping by learners is a learned process, which requires step by step facilitation by the expert in developing concepts maps and consistent practice by the learners. Literature presents varying reports on the time and approach required to develop concept maps, but in general it is suggested that up to three sessions over a two-week period is needed to assist students in learning how to develop concept maps, whether individually or in groups (Caelli, 1998; Cannon, 1998; Daley, 1996; Reynolds, 1994; Roberts et al., 1995).

Literature indicates that the use of concept maps have significant advantages. Irvine (1995) reported that when students adopted concept mapping for learning it became an

"integrated educational experience, and claimed enhancement of meaningful learning" (p.1179). Since, it offers a metacognitive approach to critical thinking and concept synthesis (Beissner, 1992; Wheeler and Collins, 2003), many scholars view concept mapping as a teaching strategy for development and evaluation of critical thinking (All and Havens, 1997; Chenoweth, 1998; Daley et al., 1999; Gul and Boman, 2006; Luckowski, 2003; West et al., 2000). These writers also identified barriers to the use of concept maps. They have pointed out that development of concept maps is time consuming, as it requires students to first identify concepts from their readings and then have to think for the link words to relate one concept to another before putting it on a paper (Reynolds, 1994; Roberts et al., 1995).

Numerous studies are reported in the literature that have used concept mapping as the methodology for assessing acquisition of knowledge, enhancement of problem-solving ability, and critical thinking abilities (Beissner, 1992; Daley et al., 1999; Reynolds, 1994; Staib, 2003; West et al., 2000; Wheeler and Collins, 2003). Concept mapping has been used for teaching of Pathophysiology (Cannon, 1998; Reynolds, 1994), in clinical experience courses (Baugh and Mellott, 1998), and in professional development (Wade, 1998). Beissner (1992) reported that students who used concept mapping to develop linkages between patient problems and interventions showed a problem-solving score 1.44 points higher than those who did not. Likewise, Wheeler and Collins (2003) explored the effectiveness of concept mapping versus traditional care plan as a means to develop students' critical thinking skills in their introductory clinical courses. Using a pre and post test design, these researchers measured students' critical thinking on California Thinking Skills Test (CCTST). Wheeler and Collins found no significant differences between the groups, but they noted significant differences within the experimental group after the intervention. In conclusion, there is growing evidence in the literature that concept mapping could help to enhance students' critical thinking and problem solving ability. However, there was no data in Pakistan to determine the effectiveness of concept mapping on students in Pakistani context who are assumed to be rote learners.

## PURPOSE

This study aims to assist nursing students towards adopting a more problem-solving approach that is concept mapping, instead of rote learning or memorization as their dominant approach to acquire knowledge upon entering into the programme. Specifically, this study focusses to answer the following questions:

1. What is the students' dominant way of acquiring knowledge in the first year of their professional nursing programme at Aga Khan University School of Nursing?
2. What is the relationship between rote learning and students' self-directed learning readiness?
3. Will nursing students with rote learning habit demonstrate greater conceptual thinking skills after they are taught to use concept mapping skills?
4. Is there a relationship between students' use of concept mapping to guide their learning and their academic success in their nursing programme?

## METHODS

### *Design*

This study utilized a pre-test post-test time-measured quasi-experimental design.

### *Setting and Sample*

The study was conducted at Aga Khan University School of Nursing (AKU-SON) in 2003. All 1st year students (N=120) in the General Nursing Diploma (GND) and Baccalaureate degree in Nursing (BScN) programmes were invited to participate in this study. Although 97 students consented to participate in the study, 95 students completed the pre-reassessment tests; hence, the response rate was 97%.

### *Data Collection Instruments*

In addition to students' demographic variables, such as age, gender, and educational background, three instruments, Guglielmino's Self-Directed Learning Readiness Scale (SDLRS), Ways of Knowing Assessment Tool (WOKAT) and a modified version of Roberts et al.'s instrument for adoption of concept mapping (1995) were used in this study.

SDLRS consists of 58 items, in which responses are measured on a 5-point Likert scale (from almost never to almost always). The tool assesses a person's perceived ability to be a self- directed learner (Brochett and Hiemstra, 1991, p. 56-7). This instrument has a reported reliability coefficient of 0.87 whereas WOKAT is 33-item questionnaire, partially developed by Dr. Carol Orchard and her colleagues at the Memorial University, Canada, in which 16-items are incorporated from Bucynski's WOKI (Ways of knowing Instrument). Responses are measured on a 4-point Likert scale from "strongly disagree to strongly agree". WOKAT has five constructs: (a) silence—no reliance on external sources of knowledge; (b) received knowledge —reliance on listening for acquiring knowledge; (c) subjective knowledge—use own thinking to construct knowledge; (d) procedural knowledge—use a process for acquiring knowledge and solving problems; and (e) constructed knowledge—acquiring knowledge through a variety of sources with critical consideration of others' views. It assesses stages of women's way of seeking knowledge and can be used to identify learners' dominant pattern of seeking knowledge such as rote learning or constructing knowledge which is reflective of critical thinking. The Bucynski instrument has an alpha coefficients of .69 for silence, .69 for subjective; .72 for received; .74 for constructed; and .80 for procedural knowledge (Buczynski, 1993). The adapted instrument was pilot tested for validity by second year nursing students at AKU-SON and, minor amendments were made in the language accordingly. The alpha coefficient for the revised tool is 0.74. The modified version of Roberts et al.'s (1995) tool consisted of both closed and open ended questions to assess students' educational priorities and attitudes about the effectiveness of concept mapping.

### *Procedure for Data Collection*

After obtaining approval from the Ethical Review Committee at AKU, all nursing students at the beginning of their second semester of year were invited to participate in the study. Those willing to participate signed a written consent form. For the pre-test phase, all students enrolled in this study were asked to complete two instruments that are SDLRS and WOKAT. The biographical data of students were obtained from their personal records at the school. After analysis of pre-test data, students were assigned to experimental and control groups based on their scores for various constructs in WOKAT. Those students who scored high in *the silent* or in the *received knowledge* items but low

in the procedural and constructed knowledge were selected for experimental group. In contrast, students who scored high in procedural and constructed knowledge items but low in the *silent* or in the *received knowledge*, were assigned to the controlled group. Some students, who had similar scores on all constructs, were assigned to both experimental and controlled group based on their Grade Point Average (GPA) scores of semester I of year I. Those students who had comparatively low GPA were assigned to the experimental group and the rest were assigned to the control group based on the researchers' assumptions that students having higher GPA were more likely to be critical thinkers and might not be dependent to seek knowledge via silence or received mode. Using the said measures, of the 95 students, 41 were identified for the experimental group, out of which 30 came to attend the intervention.

Students in the experimental group were introduced to the use of concept maps and then assisted in development of concept maps thorough multiple sessions. The first session focused on what learning is and how it occurs. In the second session, students were taught how to develop concept maps. For the third session, students were asked to prepare a concept map, identifying key concepts from their Anatomy and Physiology (A&P) course to be learned in the following week. Researchers also prepared concept maps of the same content in consultation with the A&P faculty. Thus in the third session, students compared their maps with those of the researchers discussing similarities and differences. Students were given samples of concept maps for other courses content that they had studied in the previous weeks in a didactic manner. They were encouraged to continue developing concept maps and approach any member of the research team at their own convenience.

At the end of the 18-week semester, all students who had gone through pre-assessment phase were invited to complete the post intervention questionnaire. Students in the experimental group were asked to complete a set of three questionnaires namely: SDLRS, WOKAT and Roberts et al.'s instrument for adoption of concept mapping; whereas rest of the students were required to complete SDLRS and WOKAT only.

### *Analysis of Data*

All the data on the questionnaire were double entered in EPI INFO version 6.04 and analysis was performed in SPSS software version 12.0. Descriptive statistics were generated for variables related to students to ascertain the patterns of distribution, which included means and standard deviation for continuous variables and proportions for categorical variables. Likewise, Independent sample t-test was used for comparing scores among controlled and experimental group, whereas chi-square was used to compare the students' preferred ways of knowing in the BScN and GND programmes. In all these comparisons, p-value of less than 0.05 was taken as significant.

### *Limitations of the Study*

Although the researchers were having a good grasp of concept mapping, most teachers in the school were new to this teaching strategy. Consequently, students were not sufficiently encouraged to use concept mapping for their learning in the course work. Likewise, many students attended the first 3 sessions in the intervention but did not come for the subsequent practice and feedback session. As a result, students had limited time

and exposure to practice concept mapping. Although the response rate for students' participation in the study was excellent (i.e.97%), the attrition rate (nearly 36%) was quite high which may have affected the results.

## RESULTS

A total of 95 students were enrolled in the study. The mean age of students was 19.9 years with a range of 18-25 years and most (94%) of them were females. The majority (73) of students was from Karachi, 9 from other cities of Sindh, 12 from other cities of NWFP and Punjab, whereas one student was from overseas, that is Nairobi. In terms of basic schooling, nearly 40% of the students had 12 years and rest of them had 10-11 years of education. Of the 95 students, 34 were lost in the process and 61 students were able to complete the study. However, 5 questionnaires (2 in experimental and 3 in control) were returned incomplete; hence, the post intervention result accounts for 56 students.

The pre-test scores for SDLRS ranged from between 174 to 251. The mean score was 215.63 with a standard deviation of 17.256. The distribution of scores indicating various levels of readiness for self-directed learning among the students are presented in table 1. Based on stated figures, the majority (59%) of students had average readiness for self-directed learning. Whereas 23% showed above average and 18% showed less than average readiness for self-directed learning.

***Table-1: Distribution of Scores for Self Directed learning Readiness***

| Levels of Readiness for SDLRS | Cut off range | Number and % of students |
|---|---|---|
| Low readiness | 58 – 176 | 01 (1.6%) |
| Below average readiness | 177 – 201 | 10 (16.4 %) |
| Average readiness | 202 – 226 | 35 (59.0 %) |
| Above average | 227 – 251 | 14 (23.0%) |

In regards to measuring students' responses for dominant ways of acquiring knowledge in the first year of their programme, the findings in Table 2 indicate no clear pattern. With the exception of silence mode, the majority of the students seemed to use multiple ways of acquiring knowledge. Although 56% of the students also indicated the use of silence, at least 44% were not used to acquiring knowledge that way.

***Table 2: Way of Acquiring Knowledge in First year of the Programme***

| Constructs of WOKAT | Strongly Agreeing/ Agreeing | | Disagree/Strongly Disagree | |
|---|---|---|---|---|
| | *Score* | *Number of Students* | *Score* | *Number of Students* |
| Silence | <15 | 34 (55.7%) | ≥ 15 | 27 (44.3%) |
| Received Knowledge | <18 | 60 (98.4%) | ≥ 18 | 01 (1.6%) |
| Subjective Knowledge | < 21 | 57 (93.4%) | ≥ 21 | 04 (6.6%) |
| Procedural | < 24 | 60 (98.4%) | ≥ 24 | 01 (1.6%) |
| Constructed Knowledge | < 21 | 60 (98.4%) | ≥ 21 | 01 (1.6%) |

Using a Chi-square test, no significant association was found between the students' scores for WOKAT and SDLRS (See Table 3). Hence, there was no relation in the students' ways of learning including rote learning (indicated by their scores on silence and received mode of learning) and their perceived ability for self-directed learning readiness.

***Table 3: Relationship of WOKAT and SDLRS***

| Constructs of WOKAT | | Students' self- directed learning readiness | | | P Value |
|---|---|---|---|---|---|
| | | Below average | Average | Above average | |
| Silence | Agree | 07 (63.6) | 20 (55.6) | 07 (50) | 0.792 |
| | Disagree | 04 (36.4) | 16 (44.4) | 07 (50) | |
| Received knowledge | Agree | 11 (100) | 36 (100) | 13 (92.9) | 0.181 |
| | Disagree | 0 | 0 | 01 (7.1) | |
| Subjective knowledge | Agree | 9 (81.8) | 35 (97.2) | 13 (92.9) | 0.195 |
| | Disagree | 02 (18.2) | 01 ( 2.8) | 01 (7.1) | |
| Procedural knowledge | Agree | 11 (100) | 36 (100) | 13 (92.9) | 0.181 |
| | Disagree | 0 | 0 | 01 (7.1) | |
| Constructed knowledge | Agree | 11 (100) | 36 (100) | 13 (92.9) | 0.181 |
| | Disagree | 0 | 0 | 01 (7.1) | |

***P value is obtained from chi-square test of independence***

Based on independent t-test for comparing the students' pre and post-intervention scores on WOKAT and SDLRS, no significant difference was found between the control and experimental group. However, significant difference (2.21 at p-value 0.037) was found in the GPA of the control and experimental groups after the intervention. Likewise, the majority of the students who relied more on the constructed mode of acquiring knowledge had a GPA of 3 or above out of 4.

Assessing the effectiveness of using concept mapping in the experimental group, student responses to the modified questionnaire by Roberts et al.'s are summarized below in three themes.

### *Students' ways of studying new material*

The students responded that prior to the intervention, 43% were used to learning new material by reading for meaning and understanding; whereas 30% of students used to memorize from books or teachers notes. Other 13% learnt new material by doing group study; whereas remaining 13% used to make diagrams or flow charts to study new material. After learning the concept mapping strategy and using it during the semester, 80% students were of the opinion that concept mapping is a valuable tool for learning new material, and even though it was difficult, and time consuming, it had benefitted them in making learning more clear, and meaningful. One student who had practiced making concept mapping frequently, expressed the reason of her comfort with this strategy by stating "practice made me perfect."

### *Usefulness of concept mapping*

To explore the impact of intervention, students were asked if their approach to study had changed since participation in concept mapping session. Majority (87%) of the subjects

responded in affirmation and gave positive comments about concept mapping such as "…it helps me to remember difficult concepts"; "helps in better retention"; and "gives sequence in my thoughts to perceive new things; "learnt the efficient use of time". Likewise, a student expressed, "learning is enjoyable and easy with concept mapping." However, 13% of the subjects did not experience any change in their approach to studying after participation in the concept mapping sessions.

On identifying the reasons for not adopting concept mapping approach to study new material, students expressed that "it is time consuming", "and does not match with the way the course work is examined which is MCQs". Some students commented that the process of making a concept map is difficult, because to them, either "finding the key terms or the linking words" was challenging, or summarizing the content in a map when everything appears important. It is significant to note that some students highlighted the importance of practicing more for adopting the strategy as eloquently expressed by a student: "concept mapping approach seems difficult in the beginning but gets easier overtime." Some students did not appreciate the idea of introducing a new learning strategy (i.e. concept mapping) in the middle of the semester as clearly noted in this comment: "teaching concept mapping in mid semester when there are other assignments is not appropriate, if I change my way of learning I will have problem, I need time to think"

***Application of concept mapping in nursing education***

The students were inquired about the applicability of concept mapping strategy in nursing and non nursing courses. 80% of the participants responded that they were able to use concept mapping strategy in courses other than Anatomy and Physiology, such as Adult Health Nursing, Community Health Nursing, Nursing Ethics, Pharmacology and Microbiology. Interestingly, more than half of the students (53%) suggested that concept mapping strategy should be used by course teachers to increase their understanding and make students' learning enjoyable.

## CONCLUSIONS AND RECOMMENDATIONS

Findings of this study affirmed the value of concept mapping as an active teaching strategy with positive effects. Although the findings of the quantitative analysis were not significant, student responses to the qualitative data are encouraging and support the findings of other researchers in favour of using concept mapping in nursing education (Chenoweth, 1998; Irvine, 1995; Wheeler and Collins, 2003). Similar to the reports of other authors, some students did see concept mapping as a time consuming strategy while others found it something enjoyable. Students' responses in this study also indicated that once learned, concept maps could be useful for learning any subject. Moreover, as noted in the cited literature of this paper, (such as Daley et al., 1999; Cannon, 1998) participants' responses in this study affirmed that learning to develop concept maps requires practice which initially demands some investment of time on the students' part. To make this strategy more plausible to student, it has to be introduced in the first semester of the programme. Considering students' responses, it is recommended that teachers be trained first to become expert in developing concept map related to their subject matter and then use it as a teaching strategy in classroom discourse. Moreover, it is desirable that concept mapping be incorporated into student assessment.

Although not surprising, it was interesting to note that students at AKU-SON do use multiple ways of learning instead of having any dominant way of learning. Despite the fact that no statistical significance was noted in the student ways of acquiring knowledge after their exposure to concept mapping, the change in their pre and post test GPA is one reason to further explore the effectiveness of this strategy in nursing and other students in Pakistan. We, therefore, recommended the replication of the study and propose a longitudinal design having a larger sample and focusing multiple schools.

## REFERENCES


1) All, A. C. & Havens, R. L. (1997), "Cognitive/concept mapping: a teaching strategy for nursing", *Journal of Advanced Nursing*, vol. 25, no. 6, pp. 1210-1219.
2) Ausubel, D. P., Novak, D. J., & Hanesian, H. (1986), *Educational psychology: A cognitive view*, (2nd ed.), Werbel and Peck, New York.
3) Baugh, N. G. & Mellott, K. G. (1998), "Clinical concept mapping as preparation for student nurses' clinical experiences", *Journal of Nursing Education*, vol. 37, no. 6, pp. 253-256.
4) Beissner, K. L. (1992), "Use of concept mapping to improve problem solving", *Journal of Physical Therapy Education*, vol. 6, no. 1, pp. 22-27.
5) Boland, D. L. (2005), "Developing Curriculum: Frameworks, outcomes, and competencies," in *Teaching in Nursing: A guide for faculty (2nd ed.)*, D. M. Billings & J. A. Halstead, (Eds.), Elsevier Saunders, St. Louis, pp. 167-185.
6) Boychuk Duchscher, J. E. (1999), "Catching the wave: understanding the concept of critical thinking", *Journal of Advanced Nursing*, vol. 29, no. 3, pp. 577-583.
7) Brochett, R. G. & Hiemstra, R. (1991), *Self-direction in adult learning: Perspectives on theory, research and practice*, Routledge, London.
8) Brookfield, S. D. (1987), *Developing critical thinkers: Challenging adults to explore ways of thinking and acting* Jossey-Boss Publisher, San Francisco.
9) Buczynski, P. L. 1993, "The development of a paper-and-pencil measure of Belenky, Clinchy, Goldberger and Tarule's (19860 conceptual model of women's ways-of-knowing instrument.", *Journal of College Student Development*, vol. 34, pp. 197-199.
10) Caelli, K. (1998), "Shared understandings: negotiating the meanings of health via concept mapping", *Nurse Educator Today*, vol. 18, no. 4, pp. 317-321.
11) Cannon, C. A. (1998), "Path charting: a process and product for linking pathophysiological concepts", *Journal of Nursing Education*, vol. 37, no. 6, pp. 257-259.
12) Castledine, G. (2001). “The problems of student supernumerary status”. Internurse.com, available at: Http://www.internurse.net/poll2.html.(accessed 24 April, 2005).
13) Chenoweth, L. (1998), "Facilitating the process of critical thinking for nursing", *Nurse Education Today*, vol. 18, no. 4, pp. 281-292.
14) Daley, B. J. (1996), "Concept maps: Linking nursing theory to clinical nursing practice", *The Journal of Continuing Education in Nursing*, vol. 27, no. 1, pp. 17-27.
15) Daley, B. J., Shaw, C. R., Balistrieri, T., Glasenapp, K., & Piacentine, L. (1999), "Concept maps: a strategy to teach and evaluate critical thinking", *Journal of Nursing Education*, vol. 38, no. 1, pp. 42-47.
16) Davies, L. & Iqbal, Z. (1997), "Tensions in Teacher Training for School Effectiveness: The Case of Pakistan", *School Effectiveness and School Improvement*, vol. 8, no. 2, pp. 254-266.
17) Gul, R. B. & Boman, J. A. (2006), "Concept mapping: A strategy for teaching and evaluation in nursing education", *Nurse Education in Practice*, vol. 6, pp. 199-206.

18) Hicks-Moore, S. L. (2005), "Clinical concept maps in nursing education: An effective way to link theory and practice", *Nurse Education in Practice*, vol. 5, no. 6, pp. 348-352.
19) Irvine, L. M. (1995), "Can concept mapping be used to promote meaningful learning in nurse education?", *Journal of Advanced Nursing*, vol. 21, no. 6, pp. 1175-1179.
20) Kamal, I. (1999), *Report on the evaluation of implementation of the revised Nursing Curriculum in Pakistan*, Rahnuma, Karachi, Pakistan.
21) Khalid, S. M. & Khan, M. F. (2006), "Pakistan: The state of education", *The Muslim World*, vol. 96, pp. 305-322.
22) Luckowski, A. (2003), "Concept mapping as a critical thinking tool for nurse educators", *Journal for Nurses in Staff Development*, vol. 19, no. 5, pp. 228-233.
23) Novak, D. J. (1992), "The theory underlying concept maps and how to construct them". Cornell University, available at: http://cmap.coginst.uwf.edu/info/. (accessed 20 April, 2006).
24) Novak, J. D. & Gowin, D. B. (1984), *Learning how to learn*, Cambridge University Press, New York.
25) Reynolds, A. (1994), "Patho-flow diagramming: a strategy for critical thinking and clinical decision making", *Journal of Nursing Education*, vol. 33, no. 7, pp. 333-336.
26) Roberts, C. M., Sucher, K., Perrin, D. G., & Rodriguez, S. (1995), "Concept mapping: An effective instructional strategy for diet therapy", *Journal of the American Dietetic Association*, vol. *95*, no. 8, pp. 908-911.
27) Simpson, E. & Courtney, M. (2002), "Critical thinking in nursing education: Literature review", *International Journal of Nursing Practice*, vol. 8, no. 2, pp. 89-98.
28) Staib, S. (2003), "Teaching and measuring critical thinking", *Journal of Nursing Education*, vol. 42, no. 11, pp. 498-508.
29) Wade, G. H. (1998), "A concept analysis of personal transformation", *Journal of Advanced Nursing*, vol. 28, no. 4, pp. 713-719.
30) West, D. C., Pomeroy, J. R., Park, J. K., Gerstenberger, E. A., & Sandoval, J. (2000), "Critical thinking in graduate medical education: A role for concept mapping assessment?", *Journal of American Medical Association*, vol. 284, no. 9, pp. 1105-1110.
31) Wheeler, L. A. & Collins, S. K. 2003, "The influence of concept mapping on critical thinking in baccalaureate nursing students", *Journal of Professional Nursing*, vol. 19, no. 6, pp. 339-346.