A systematic Review of Research on Mind Mapping and Concept Mapping to Develop Reading Comprehension

Dr. P. Arul Nehru
Assistant Professor in Pedagogy of English
Regional Institute of Education (NCERT), Mysuru

ABSTRACT

This paper reviews research about the use of mind maps and concept maps for learning and developing reading comprehension. Although plethora of research have been conducted and explored the effective reading practices with reading strategies as SQ3R, research about the meaningful learning theories and their effects in information organizers are less firmly established. The paper reviewed literature systematically, analysis of variables and discussion of findings. The learners who used mind maps or concept maps found easier to recall the information, explain the concepts, answer the comprehension questions, writing summaries and they have outperformed those who learnt with traditional reading strategies. The review suggests for future research in reading comprehension with mind maps or concept maps as a simplified concept management and meaningful organization of information graphically.

Keywords: *Reading comprehension, mind map, concept map, semantic map, cognitive map, graphic organizers*

INTRODUCATION

In this review, an attempt has been made to cull out information related to studies using mind maps for developing reading comprehension are reviewed and reported in brief here. Researchers are enthusiastic about the potential of graphic organizers as a relatively simple method of collecting information from material and promoting reading comprehension and retention of content (Hawk, McLeod, and Jonassen, 1985, Moore and Readence, 1983). Maestas and Croll (1985) carried out a study on the '*effects of training in story mapping procedures on the reading comprehension of poor readers'*. It was found that there was an increase in the students' ability to answer comprehension questions and increased tendency to maintain story mapping component in their story recall.

Ausubel (1968) suggested that advanced organizers increased learning and aid recall because they help clarify and organize the learner's cognitive structure prior to the learning task. Several studies compared high school students and college undergraduates who received mixtures of 'pictorial information' and 'verbal instructions' with students who received only verbal instructions. Supplementing pictures with the verbal information resulted in better performance on comprehension tests (Arnold and Dwyer, 1975; Booher, 1975; Rigney and Lutz, 1976). Eric Jensen (1998) states that many successful teachers find that mind maps or other graphic organizers help students keep their learning fresh.

A research study with reading disabled subjects that used mapping to highlight the structure and major points of a text before reading, demonstrated that nineteen out of twenty seven youngsters had higher comprehension scores compared to when mapping was not used (Sinatra, Stahl-Gemake, and Berg, 1984). Some researchers examining the effectiveness of having students graphically depict the relationships among major concepts in text (concept mapping) have found benefits that carry over to related language activities. Students who used concept mapping as a pre-writing exercise were able to write longer, higher quality essays (Ruddell and Boyle, 1984). Those who were taught to map or flowchart their understanding of expository material not only improved in mastery of the mapped material, but also improved in general reading ability as measured by a Standardized Reading Test (Geva, 1983).

Braden (1983) has suggested that information displayed visually in an outline presents more to the reader than the traditionally arranged text. He adds that the graphic can be used to enrich and organize verbal material – some outline will be linear, others will be hierarchical, and others may have a loose array of subtopics. A major classroom value of such maps lies in the way that they holistically conceptualize content. The network of nodes and connections lines displays the relationship of the whole to the parts and the parts to the whole. The relationships expressed through the overall configuration and connective links are more important in conceptual development than how the nodes themselves are shaped. Moreover, when the instructor puts such a network of information-bearing nodes and connecting link relationships on the chalkboard or overhead prior to reading or writing, students can see how the new ideas assimilate with their previous knowledge. Visual displays convey information in a form that is easier to perceive.

'Using Semantic Mapping after reading to organize and write original discourse', a study conducted by Richard Sinatra (1986), promotes the use of this strategy. This has also been acknowledged on three reading reference flipchart pages in *New Directions in Reading Instruction* (IRA, 1988) as an interactive strategy to use "between reader and text by which meaning is found and created" (p- 425). Subjects of this study had an average verbal SAT score of 39 and their average reading comprehension score on the Nelson Denny Reading Test was a grade equivalent of 10.2 (SD=2.4). When reading comprehension measured prior to and after a semester of map usage, a mean grade level improvement of 1.58 was found (Sinatra, 1984). A study on '*Teaching Concept Mapping and University level study strategies using computers'*, by Larry Mikulecky (1989) agrees that graphic aids are important in reading comprehension. The students (treatment group), who paid attention to graphic displays while reading, scored significantly higher on both post tests conducted. The control group averaged 63 out of a possible 100 points on each examination, while the treatment group averaged 80 points as per the results showed in the study (Mikulecky 1989).

Another study on '*Content Area Cognitive Mapping for Reading and Writing Proficiency*' was conducted by Mark Lea Peresich (1990). While many skills are necessary for reading and learning from textbooks, one skill consistently cited across all content areas and grade levels is the ability to read and interpret graphic displays. This is graphical literacy, defined as the ability to interpret charts, maps, graphics, and other pictorial presentations used to supplement prose in textbooks, nonfiction trade-books, and newspapers (Tierney, Readence, and Dishner, 1990). The study was conducted with eleventh graders who took the Basic Skills Assessments required by the state of Mississippi during 1988 and 1989 school years. The results showed that for 413 students who took the three assessments, 28 failed in the Written Comprehension test (a 93% pass rate), 10 failed in the Reading Comprehension test (a 95 % pass rate), and only 2 students failed in the Written Essay Assessment (99.5 % pass rate). At the end of 1989, after a period of intervention enabling the students to use mind maps, 367 eleventh grade students took the three assessments. Nine failed in the Written Comprehension Test (a 97.5% pass rate), three failed in the Reading Comprehension Test (a 99.2% pass rate) and no students failed in the Written Essay Assessment (a 100% pass rate). Moreover, for the Written Essay, only 3% or 10 students fell below average while many more students than in previous years' assessments ranked in the highest three writing categories of excellent, good, and above average.

Year of examinations	1988	1989
Written Comprehension test	93%	97.5%
Reading Comprehension Test	95 %	99.2%
Written Essay Assessment	99.5 %	100%

This shows that there was a significant improvement in the three assessments conducted at the end of 1989 (Spires, 1990).

McCagg and Dansereau (1991) studied the efficacy of a specific type of spatial learning strategy. They tested the effects of student-generated knowledge maps on psychology students and found that mapping had a positive effect on students' memory retention, based on performance on recognition and recall tests. They also found that the effects were maintained over time. Boyle (1996) studied the effects of teaching a cognitive mapping strategy to middle school students with mild learning disabilities or mild mental retardation. He specifically researched changes in students' literal and inferential reading comprehension. The students were taught to use a cognitive mapping strategy which provided a series of steps to follow for constructing cognitive maps while they read. The study found

that students with mild disabilities could improve their reading comprehension of short passages once they were taught the strategy, and that they could complete the maps independently and accurately. However, students' scores on standardized tests did not show significant changes, and they found that the students did not use their new strategy on the tests, so they had not transferred their knowledge to a new situation. A study (Deesri, 2002) conducted with Mathayomasuksa students discovered that the post-test mean score in English reading comprehension of students who were taught by mind mapping techniques was significantly higher than those in their pre-test. The students' attitude towards the mind mapping techniques also showed up positive.

The most recent is a study which anlaysed the results from the use of three different concept-mapping approaches with 126 fifth-graders in Taiwan (Chang, Sung and Chen, 2007). The researchers designed three approaches – map correction, scaffold fading and map generation – and tested the effects of each on students' reading comprehension and summarization skills. With map correction, students were provided a map that was "completed" by the teacher/expert, but 30% - 40% of the map was incorrect and the students were to find and correct the errors, after reading information about the concept. Results showed that map-correction had the most significant, positive effect on reading comprehension and summarization skills. There was one control group and three experimental groups, namely, the map-correction, scaffold-fading, and map-generation groups in this study. The three experimental groups used the same articles for reading materials, but each received a different map-construction exercise, as follows:

1) The map-correction group was given an expert-generated concept map that was partly revised to contain incorrect concepts and semantic links.
2) The scaffold-fading group was given a seven-unit training course. Their map construction procedures were based on the 3D scaffolding instruction model by Kao and Lehman (1997).
3) The map-generation group was given only articles for reading. When the participants finished reading, they extracted concepts and semantic links from the text to construct concept maps for the articles by themselves.

It was observed that the scaffold-fading method significantly improved participants' summarization skills, compared to the map generation and control groups. The authors also deduced that the process of concept mapping is very similar to the steps necessary for summarization, and that the concept mapping may have effectively transferred to summarization skills, even though the connection was not explicitly made by the teachers. The end survey showed an interesting distinction: although more than half of the students reported that they used concept maps to help understand things, students also responded affirmatively that concept mapping helped them, but not with reading. In the open-ended question at the end of the survey subjects responded that, 'Concept mapping gets a little overfull, and a little hard to understand!' Five students indicated that concept mapping helps them, but not with reading. Generally, this research showed that concept mapping had no significant impact on reading comprehension with this population of language arts lab students. The researcher realized that learning concept mapping is a powerful assessment of understanding. Marilee Sprenger (2010) stated that in a brain-compatible classroom there are always choices. The brain loves music, and the digital brain will respond to various approaches to using it. Because vision is the dominant sense for most students, creating visuals such as mind maps will help many of our students. Since mind mapping is a brain compatible note-taking strategy and has been effective for developing reading skills of the students, using pictures and symbols in mind maps will definitely prove effective.

In a study on '*Assessing with mind maps'* Justin Scoggin (2011) attempted to find answers to the following questions: Who has the time to teach students how to make decent mind maps? How can students effectively share their mind maps with others? How can we know if students have understood or appreciated mind maps made by others? Is the potential learning gained by this activity worth the effort? The context of his research was a seven-week course he taught called '*Assessment for Learning in Blended Environments'*, a blend of three on-site and seven on-line classes, graduate level training course for teachers learning to design and deliver on-line courses. So, he formed five groups of three or four trainees each for the purpose of mapping concepts and lessons learned from each class. Two mind maps had to be made using the free web application called bubbl.us, a user-friendly and powerful tool for creating collaborative digital mind maps. The group had to complete mind maps and export to the wiki and all of the other trainees were asked to give formative feedback through questions, suggestions and words of encouragement. Both the maps and comments were given marks making the whole exercise formative. The study found that groups posted all ten maps and each map stimulated an average of slightly over fourteen trainee comments. The maps reflect understanding and to a lesser degree, learning. The researcher found that the maps that

evidenced less effort or understanding garnered more insightful comments from others than the more detailed and complete maps. He concluded that mind mapping can be a good learning tool. Trainees enjoy them, it provides opportunities for them to teach each other, deepen their understanding and effectively demonstrate comprehension. Mind maps seem to be best used to formatively assess trainees, preparing them for summative assessment activities that require application of the key concepts trainees used to make their maps.

A study on '*Using Mind Mapping Technique to Improve Reading Comprehension Ability of Thai EFL University Students'* (Siriphanich and Laohawiriyanon, 2010) describes an investigation into the use of mind mapping technique, whether it can improve reading comprehension ability, and students' opinions towards the use of mind mapping technique. The research design used in this study was one-group pre-test-post-test design. The study employed both quantitative and qualitative data analyses from pre-and post-tests, a questionnaire, and an interview. The results suggested that 1) The English reading comprehension post-test mean score of students was higher than the pretest mean score at the 0.05 level of significance; 2) most students were satisfied with their own reading comprehension ability; 3) they enjoyed working in group and agreed that mind mapping technique was a useful technique and can be applied to non- English subjects.

A study on the '*use of mind mapping techniques to improve the poor readers' reading ability at Rajabhat University'* (Songkhla, 2010) is an effort made to investigate the students' attitude towards the use of mind mapping techniques to enhance their reading ability. The results from the study shows that, after teaching mind mapping techniques, the majority of the students improved their reading ability and their post-test mean score was 12.15 compared to the pre-test mean score which was 11.17. The post-test mean score was higher than pre-test mean score at the 0.05 level of significance. However, the fact that only 60% of the students in this study could improve their reading comprehension ability and 22.8% did not improve made it interesting to unfold why it was the case. It can be argued that due to their poor reading ability, it was rather difficult for them to deal with the reading at a higher level such as summarizing reading passages. The students' inadequacy in many areas such as vocabularies, grammatical knowledge, finding main ideas can all cause problems.

'*Improving reading comprehensions skills by using mind mapping software with students of bachelor's degree in English attending reading and writing in English II Course at Universidad of oriente univo*', is a report of a study conducted by San Miguel (2010). This study used a mind mapping software as a technique for the improvement of reading comprehension skills with students of Bachelor's Degree in English Attending Reading and Writing in English II Course. The results showed that mind mapping software helped students in reading and writing and their performance significantly improved. '*Neuroscience and Reading: A Review for Reading Education Researchers*' published by Hruby and Goswami, (2011) reviews recent neuroscience research on correlates of proposed cognitive sub-processes in text decoding and reading comprehension and analyzes some of the methodological and conceptual challenges of bridging neuroscience and literacy education research. They noted that the diverse neural activity demonstrated in research on text comprehension contradicts our traditional categorical distinctions about the role of syntax, semantics, and discourse in meaning-making with language. They tried to conclude that contribution from neuroscience offer the possibility of interdisciplinary integration of brain, social, cognitive, and cultural perspectives in ways beneficial for reading education. Varma, McCandliss, and Schwartz (2008) suggest that the neuroscience of reading processes is most impressive in its sophistication. They briefly describe the current state of the science regarding neural correlates of acknowledged and potential reading processes and reading development. Specifically, they review the neural correlates of decoding and language comprehension and relate such findings to current models of reading, reading instruction, and reading disability. Studies of neural activation during reading can show us where and when reading processes occur in the brain. More promising, brain imaging research may help alert us to disparities between the categories of reading sub-process demonstrated in the neurological research and those variously employed in models of reading (see examples in Ruddell and Unrau, 2004).

It is also important to be aware that by introducing mind mapping, students are given a choice to read better. A meta-analysis by Marzano, Pickering, and Pollack (2001) shows that nonlinguistic representations are one way to improve student achievement. Nonlinguistic representations are a way of imaging information, but it must not be in picture form. Students may represent their learning through movement, pictures, sounds, and smells. It is more likely that they will choose movement or pictures, and those pictures may be in the form of graphic organizers, drawings, or mind maps (Danny Brassell and Timothy Rasinski, 2008). The means of representing ideas in diagrams with node-link assemblies has been termed concept mapping (Novak and Gowin, 1984), knowledge mapping (O'Donnell, Dansereau, and Hall, 2002), and mind mapping (Buzan and Buzan, 1993). When used as a part of instruction, these

types of mapping techniques have shown an increase in students' achievement scores (Horton et al., 1993) and knowledge retention (Nesbit and Adescope, 2006). Therefore, there is a need for further research to explore the area of reading comprehension with the help of graphic organizers such as mind maps, concept maps, semantic maps, etc.

CONCLUSION

This paper has presented the concept of mind mapping and types of mapping available to map the information from a text. The review of the related study shows that the use of mind mapping has always demonstrated significant effects on reading skills of the learners. The review provides a platform for further research, as much more research is needed to sufficiently broaden the understanding of the effectiveness of the mind map to enhance reading skills.

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