Using Concept Maps as an Educational Tool

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Using concept maps is a graphical technique that allows students to reflect upon and develop relationships between complex subjects. Concept maps also help students acquire new information by connecting concepts and ideas. Concept maps support critical thinking and problem solving (Smith, 2014). Ural and Ercan's study looks into the history, types, uses and value to education that concept maps provide.

Title and brief description of paper

In order to explain concept maps, we need to understand the effects concept maps have on student learning. In the study, "The Effects of Web-Based Educational Software Enriched by Concept Maps on Learning of Structure and Properties of Matter." The study examines the effects of online instructional resources enriched by concept maps (Ural & Ercan, 2015).

Summary of the review of literature

This study concentrated on understanding the effects of concept maps used in a traditional based learning environment, as opposed to a computer based learning environment supported by concepts maps. The study highlighted that concept maps help students identify relationships, demonstrate their learning, as well as allows students to revisit and revise their learning.

Analysis of methodology

The research model was a "Pretest-Posttest Control Quasi Experimental Design." Using this research model allowed the researchers to randomly assign one group as the experimental group, and the other as the control group. The study was conducted in a secondary school in Kahramanmaras, Turkey during the second semester of the 2012-2013 school year. There were 58 students in the study, 29 were in the experimental group and 29 were in the control group.

The students were studying the Science and Technology unit, "Structure and Properties of Matter." For four weeks the experimental group used instructional software, which contained concept maps, visuals and other graphics, while the controlled group received instruction in a traditional learning environment. Prior to the science lesson all of the students were given the same pre-test, and that data was collected and reviewed. One week later instruction began, and the experimental group received computer-based instruction, and the control group received information traditionally. The data collection tools were: *Science and Technology Attitude Scale; Computer Attitude Scale; and Structure of Matter Achievement Test*.

Summary of results

The data from the post-tests revealed that academic achievement was higher for the students in the experimental group using web-based learning materials. The software program used contained rich graphics, allowed the student to monitor their own learning by reviewing or repeating the learning materials as often as needed to acquire the information, as well as the concept maps in the instructional material allowed the students to demonstrate prior knowledge.

My opinion about research

This was one of the best studies I have ever reviewed. It was methodical and well prepared. It was also easy to understand the questions the researchers were looking to answer. The primary question of the study was: "is web assisted instructional material enriched by concept maps" to improve academic achievement? Because our students were born in the age of digital technology, they responded very positively to online learning.

What did I learn from the study

I learned that concept maps improve and enhance the digital learning experience. Teachers need to use concept maps in classes to allow students to attach prior knowledge to new concepts, and therefore improve student learning.

Title and brief description of paper

The title of the research I read on the history of concept maps is "The Origins of the Concept Mapping Tool and the Continuing Evolution of the Tool," written jointly by Joseph D. Novak, Professor Emeritus at Cornell University, and Alberto J. Canos, Associate Director at the Florida Institute for Human & Machine Cognition (Novak & Canas, 2006). The research provided a look into how concept-mapping evolved.

Summary of the review of literature

A study at Cornell University studied first and second grade children, and how the students learn basic science concepts. The study followed the students for twelve years, and this study led to the need for a new tool to describe children's conceptual understanding of new information. The study took place in 1971, and resulted in the invention of the concept map.

Analysis of methodology

The research began in 1971. It was centered on Jean Piaget's study on cognitive operational states. The questions for the study were:

1. Are cognitive limitations the result of brain development, or the kind of education students are receiving?

2. With proper instruction, can six to eight year-olds gain enough understanding of a subject, to retain and apply the information for later learning?

3. Can the development of children's learning be observed?

4.   Will the results from the study support Ausubel's assimilation theory of learning? David Ausubel believed that children made since of their world with knowledge they already have.

The study was conducted in West Florida, with the same students for a period of twelve years. The data was gathered through interviews, which were tape-recorded. Graduate students working on the study transcribed the children's tape-recorded answers. The interviewers were looking to ascertain how much information the students were learning in two separate study groups.

The students involved in the study were first grade children (age 6). There were 191 children studied, who received 28 audio-tutorial lessons in first and second grade, and 48 children who did not receive these lesson. The children were interviewed periodically through grade twelve to ascertain how much they had learned. All students were interviewed on the concepts of matter, energy and energy transformations. Over the years, not all participants were interviewed due to a lack of staff, therefore, only random children were selected to be interviewed. The study was based on young children's ability to learn science concepts, and how prior learning impacted later schooling.

Summary of results

The results from the study yielded that the 191 children who received audio-tutorial lessons, as well as with lessons that contained pictures, manipulatives and other types of learning materials, retained more information that could be used for later learning, and applied as prior knowledge. These students performed better than students who did not receive technology-enhanced instruction.

My opinion about research

The research was good, however, the findings of the research were not the data from the research, it was the discovery of the concept map. This study demonstrated how the concept map was developed. The research found that meaningful learning, facilitated by different stimuli and media, is important in building knowledge for future learning. Additionally, the study also found that rote learning contributed little to helping a student acquire and retain information.

What did I learn from the study

Concept maps were born out of interviews conducted and transcribed by graduate students. Random children were interviewed over a period of twelve years. As the graduate students were transcribing the information, they found that the interviews could easily be turned into a concept map. It further showed that the interviews in a concept map layout graphically became a powerful knowledge representation tool. Additionally, I learned that concept maps are arranged hierarchically, with the most general at the top. Further, statements or propositions show a relationship between two ideas, and that there may also be cross-inks demonstrating relationships between ideas.

There are many types of concept maps that students may use for different assignments. Some of types of concept maps are:

1. Problem-Solution Map;

2. Process Development Map;

3. Persuasive Argument Map;

4. Characteristics Map;

5. Research Topic Map; and

6. Narrative Story Line (Margerum-Leys, 1999).

Title and brief description of paper

In the study, "Mind Maps as Facilitative Tools in Science Education," researchers explored the perceptions, attitudes and willingness of pre-service teachers as they learn about concept maps. As listed above, there are many types of concept maps available to teachers and students to use, therefore, this study was particularly interesting inasmuch as the pre-service teachers knew little about concept maps. This study's objectives were to research if pre-service science teachers were aware of concept maps, and do they understand or believe that concept maps are useful educational tools (Safar, Jafer, & Alqadiri, 2014).

Summary of the review of literature

Since 1977 when Joseph Novak developed and published his educational theory on how concept maps support student learning, educators world-wide have been using and researching concept maps, however, there was no study in the Arab Gulf Cooperation Council (AGCC). This research provided information for the AGCC's policy and decision makers, scholars and teachers regarding the implantation and integrating of computer-based concept maps.

Analysis of methodology

A descriptive research design was used in the study to collect the pre-service science teachers' knowledge of concept maps and software. A descriptive research design allows assessment of reaction, learning, transfer, results and return on investment. The pre-service teachers' responses ranged from strongly agree to strong disagree. Thirty-one female junior and senior undergraduate students, attending the College of Education at Kuwait University, enrolled in "Elementary Science Teaching Methods" during the 2011-2012 school year were studied. The pre-service teachers were asked to perform several tasks. First, the teachers were given an introduction of concept maps and how they benefit student learning. Next, the pre-service

teachers were asked to select a topic and construct a hand-made concept map about their topic.

Later, the pre-service teachers were asked to use any type of computer program to create their

concept map. After the pre-service teachers were allowed to independently develop concept

maps, the researchers introduced concept-mapping software.

Summary of results

The questions addressed the awareness of the pre-service teachers' understanding of

concept maps. The questions focused on pre-service teachers utilization, satisfaction,

complication, usefulness and reaction to concept maps. All of the students had never used

concept-mapping software, however, all of the students responded positively to concept mapping

utilization. All pre-service teachers viewed concept mapping as a valuable and appropriate

teaching tool.

My opinion about the research

This was very good research. In the "Conclusions and Recommendations" section of the

study it makes very specific recommendations, which should certainly be revisited. The bottom

line is that the research concluded that positive learning outcomes occur through concept

mapping. While the research did not reveal what types of concept maps were created by the pre-

service teachers, there are many styles and uses for concept maps in any learning environment,

whether a traditional classroom or web-based.

What did I learn from the study

This study expanded my ideas for concept maps. Concept maps can have links to

graphics, video, audio clips, text, charts, tables, documents, etc. Further, concept maps are a very

valuable tool in providing information, thereby creating ease of knowledge acquisition of information for the learner. While students do not necessarily understand that concept maps allow indexing of information, concept maps are a powerful tool for teachers to use to teach students how to acquire information quickly and digitally.

Title and brief description of paper

There are many uses for concept maps in the educational arena, as well as business, medical and legal. There are also just as many online concept map tools to enhance teaching and learning. This paper investigates how concept maps were transformed by the advent of the Internet. Once concept maps could be manipulated on a computer screen, concept maps became a global educational tool. In the article, "Effects of Touch Technology-based Concept Mapping on Students' Learning Attitudes and Perceptions (Hwang, Wu & Kuo, 2013), the researchers discuss the impact concepts maps have on learners in a technology based environment opposed to a paper and pencil learning environment.

Summary of the review of literature

Concept maps are rapidly evolving due to information technology. Two experimental groups and one control group were used to study three types of learning strategies using concept maps. The researchers sought to clarify if the students who learn with touch technology based concept-mapping show a significant better attitude toward learning natural science, compared to students who learn with traditional paper and pencil method.

Analysis of methodology

To gather accurate data three variables were considered that could affect the outcome of the research. The variables were the: instruction; amount of learning time; and the subject students were studying.

The study was conducted in southern Taiwan in an elementary school. Ninety-two sixth graders (ages 12-13) from three different classes participated in the study. Of the three classes studied, one was controlled and the other two were experimental. Group One consisted of 31 students who learned with an Interactive White Board concept mapping approach, Group Two also had 31 students who learned with touch-screen based concept mapping, and Group Three (or the control group) learned with a paper and pencil concept mapping approach.

The two measuring tools used in the study were a student learning attitude questionnaire, as well as a questionnaire inquiring as to the acceptance by the students of concept mapping. The students were asked to complete the questionnaires prior to the concept mapping instructional activity. During instruction, two groups were introduced to computer-based concept mapping tools, and the other group was instructed using paper and pencil. Upon completion of the instructional activities, all students were asked to complete another questionnaire on their learning attitudes toward concept mapping.

Summary of results

The outcome of the learning attitudes study was quite surprising. The group using a teacher led Interactive White Board concept mapping approach showed significant improvement in learning after the instructional activity, indicating the Interactive White Board, as well as teacher-peer interaction, positively impacted student learning. The group using touchscreen-based learning shows no significant improvement. Further, the study revealed that students in the paper and pencil group showed a decline in their attitude toward learning, which indicated that paper and pencil concept mapping could have a negative impact on student learning.

My opinion about research

Studying attitudes to gather data is difficult, especially when working with children. There are so many variables that could affect a student's attitude the day of a study, such as hunger, illness, fatigue, etc. Additionally, the research analyzed different types of subjective data, such as learning attitudes and perceived ease of use of the three different concept mapping approaches. Ultimately and contrary to the learning attitudes discussed above, the perceived ease of use study revealed that the students using the touchscreen concept mapping approach showed increased learning achievement, and the students in a teacher led Interactive White Board learning environment decreased, making a strong argument for allowing students practice time and interaction with new knowledge. The final results were confusing, and I did not think this was a good study.

What did I learn from the study

Students in the 21st Century are accustomed to learning with technology, and technology enhances student achievement. Students also need a balance of instructional delivery styles. Students need less teacher talk and more practice and integration time of new concepts to acquire new knowledge. In order for a meaningful learning environment to exist, teachers need to be knowledgeable of student-centered, technology based concept mapping to improve student achievement.

Title and brief description of paper

Helping students develop critical thinking skills is a global educational concern. As technology and the digital age evolve, so do the ways our students think, evaluate, analyze and make decisions. The article, "Making Student Thinking Visible Through a Concept Map in Computer-Based Assessment of Critical Thinking," captures what the studies discussed in this

paper are seeking to prove. This research demonstrates that computer-based learning and thinking tools, such as concept maps, support student achievement (Rosen & Tager, 2014).

Summary of the review of literature

Thinking tools, or concept maps, are a qualitative means to measure students' complex thinking skills. Identifying the role that concept mappings plays in helpful students achieve critical thinking skills is important in developing learning tasks that will yield meaningful learning. At this point in time, most students and households have access to a computer other type of device. This study was conducted in four countries, the United States, Africa, United Kingdom and Singapore. Computer-based instruction allowed for analysis of data from the different countries.

Analysis of methodology

The study was conducted in the United States, Africa, United Kingdom and Singapore. The participants were 14 years old, and there were 190 participants involved in the study. The study took place from November 2012 to January 2013. The schools invited to participate in the study demonstrated that the school teaches and is involved in 21st Century learning and projects; the students spoke English; and each school had enough computers in the building for individual student access, as well as high speed internet, to support the study. Additionally, the participants all had similar GPA, ELA and Math grades. The closeness of grade averages allowed for an equitable study of critical thinking skills.

Two computer-based strategies were used to study the students' critical thinking performance. A group of 102 students participated in the Evidence-Centered Concept Map mode, and 88 students participated in the notepad mode. The students were given tasks in both modes and no time limit was placed on the tasks. Teachers at the schools monitored the activity

to ensure students stayed on task. Student scores were collected and analyzed with rubrics developed for the study.

Summary of results

The study identified that students' critical thinking skills significantly improved when working in the Evidence-Centered Concept Map mode, and they scored higher than students who were assessed in the notepad mode. It also found that females scored higher than males in critical thinking in the Evidence-Centered Concept Map mode, however, both male and female students scored similarly in the notepad mode.

My opinion about the research

This was a very interesting study, particularly since, in my opinion, we often consider males to be the higher users of technology. The study demonstrated that students who use concept maps to organize their thinking experienced higher achievement, synthesis of information, as well as the ability to make connections between separate pieces of information.

What did I learn from the study

The studies presented confirmed that concept maps are a powerful organizational learning tool. Concept mapping supports, guides and extends student learning. Computer-based concept mapping creates a plus-plus learning environment for students. Additionally, the studies reviewed demonstrated that concept maps are educational tools, which support higher order thinking. In conclusion, concept mapping facilitates the task of analyzing different pieces of information to solve a problem. From the invention concept maps, throughout their history, the evolution of different types of concept maps and different uses, concept maps have been proven to efficient and effective critical thinking and problem solving tools that support our students as they move through their academic and personal lives.

References

Dougherty, J. j., Custer, R. c., & Dixon, R. r. (2012). Mapping Concepts for Learning and

Assessment. *Technology & Engineering Teacher*, *71*(8), 10-14.

Gwo-Jen Hwang1, g., Chih-Hsiang Wu2, p., & Fan-Ray Kuo3, r. (2013). Effects of

Touch Technology-based Concept Mapping on Students' Learning Attitudes and

Perceptions. *Journal Of Educational Technology & Society*, *16*(3), 274-285.

Margerum-Leys, J. (1999). Types of Maps. Retrieved June 25, 2015, from

http://www-perspma;/umich.edu/~jmargeru/conceptmap/types.htm

Novak, J., & Canas, A. (2006). The origins of the concept mapping tool and the

continuing evolution of the tool. *Information Visualization Journal*, 175-184. Retrieved

June 23, 2015, from

http://cmpa.ihmc.us/publications/researchpapers/originsofconceptmappingtool

Rosen, Y., & Tager, M. (2014). Making Student Thinking Visible through a Concept

Map in Computer-Based Assessment of Critical Thinking. *Journal Of Educational

Computing Research*, *50*(2), 249-270.

SAFAR, A. H., JAFER, Y. J., & ALQADIRI, M. A. (2014). MIND MAPS AS FACILITATIVE

TOOLS IN SCIENCE EDUCATION. *College Student Journal*, *48*(4), 629-647.

Smith, R. O. (2014). Beyond Passive Learning: Problem-Based Learning and Concept Maps to

Promote Basic and Higher-Order Thinking in Basic Skills Instruction. *Journal Of

Research & Practice For Adult Literacy, Secondary & Basic Education*, *3*(2), 50-55.

Ural, E., & Ercan, O. (2015). THE EFFECTS OF WEB-BASED EDUCATIONAL SOFTWARE

ENRICHED BY CONCEPT MAPS ON LEARNING OF STRUCTURE AND

PROPERTIES OF MATTER. *Journal Of Baltic Science Education*, *14*(1), 7.