# A STUDY OF ATTITUDE OF SECONDARY SCHOOL STUDENTS TOWARDS CONCEPT MAPPING STRATEGY FOR TEACHING SCIENCE

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**Meaning of Concept Mapping**

In the recent two decays, concept maps have been widely used both to promote and to measure meaningful learning in various disciplines, especially in science teaching (Kinchin 2000a; Novak & Gowin 1984). It has also been applied in a range of contexts such as teacher education (Trent et al. 1998) and evaluation of students' misconceptions (Bartels 1995) or conceptual change (Kinchin 2000b; Trent et al. 1998; Wallace & Mintzes 1990; Trowbridge & Wandersee 1994). The use of concept maps as an assessment tool of academic achievement is an important recent application (Aidman & Egan 1998; Parkes et al. 2000; Wilson 1994), and will form the focus of the present study in the context of an introductory statistics course for the education degree students in a Finnish university. More specifically, this study aims at examining how the students' concept map working supports their learning process and how it is related in their learning outcomes. In addition, results of the study will bring valuable knowledge, the viewpoint which has been emphasized in previous studies (Slotte & Lonka 1999); in what circumstances and what way concept mapping is truly effective to use as a tool for support students representation of statistical knowledge and what methodological limitations and improvements we have to take account in the future concept map research settings.

This study is a relatively new conquest because only a few studies (Roberts 1999; Schau & Mattern 1997) have been reported using this technique in statistics instruction until now. Roberts (1999) used concept maps to measure university science students' understanding of fundamental concepts in statistical inference and problem definition. Concept map scores were also compared with marks awarded for the practical assignment students made after their practical statistical investigation. Schau and Mattern (1997) suggest that concept maps constructed by the students may stimulate their connected understanding and enhance the formation of networks of interrelated propositions in statistics.

Much of the recent reform movement in education, especially in mathematics and science, has been based on the constructivist theory of learning. This theory explains the process of learning as actively constructing knowledge, which interacts with previous knowledge, beliefs, and intuitions. Therefore, we should encourage our students also in statistics classes (e.g. Moore & Cobb 1995; Rautopuro 1999) to be actively involved in their own learning and offer a learning environment that stimulates active learning. Thus, also tools for assess students learning and achievement should be in congruence with constructivist theory of learning.

This emphasis on the cognitive theory in research on learning (Brown et al. 1992) has contributed to the changes in the methods of assessment.

In this study, by analysing and comparing concept map- and non-concept-map groups students' knowledge of statistics before and after introductory statistics course we can also conclude how concept mapping facilitates students' conceptual change in understanding statistical concepts.

In a concept map, each word or phrase is connected to another and linked back to the original idea, word or phrase. Concept maps are a way to develop logical thinking and study skills, by revealing connections and helping students see how individual ideas form a larger whole.

Concept maps were developed to enhance meaningful “earning in the sciences. A well-made concept map grows within a context frame defined by an explicit “focus question”, while a mind map often has only branches radiating out from a central picture.

Because concept maps are constructed to reflect organization of the declarative memory system, they facilitate sense-making and meaningful learning on the part of individuals who make concept maps and those who use them.

A concept map is a special form of a web diagram for exploring knowledge and gathering and sharing information. Concept mapping is the strategy employed to develop a concept map. A concept map consists of nodes or cells that contain a concept, item or question and links. The links are labeled and denote direction with an arrow symbol.

**Theoretical Background of Concept Mapping**

The technique of concept mapping was developed by Joseph D. Novak and his research team at Cornell University in the 1970s as a means of representing the emerging science knowledge of students. It has subsequently been used as a tool to increase meaningful learning in the sciences and other subjects as well as to represent the expert knowledge of individuals and teams in education, government and business. Concept maps have their origin in the learning movement called constructivism. In particular, constructivists hold that learners actively construct knowledge.

Novak states that “meaningful learning involves the Assimilation of new concepts and propositions into existing cognitive structures.”

Concept maps are used to stimulate the generation of ideas, and are believed to aid creativity.

**Importance of Attitude Towards Concept Mapping Strategy**

Attitude is the state of consciousness within the individual human being. It refers to certain regularities of the individuals, feelings, thoughts and pre-dispositions to act toward some aspect of his environment. All attitudes imply objects towards which they

are directed. Therefore the pre-disposition of the child will decide influence and directs most of the activities of his life.

It is generally seen that the classroom teachers or researchers in comparison to cognitive achievement have paid less attention to the student's attitude. Mathematics, specially, can be quoted as an example in which very few attempts at measuring attitudes towards its study have been made. Now, models of teaching, innovation and new modern techniques of teaching especially concept mapping strategy is frequently used.

Although attitude toward concept mapping strategy for teaching Science is usually either undefined or defined by the instruments used in the study (Husen, 1967) at least two definitions of attitude in general have been used by Science educators who have been prominent in attitude research.

**Previous Studies**

Okebukola (1992) studied the Attitude of teachers towards concept mapping and vee diagramming as metalearning tools in science and mathematics. Concept mapping and vee diagramming are metalearning tools that have recently appeared on the science education scene. One of these is the observed poor attitude of mathematics teachers towards vee mapping. The other is how to assist teachers in teaching both concept mapping and vee mapping such that they can gain greater confidence, especially with teaching vee mapping in science and mathematics classrooms.

Edmundson and Smith (2000) reported that concepts maps greatly facilitated understanding of the relevant pathophyologic mechanism among the students studying eternity. Study also reported that the responses from the faculty were also very positive. It is also argued that concept can help make conceptual relationships explicitly, identify errors and omissions and reveal misconcepts in student understand.

Swarthout and Beth (2001) on 7$^{th}$ preservice elementary teacher found that the treatment group had significant positive change on mathematical achievement,

mathematics confidence and belief about the nature of mathematics, attitude towards mathematics and attitude towards concept mapping.

Rao (2003) studied on "Effectiveness of concept mapping in science on achievement, cognitive skills and attitude of students". The study concluded that there is a significant difference between the experimental and control group in science achievement, achievement in process skills, concept attainment and attitude.

Karakuyu (2010) studied on the effect of concept mapping on attitude and achievement in a physics course. The aim of this study was to investigate the effect of students' concept mapping on their physics achievement and attitudes towards physics lesson. The study reveals that the experimental group students were observed to have a tendency of more positive attitude than the control group students. Results also that drawing concept map instruction was more effective than traditional instruction in improving physics achievement of the participating students.

Starr (2015) studied Concept maps as a heuristic for science curriculum development: Toward improvement in process and product. This study outlined the use of concept maps as a tool for science curriculum development and discusses the changes that occur in the teacher's view of the curriculum with successive revisions of the maps. The use of concept maps can help science teachers to develop science curriculum that is hierarchically arranged, integrated, and conceptually driven.

The above study reveals that there are very few studies conducted on Concept Mapping in Science and attitude towards Concept Mapping Strategy for teaching Science among different population. Therefore, there is a need to conduct the experimental study on the effectiveness of concept mapping strategy on achievement in science and students' attitude towards concept mapping strategy at the secondary school level. Hence, the present study is an attempt in this direction and stated the problem.

**Design of the Study**

The study is of experimental in nature, only one experimental group is considered. The experimental group is taken intact in its natural setting without controlling many

variables. The investigator has taught experimental group by using concept mapping as instructional strategy. The intact classes of IX standard as a whole were considered as experimental group for the study. The pre-test and the post-test are adopted for the study.

**Sample of the Study**

The sample of the study consists of 40 students of IX standard studying in English Medium School of Tumkur city. The sample was drawn based on purposive and cluster sampling technique. Only one section was chosen for the study which is considered as experimental group.

**Variables of the Study**

a. **Independent Variables:** Concept Mapping Strategy and Attitude Towards Concept Mapping
b. **Dependent Variables:** Achievement in Science
c. **Moderate Variables:** Gender – Boys & Girls

**Objectives of the Study**

1. To study whether there is a significant difference between boys and girls with respect to attitude towards concept mapping and its dimensions i.e. cognitive, conative and affective scores of students of experimental group.
2. To study whether there is a significant difference between students with low and high attitude towards concept mapping with respect to pre-test, post-test and gain scores of science achievement of students of experimental group.
3. To study whether there is a significant difference between boys with low and high attitude towards concept mapping with respect to pre-test, post-test and gain scores of science achievement of students of experimental group.
4. To study whether there is a significant difference between girls with low and high attitude towards concept mapping with respect to pre-test, post-test and gain scores of science achievement of students of experimental group.

**Hypotheses of the Study**

In pursuance of above stated objectives the following hypotheses were formulated.

1. There is no significant difference between boys and girls with respect to attitude towards concept mapping and its dimensions i.e. cognitive, conative and affective scores of students of experimental group.
2. There is no significant difference between students with low and high attitude towards concept mapping with respect to pre-test, post-test and gain scores of science achievement of students of experimental group.
3. There is no significant difference between boys with low and high attitude towards concept mapping with respect to pre-test, post-test and gain scores of science achievement of students of experimental group.
4. There is no significant difference between girls with low and high attitude towards concept mapping with respect to pre-test, post-test and gain scores of science achievement of students of experimental group.

**Tools Used in the Study**

The tool used in the study was Concept Attainment test which was prepared by the investigator with the help of the research guide.

a. Concept Attainment test constructed by the investigator.
b. Concept Mapping strategy based lesson plan constructed by the investigator.
c. Attitude Scale towards Concept Mapping constructed by the investigator.

**Concept Attainment Test**

**Construction:** The concept attainment test was developed to assess the attainment of certain concepts in Science, among IX standard students. The concept attainment test in science consists of multiple choices of Twenty-five items, with a total of Twenty-five marks.

The test items were given to experts based on the area of science for valuable comments and suggestions.

**Administration:** Concept attainment test was administered to experimental group only. The science was taught by the investigator by using concept mapping to the experimental group. The same test was given as a posttest for assessing the attainment of science concepts after two weeks of teaching the unit by concept mapping and also administered the attitude scale towards concept mapping strategy to the students of experimental group only.

**Scoring:** The scoring of concept map was based on Novak's scoring criteria for concept maps.

**Scale of Attitude Towards Concept Mapping**

Attitude scales are designed to measure attitudes of an individual on a group of people towards issues, irritations and group of people.

**Meaning of Attitude:** Attitude is what a person feels or believes in. In fact it is the inner feelings of an individual, which is difficult, if not impossible to describe.

In the present study, the investigator constructed a scale of attitude towards concept mapping as the research required to study students' attitude towards concept mapping as an instructional strategy.

The construction of the tool was done in the following steps. They are Preparation of initial draft, Verification of the statements by experts, Preparation of the second draft, Validation of the attitude scale, Preparation of final draft and Method of scoring.

The construction of a tool is always to decide about the areas, which cover the content to be measured. In the present investigation for the purpose of deciding this universe of content, the available sources on the concept mapping were consulted.

The investigator has selected three dimensions for the construction of the attitude scale: 1. Cognitive Component, 2. Conative Component and 3. Affective Component

The investigator has prepared an initial draft of 35 items. The items were prepared under each dimension.

The initial draft of tool was submitted to the supervisor for evaluation. The supervisor suggested the following modification in order to make it suit the purpose of the study.

- Use of appropriate grammatical sentences
- Long statement were to be spilt into short specific statement
- Unspecific statements, which could not measure the objectives of the study, were to be excluded.

Based on the suggestions given by the supervisor for the initial draft the statements were made concise and the items were made more specific.

All the statements of the tool were of positive polarity as suggested by the supervisor. After verification of the tool, 35 items were selected for validation.

**Components of Attitudes**

1. **Cognitive Components of Attitude:** It refers to opinion or belief part of attitude. When one forms his opinion or judgement on the basis of available information and decide whether one has a favorable or unfavorable opinion on that, it the cognitive part of attitude one is talking about.
2. **Conative Component of Attitude:** It refers to the emotional aspect of attitude. This is perhaps the most often referred part of attitude and decides mostly the desirable or undesirable aspect attitude.
3. **Affective Component of Attitude:** It refers to the behavioral part of attitude. If one has positive attitude for a particular object, it is likely to be translated into a particular type of behavior, such as buying or procuring that object.

The tool was administered on 40 students as try out. Each item of the tool was tested for validity. The validity and reliability of the tool was established using Spilt half method. The reliability of the tool was found to be 0.4520. The validity of the tool was established to be 0.6723. As some of the items in the tool were found non-significant during validation, they were omitted in the final drafting.

The final draft of the tool consisted of 35 items under 3 dimensions and were mixed and rearranged.

A five-point scale was prepared to avoid central tendency effect. The points given were “Strongly Agree”, “Agree”, “Undecided”, Disagree” and “Strongly Disagree”.

The general instructions regarding the method of answering the tool were given along the tool.

**Score:** Since all the items in the attitude scale used positive polarity, the scores were given as Strongly Agree – 5, Agree – 4, Undecided – 3, Disagree – 2, Strongly Disagree – 1.

It is five point scale, it is a Likert type having 35 statements of positively worded summated score of all the 35 items provide the total attitude towards concept mapping score of pupils. The test-retest reliability of the scale was found to be 0.681 and the split half method was found to be 0.741. The intrinsic validity of the scale ranged from 0.825 to 0.844 also established its content validity.

**Administration:** The final from of the scale of attitude towards concept mapping was administrated only in the experimental group. The tool was given to pupils and they were asked to read the instructions carefully and mark their responses.

**Analysis and Interpretation of Data**

**Table-1 : Results of t-test between Boys and Girls with respect to attitude towards concept mapping and its dimensions i.e. cognitive, conative and affective scores in experimental group**

| Variable | Gender | n | Mean | SD | t-value | P-value | Signi. |
|---|---|---|---|---|---|---|---|
| Total Attitude | Boys | 20 | 163.1500 | 4.0559 | -1.1951 | >0.05 | NS |
| | Girls | 20 | 164.3500 | 1.9270 | | | |
| Cognitive | Boys | 20 | 56.1500 | 2.9961 | -0.5239 | >0.05 | NS |
| | Girls | 20 | 56.5500 | 1.6376 | | | |
| Conative | Boys | 20 | 56.0500 | 1.9050 | -0.0873 | >0.05 | NS |
| | Girls | 20 | 56.1000 | 1.7137 | | | |
| Affective | Boys | 20 | 50.9500 | 2.1145 | -1.2484 | >0.05 | NS |
| | Girls | 20 | 51.7000 | 1.6575 | | | |

From the above table it can be seen that,

- A non-significant difference is observed between Boys and Girls of experimental group with respect to attitude towards concept mapping (t=-1.1951, p>0.05) at 0.05 level of significance. Hence, the null hypothesis is accepted and alternative hypothesis is rejected. It means that the Boys and Girls of experimental group have similar attitude towards concept mapping.
- A non-significant difference is observed between Boys and Girls of experimental group with respect to dimension of attitude towards concept mapping i.e. cognitive scores (t=-0.5239, p>0.05) at 0.05 level of significance. Hence, the null hypothesis is accepted and alternative hypothesis is rejected. It means that the Boys and Girls of experimental group have similar cognitive attitude towards concept mapping.
- A non-significant difference is observed between Boys and Girls of experimental group with respect to dimension of attitude towards concept mapping i.e. conative scores (t=-0.0873, p>0.05) at 0.05 level of significance. Hence, the null hypothesis is accepted and alternative hypothesis is rejected. It means that the Boys and Girls of experimental group have similar conative attitude towards concept mapping.
- A non-significant difference is observed between Boys and Girls of experimental group with respect to dimension of attitude towards concept mapping i.e. affective scores (t=-1.2484, p>0.05) at 0.05 level of significance. Hence, the null hypothesis is accepted and alternative hypothesis is rejected. It means that the Boys and Girls of experimental group have similar affective attitude towards concept mapping.

**Table-2 : Results of t-test between students with low and high attitudes with respect to pre-test, post-test and gain scores of science achievement of students of experimental group**

| Test | Attitude | n | Mean | SD | t-value | P-value | Signi. |
|---|---|---|---|---|---|---|---|
| Pre-test | Low | 14 | 11.5000 | 1.7431 | -0.0790 | >0.05 | NS |
| | High | 26 | 11.5385 | 1.3033 | | | |
| Post-test | Low | 14 | 17.3571 | 3.3651 | 0.1199 | >0.05 | NS |
| | High | 26 | 17.2308 | 3.0765 | | | |
| Gain | Low | 14 | 5.8571 | 3.3480 | 0.1504 | >0.05 | NS |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | High | 26 | 5.6923 | 3.2835 | | | |

From the above table it can be seen that,

- A non-significant difference is observed between students with low and high attitude towards concept mapping with respect to pre-test in science achievement (t=-0.0790, p>0.05) at 0.05 level of significance. Hence, the null hypothesis is accepted and alternative hypothesis is rejected. It means that the students with low and high attitude towards concept mapping have similar pre-test science achievement of students of experimental group.
- A non-significant difference is observed between students with low and high attitude towards concept mapping with respect to post-test science achievement (t=0.1199, p>0,05) at 0.05 level of significance. Hence, the null hypothesis is accepted and alternative hypothesis is rejected. It means that the students with low and high attitude towards concept mapping have similar post-test science achievement of students of experimental group.
- A non-significant difference is observed between students with low and high attitude towards concept mapping with respect to gain of pre and post-test science achievement (t=0.1504, p>0.05) at 0.05 level of significance. Hence, the null hypothesis is accepted and alternative hypothesis is rejected. It means that the students with low and high attitude towards concept mapping have similar gain of pre and post-test science achievement of students of experimental group.

**Table-3 : Results of t-test between Boys with low and high attitudes with respect to pre-test, post-test and gain scores of science achievement of students of experimental group**

| Variable | Attitude | n | Mean | SD | t-value | P-value | Signi. |
|---|---|---|---|---|---|---|---|
| Pre-test | Low | 8 | 12.0000 | 1.6903 | 0.5324 | >0.05 | NS |
| | High | 12 | 11.5833 | 1.7299 | | | |
| Post-test | Low | 8 | 19.5000 | 2.2039 | 0.2193 | >0.05 | NS |
| | High | 12 | 19.2500 | 2.6671 | | | |
| Gain | Low | 8 | 7.5000 | 3.2950 | -0.1140 | >0.05 | NS |
| | High | 12 | 7.6667 | 3.1431 | | | |

From the above table it can be seen that,

- A non-significant difference is observed between Boys with low and high attitude towards concept mapping with respect to pre-test science achievement (t=0.5324, p>0.05) at 0.05 level of significance. Hence, the null hypothesis is accepted and alternative hypothesis is rejected. It means that the Boys with low and high attitude towards concept mapping have similar pre-test science achievement of students of experimental group.
- A non-significant difference is observed between Boys with low and high attitude towards concept mapping with respect to post-test science achievement (t=0.2193, p>0.05) at 0.05 level of significance. Hence, the null hypothesis is accepted and alternative hypothesis is rejected. It means that the Boys with low and high attitude towards concept mapping have similar post-test science achievement of students of experimental group.
- A non-significant difference is observed between Boys with low and high attitude towards concept mapping with respect to gain of pre and post-test science achievement (t=-0.1140, p>0.05) at 0.05 level of significance. Hence, the null hypothesis is accepted and alternative hypothesis is rejected. It means that the Boys with low and high attitude towards concept mapping have similar gain of pre and post-test science achievement of students of experimental group.

**Table-4 : Results of t-test between Girls with low and high attitudes with respect to pre-test, post-test and gain scores of science achievement of students of experimental group**

| Variable | Attitude | n | Mean | SD | t-value | P-value | Signi. |
|---|---|---|---|---|---|---|---|
| Pre-test | Low | 6 | 10.8333 | 1.7224 | -1.1751 | >0.05 | NS |
| | High | 14 | 11.5000 | 0.8549 | | | |
| Post-test | Low | 6 | 14.5000 | 2.3452 | -0.8921 | >0.05 | NS |
| | High | 14 | 15.5000 | 2.2787 | | | |
| Gain | Low | 6 | 3.6667 | 1.9664 | -0.3000 | >0.05 | NS |
| | High | 14 | 4.0000 | 2.3859 | | | |

From the above table it can be seen that,

- A non-significant difference is observed between Girls with low and high attitude towards concept mapping with respect to pre-test science achievement (t=-11751, p>0.05) at 0.05 level of significance. Hence, the null hypothesis is accepted and alternative hypothesis is rejected. It means that the Girls with low and high attitude towards concept mapping have similar pre-test science achievement of students of experimental group.
- A non-significant difference is observed between Girls with low and high attitude towards concept mapping with respect to post-test science achievement (t=-0.8921, p>0.05) at 0.05 level of significance. Hence, the null hypothesis is accepted and alternative hypothesis is rejected. It means that the Girls with low and high attitude towards concept mapping have similar post-test science achievement of students of experimental group.
- A non-significant difference is observed between Girls with low and high attitude towards concept mapping with respect to gain of pre and post-test science achievement (t=-0.3000, p>0.05) at 0.05 level of significance. Hence, the null hypothesis is accepted and alternative hypothesis is rejected. It means that the Girls with low and high attitude towards concept mapping have similar gain of pre and post-test science achievement of students of experimental group.

**Statistical Techniques Used**

The hypotheses of the study were tested by making an analysis of the collected data with the help of descriptive and differential statistical techniques.

**Results of the Study**

On the basis of the above analysis reported from the above tables, the findings of the study are as follows:

- The Boys and Girls of experimental group have similar attitude towards concept mapping.
- The Boys and Girls of experimental group have similar cognitive attitude towards concept mapping.

- The Boys and Girls of experimental group have similar conative attitude towards concept mapping.
- The Boys and Girls of experimental group have similar affective attitude towards concept mapping.
- The students with low and high attitude towards concept mapping have similar pre-test science achievement of students of experimental group.
- The students with low and high attitude towards concept mapping have similar post-test science achievement of students of experimental group.
- The students with low and high attitude towards concept mapping have similar gain of pre and post-test science achievement of students of experimental group.
- The Boys with low and high attitude towards concept mapping have similar pre-test science achievement of students of experimental group.
- The Boys with low and high attitude towards concept mapping have similar post-test science achievement of students of experimental group.
- The Boys with low and high attitude towards concept mapping have similar gain of pre and post-test science achievement of students of experimental group.
- The Girls with low and high attitude towards concept mapping have similar pre-test science achievement of students of experimental group.
- The Girls with low and high attitude towards concept mapping have similar post-test science achievement of students of experimental group.
- The Girls with low and high attitude towards concept mapping have similar gain of pre and post-test science achievement of students of experimental group.

**Discussion and Educational Implications**

This study provides an additional insight into prior research conducted in concept mapping and its effect on learning. The findings reveal that concept mapping has a noticeable impact on student achievement and student attitudes. Further, although results of the learning outcomes are encouraging.

Investigator has found that concept maps were found to be useful tool for organizing a lecture or teaching science. Moreover, they were not only aided in planning instruction, but also has their own understanding of the subject matter been increased in students. It has to be considered that the methods of mind mapping and concept mapping can be used only if one has got familiar with them.

Results about the effect of attitude on students' concept mapping performance in this study must be viewed very conservatively because of the limited nature of instrument used in characterizing students' attitude toward mapping. Although there was a significant difference between the mean scores of groups, this result provide some support for the argument that attitude, particularly a negative one, was not a factor in concept map scores.

From the above results, it is accepted that there may be differences in attitude towards concept mapping strategy for teaching science. There is need of sufficient information and awareness about the concept mapping strategy so that student will be able to understand different concepts and they can follow very easily. Hence, there is need to construct concept mapping on various topics in science at any level of education. There is a need for training for teachers to make use of concept mapping strategy along with mixing the use of technology media. From the study, it is important and attention must be given for the development and construction of concept mapping on various topics. Teacher should encourage the students to make use of concept mapping especially the lesson which involves different concepts inturn we can easily develop desirable attitude towards concept mapping strategy.

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