

## Determining the Attitude of Undergraduate Students towards Physics through Concept Mapping

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### Abstract

*The aim of this study was to investigate the effect of using concept mapping strategy in teaching physics on the attitude towards physics. Participants were (46) first year students from two classes enrolled to the course "Fundamentals of Physics I", in Dhofar University, Oman. One of the classes was randomly selected as experimental group (23), while the other was a control group (23). The data was collected via the pre- and post attitude scale. The study was conducted within a period of 8 weeks and the class had three lessons in a week. The material covered was about mechanics. The results showed that there was a significant difference at ( $\alpha=0.05$ ) in the attitude towards physics between the experimental and the control group. The study also showed that there was no significant difference attributed to the gender and the interaction between teaching methods and gender.*

**Keywords:** Concept Mapping, Attitude towards Physics, Teaching Physics.

### 1. Introduction

Students that are at the school level or even at the university level believe that Physics is a challenge of a special type. Physics instructors also have the same viewpoint. They said that teaching Physics requires special skills and more effective approaches. There are many difficulties in teaching Physics, but making students aware of the overall picture of a set of concepts and the links between them might be the most important one. Researchers (Erdemir, 2004; Halloun and Hestenes, 1987; Van Heuvelen, 1991) have shown that conventional teaching and traditional teaching methods have negative effects on the ability of learning physics for the majority of the students. Conclusions from researches show that in order to increase the level of attitude and success in physics education, new teaching methods and technology need to be implemented into physics education (Adesoji, 2008; Gonen and Basaran, 2008; Reid & Skryabina, 2002). Exploratory researches (Craker, 2006; Normah and Salleh, 2006; Hough and Peter, 1982; Newble, 1998) have revealed the reason associated with students' attitudes towards physics courses and methods of teaching, while highlighting that they take pleasure in physics course if the students know how to plan and implement the strategies of solution to the questions through teaching methods.

Several teaching methods can be used in physics teaching, and Concept mapping is one approach. Conceptual maps are effective tools in knowledge representation; they are important tools to make learning visible, spectators and meaningful both for the person himself and to others. Meaningful learning occurs when learners can connect new knowledge with something they already know (Zaitoon, 2001). Concept mapping is an instructional tool that is currently gaining popularity in the field of science education. It is a product of recent advances in cognitive science and the new philosophy of science. Contemporary perspectives of cognitive psychologists and the new philosophers of science on cognition view learning as an active internal process of construction where the learner's prior knowledge plays a significant role in further conceptual learning (Ausubel, 1963; Ausubel, Novak and Hanesian, 1978).

The hierarchical attribute of a concept map also makes meaningful learning to proceed more easily as new concepts or concept meanings are subsumed under broader and, inclusive concepts (Novak & Gowin, 1984). Normah

and Salleh (2006) indicated that students' attitude and interests could play a substantial role among pupils studying science. The main purpose of the study is to investigate the effect of using concept mapping in teaching physics on the attitude towards physics of first year students in Dhofar University. The objectives of this study was to; determine the effect of using concept mapping in teaching physics on the attitude towards physics of first year students in Dhofar University, find out the effect of gender on the attitude towards physics of the first year students in Dhofar University and to establish the effect of the interaction between concept mapping strategy and gender on the attitude towards physics of first year students in Dhofar University.

### Statement of the Problem

This study is a direct response to the deteriorating performance by students in physics at undergraduate level. Despite using the availability of quality textbooks, appropriate learning facilities, and qualified Professors at Dhofar University, Oman, the academic achievement of the first year students is consistently poor. Physics Professors at the department discussed the problem and are in search of finding out the possible causes and solutions. The situation therefore calls for a search for alternative methods that will improve the students' attitudes towards physics. The study therefore seeks to find out the extent to which the use of Concept Mapping as a teaching strategy by teachers can impact on the students' attitude towards leaning physics.

### Research Questions

- i. What is the effect of using concept mapping in teaching physics on the attitude towards physics of first year students in Dhofar University?
- ii. What is the effect of gender on the attitude towards physics of the first year students in Dhofar University?
- iii. What is the effect of the interaction between concept mapping strategy and gender on the attitude towards physics of first year students in Dhofar University?

### Study Hypotheses

- i. There is no statistically significant difference at ( $\alpha = 0.05$ ) in the attitude towards physics of the first year students in Dhofar University attributed to using concept mapping in teaching physics.
- ii. There is no statistically significant difference at ( $\alpha = 0.05$ ) in the attitude towards physics of first year students in Dhofar University attributed to the gender of the students.
- iii. There is no statistically significant difference at ( $\alpha = 0.05$ ) in the attitude towards physics attributed to the interaction between concept mapping strategy and gender of first year students in Dhofar University.

### Research Methodology

This chapter describes the method and procedures that were followed in this study. It includes a description of study sample, instruments, and procedures for validity and reliability. It also deals with a description of the design, and the statistical treatments used in data analysis. The sample of this study consisted of (46) first year students from two classes enrolled to a course, "Fundamentals of Physics I" in Dhofar University. One of the classes was randomly selected as an experimental group (23) students and the other was a control group (23) students. Both groups are taught by the same teacher.

**Table 1:** The distribution of participants according to gender and groups.

Gender	Control group		Experimental group		Total
	N	(%)	n	(%)	
Male	10	43	16	70	26
Female	13	57	7	30	20
Total	23	50	23	50	46

n: number of participants in groups; %: percentage of participants in groups.

Study Instruments: The following instruments were used in this study :

Concept maps: Based on the topic "Mechanics", the first four chapters of Physics textbook (Serway, 8th edition).

### 1.1 Attitude Scale:

Attitude scale towards physics subject was developed by the researcher. This instrument consisted of 40 items in 5 points Likert Scale. The responses were specified: Strongly Agree (5), Agree (4), Neither (3), Disagree (2) and, Strongly Disagree(1) respectively allocate each value point for positive and reverse sort for negative responses.

The content validity of items was assessed at the time they were arranged by two physics experts and an educational psychologist. After handing the feedback, their notes were studied and the alterations were made for some paragraphs. Based on their suggestions, some items were modified. Using Cooper equation, the degree of agreement was found (78%). Darwaza (1997) indicated that the degree of agreement is acceptable if the coefficients exceeded (75%).

The reliability determination of the instrument was carried out by using Cronbach's alpha method with the scores acquired from the responses of twenty students. Cronbach's alpha was found to be 0.89. Independent variables: Teaching methods includes two levels (Concept mapping and Traditional Method) and Gender includes two levels (Female and Male). Dependent variable **the a** was attitude towards Physics.

A factorial design with two treatments (CRF<sub>2x2</sub>) has been used. The following table illustrates this design:

Teaching Method Gender	Concept Mapping	Traditional Method
Female	G <sub>1</sub>	G <sub>2</sub>
Male	G <sub>3</sub>	G <sub>4</sub>

- G<sub>1</sub> : Females group taught by concept mapping
- G<sub>2</sub> : Females group taught by traditional method
- G<sub>3</sub> : Males group taught by concept mapping
- G<sub>4</sub> : Males group taught by traditional method

### 1.2 Study Design

G1	X1	O1	O2
G2	X2	O1	O2
G3	X3	O1	O2
G4	X4	O1	O2

- O<sub>1</sub>: Performance on the pre test of attitude towards physics.
- O<sub>2</sub>: Performance on the post test of attitude towards physics.
- X<sub>1</sub>: Experimental treatment for the 1st group (Female-Concept mapping).
- X<sub>2</sub>: Experimental treatment for the 2nd group (Female-Traditional method).
- X<sub>3</sub>: Experimental treatment for the 3rd group (Male-Concept mapping).
- X<sub>4</sub>: Experimental treatment for the 4th group (Male-Traditional method).

### 1.3 Statistical Treatment:

Data analyses were carried out using means, standard deviations, and Analysis of variance (ANOVA).

### 1.4 Treatment

This study was conducted over a 24 lecture hours. The experimental (Concept mapping) and control (traditional) groups were pre-tested. The study was extended over eight weeks. The class met three times per week. The material covered was Mechanics which involves physics and measurements, dimensional analysis, significant figures, motion in one dimension, motion diagram, freely falling objects, vectors, coordinate systems, motion in two dimensions, projectile motion, and uniform circular motion. At the end of the treatment period, the students were post-tested.

## Results

### 1.5 Pre-test

Based on the data obtained by the pre- test, the students' mean and standard deviation for pretest scores for experimental and control groups were shown in Table 2. The mean score of the pre-test for the experimental group was found to be (133.7391), while that of the control group was found to be (131.2174) out of a maximum possible score of 200.

**Table 2:** The means and standard deviations for the results of pre-test prior to treatment

Experimental and Control	Male and Female	Mean	Std. Deviation	N
Experimental	male	133.8125	14.23713	16
	female	133.5714	12.20460	7
	Total	133.7391	13.37303	23
Control	male	128.0000	11.23487	10
	female	133.6923	19.28464	13
	Total	131.2174	16.21155	23
Total	male	131.5769	13.24288	26
	female	133.6500	16.79058	20
	Total	132.4783	14.74937	46

According to the pre- test of academic achievement, there is a convergence of the values in the mean of the female experimental group (133.5714), and the female control group (133.6923). However, there is a considerable variation in the mean of the male experimental group (133.8125) and male-control group (128.0000). To find out whether the difference of the achievement in the pre- test is statistically significant, an analysis of variance has been associated (ANOVA). Table (3) shows the results of this analysis.

**Table 3:** Analysis of variance (ANOVA) of the scores in attitude scale of experimental and control groups before treatment.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	256.557(a)	3	85.519	.377	.770
Intercept	732242.081	1	732242.081	3226.101	.000
Group	84.740	1	84.740	.373	.544
Gender	77.733	1	77.733	.342	.562
Group * Gender	92.092	1	92.092	.406	.528
Error	9532.921	42	226.974		
Total	817112.000	46			
Corrected Total	9789.478	45			

Table (3) shows that there was no significant difference between the two groups ( $F = 0.544, p > 0.05$ ) in the pre- test. Table (3) also showed that there was no significant difference in the attitude of the pre- test attributed to the gender ( $F = 0.562, p > 0.05$ ). Since there is no significant difference between the two groups, it is assumed that the two groups are equivalent.

### 1.6 Post- test

The main purpose of the study was to investigate the effect of using concept mapping in teaching physics on the attitude towards physics of the first year students in Dhofar University.

1.6.1 *First Question: What is the effect of using concept mapping in teaching physics on the attitude towards physics of the first year students in Dhofar University?*

The following hypothesis emerged from this question:

There is no statistically significant difference at ( $\alpha = 0.05$ ) in the attitude towards physics of first year students in Dhofar University attributed to using concept mapping in teaching physics..

To answer this question, the means and standard deviations was obtained and explained in table (4) below.

**Table 4:** The Means and standard deviations for the results of post- test after the treatment

Experimental and Control	Male and Female	Mean	Std. Deviation	N
Experimental	Male	138.5000	13.64795	16
	Female	141.0000	17.35896	7
	Total	139.2609	14.51087	23
Control	Male	118.0000	13.94035	7
	Female	129.0625	8.42590	16
	Total	125.6957	11.33552	23
Total	Male	132.2609	16.52331	23
	Female	132.6957	12.73304	23
	Total	132.4783	14.58727	46

Based on the data obtained by the post- test, the students' mean and standard deviation for post- test scores for experimental and control groups were shown in Table 4. The mean score of the pre-test for the experimental group was found to be (133.7391), while that of the control group was found to be (131.2174) out of a maximum possible score of 200.

According to the post- test of the attitude towards physics, the mean score of the post -test for the experimental group was found to be (139.2609), while that of the control group was found to be (125.6957). There is a considerable variation in the mean of the male-experimental group (138.5000) and the male control group (118.0000). There is also a considerable variation of the values in the mean of the female experimental group of (141.0000) and the female control group (129.0625).

To find out whether these differences of attitude towards physics in the post test are statistically significant, an analysis of variance has been associated (ANOVA). Table (5) shows the results of this analysis.

**Table 5:** Analysis of variance (ANOVA) of the scores in attitude scale of experimental and control groups after treatment

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2742.541(a)	3	914.180	5.619	.002
Intercept	675087.466	1	675087.466	4149.558	.000
Group	2561.857	1	2561.857	15.747	.000
Gender	447.857	1	447.857	2.753	.105
Group * Gender	178.510	1	178.510	1.097	.301
Error	6832.938	42	162.689		
Total	816898.000	46			
Corrected Total	9575.478	45			

Table (5) explains that there is a statistically significant difference at a level ( $\alpha = 0.05$ ), where the value concerning the effect of using concept mapping in teaching physics on the attitude towards physics is (0.000). The result means that the first null hypothesis is rejected and accepting the alternative hypothesis, which states that there is a statistical significant difference at a level ( $\alpha = 0.05$ ) in the attitude towards physics of the first year students in Dhofar University attributed to using concept mapping in teaching physics.

### 1.6.2 *Second Question: What is the effect of gender on attitude towards physics of the first year students in Dhofar University?*

The following hypothesis emerged from this question:

There is no statistically significant difference at ( $\alpha = 0.05$ ) in the attitude towards physics of the first year students in Dhofar University attributed to the gender of the students.

Table (5) explains that there is no statistically significant difference at a level ( $\alpha = 0.05$ ), where the value concerning the effect of gender on the academic achievement of the post- test is (0.105). The result means that the second null hypothesis is accepted, which states that: There is no statistically significant difference at ( $\alpha = 0.05$ ) in the attitude towards physics of first year student in Dhofar University attributed to the gender of the students.

### 1.6.3 *Third Question: What is the effect of the interaction between concept mapping strategy and gender on the attitude towards physics of first year students in Dhofar University?*

The following hypothesis emerged from this question:

There is no statistically significant difference at ( $\alpha = 0.05$ ) in the attitude towards physics attributed to the interaction between concept mapping strategy and gender of first year students in Dhofar University.

Table (5) shows that there is no statistically significant difference at a level ( $\alpha = 0.05$ ), where the value concerning the interaction between concept mapping strategy and gender on the academic achievement is (0.301). The result means that the third null hypothesis is accepted, which states that: There is no statistically significant difference at ( $\alpha = 0.05$ ) in the academic achievement attributed to the interaction between concept mapping strategy and gender of first year student in Dhofar University.

## Discussion

The main question of this study was: What is the effect of using concept mapping in teaching physics on the attitude towards physics of the first year students in Dhofar University?.

The results in Table (5) showed that there was a statistical significant difference at ( $\alpha = 0.05$ ) on the attitude towards physics attributed to using concept mapping in teaching physics. The result also showed that there was no statistically significant difference at ( $\alpha = 0.05$ ) in the attitude towards physics due to the gender or due to the interaction between concept mapping strategy and gender.

The findings of this study can be attributed to the following: A concept map is a visual organization and representation of knowledge. It shows concepts and ideas and the relationships among them. When new knowledge is integrated with, and connected to existing knowledge, that new knowledge is easier to understand, remember, and to develop higher-level thinking skills (create, analyze, evaluate). This makes the learners active and satisfied.

The result of the study supports the assumption that using new methods or strategies in teaching science or physics increases the attitude of the students. The findings of this study are in agreement with that of Erdimer (2009) who examined whether the problem-solving strategies (independent value) have a positive impact on the students' attitude scores (dependent value) or not. The analyses showed that there was a significant difference between attitude scores of the experimental and control groups after treatment. This significant difference was in favor of experimental group. The findings of this study are not in agreement with the study of Karakuyu (2010) or Ates and Eryilmaz (2011) where there was no significant difference between attitude scores of the experimental and control groups.

## Recommendation

In the light of the findings, the study recommended the instructor to use concept mapping as a teaching strategy to help students in increasing their attitude towards physics, with the understanding that there is a need to help students become more engaged in using the technique because of its possible benefits. More research should be conducted to test further the effect of concept mapping as a study tool or homework.

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