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Enhancing students' motivation in science through concept mapping technique

Neil Ian G Cabiling[1], Ehlrich Ray J Magday[2]
[1] Tagoloan National High School, Tagoloan, Misamis Oriental, Philippines
[2] Department of Science Education, Central Mindanao University, Philippines

Abstract
Students' level of motivation in Science in relation to intrinsic motivation, self-efficacy, self-determination, grade motivation, and career motivation when taught using concept mapping technique was investigated. A quasi-experimental research design was utilized involving two (2) sections. The first section was exposed to the concept mapping technique and the second was exposed to non-concept mapping technique. An adopted motivational survey questionnaire was used as research instrument. Findings of the study revealed that students' motivation in Science as exposed to CMT and non-CMT indicated highly motivated towards Science in relation to the five domains. Furthermore, motivation level of CMT were found higher than those on non-CMT. The use of concept mapping may be applied in science classes in the secondary level to enhance students' motivation.

Keywords: science motivation, concept mapping, self-efficacy, grade motivation

Introduction

The teaching of science is often challenging due to different factors such as aligning objectives with content and evaluation strategies, selection of teaching strategy to employ, instructional materials to be used and ensuring that learners are committed to learning the subject content. As a teacher, it is imperative to choose pedagogical techniques that are not only known to enhance conceptual understanding but also motivates the learners to be engaged and be active part of the teaching and learning process. According to Gopalan *et al.*, (2017) [1], motivation and learning process have a deep connection. Motivation is the core for human being's aspirations and achievements. Thus, motivation is crucial to succeed in educational matters and without the fighting spirit nothing is possible not only in education but also in real life. Furthermore, f (2013) [2] highlighted that student motivation is probably the single most important element of learning. Highly motivated students will learn readily, and make any class fun to teach, while unmotivated students will learn very little and generally make teaching painful and frustrating.

Concept mapping is the process of creating a visual representation of knowledge. This type of system predates the development of alphabets and the written word and is a deeply embedded way that humans organize and communicate information. It is a graphic organizer that not only gives a visual representation of concepts and the relationships between and among them and then identifies the relationship to each other. Mapping is an active learning strategy that moves learners beyond rote memorization to critical thinking and helps them to learn about how they learn. This gets students beyond just knowing to reflecting on what they know and how they know it. Concept Mapping requires that students break down component parts to see how things are put together. This promotes a richer construction of knowledge because students must organize, select, relate and interpret data (Kwantlen Polytechnic University, 2015) [3].

With concept-mapping seen as an instructional technique that may improve students' motivation in learning science, this present investigation looks into the motivation of secondary school students in relation to intrinsic motivation, self-efficacy, self-determination, grade motivation; and career motivation when exposed to concept mapping technique in a science class.

Research Questions

1. What is the extent of students' motivation in Science as exposed to concept mapping and those exposed to non-concept mapping technique in relation to: a) intrinsic motivation; b) self-efficacy; c) self-determination; d) grade motivation; and e) career motivation? and
2. Is there a significant difference between student's motivation in Science as exposed to concept mapping technique and those exposed to non-concept mapping technique?

Research Hypothesis

Ho: There is no significant difference on students' motivation in Science as exposed to concept mapping technique and those exposed to non-concept mapping technique.

Material and Methods

Quasi-experimental research design was used in this study. Two intact Grade 9 sections were made participants of the study. Both groups received the same lessons but varies in the implementation of the content. One group was exposed to concept mapping technique while the other group was exposed to conventional teaching utilizing lecture-discussion and the use of PowerPoint presentation. The

motivational survey questionnaire adapted from Glynn, *et al*., (2011) [4] was utilized to measure the students' level of motivation. It composed of 25 items and had a Cronbach alpha of 0.92. This was administered to all respondents in the study to identify their level of motivation towards the learning of Science 9 using Concept Mapping Technique. This five-point Likert scale is used to analyse the level of motivation of the students towards Science 9.

Scale	Range	Descriptive Rating	Qualitative Interpretation
5	4.51- 5.0	Always	Very Highly Motivated
4	3.51-4.5	Usually	Highly Motivated
3	2.51-3.5	Sometimes	Motivated
2	1.51-2.5	Rarely	Less Motivated
1	1.00-1.5	Never	Not Motivated

Descriptive statistics such as mean, frequency values, percentage and standard deviation were employed to describe the motivation of students. An Analysis of Covariance (ANCOVA) was used to measure significant difference on students' motivation exposed to Concept Mapping Technique and non-Concept Mapping Technique.

Results and Discussion

Table 1 presents the motivation of the students' in terms of "Intrinsic Motivation" between two groups.

Table 1: Level of students' motivation in both groups under Intrinsic motivation

Intrinsic Motivation	CMT		NCMT	
	Mean	**Qualitative Interpretation**	**Mean**	**Qualitative Interpretation**
1. The Science I learn is relevant to my life.	4.55	Very Highly Motivated	3.31	Motivated
2. I enjoy learning Science	4.47	Highly Motivated	4.51	Very Highly Motivated
3. I am curious about discoveries in Science.	4.29	Highly Motivated	4.47	Highly Motivated
4. Learning Science makes my life more meaningful.	4.27	Highly Motivated	3.34	Motivated
5. Learning Science is interesting.	4.22	Highly Motivated	3.37	Motivated
Mean	4.36	Highly Motivated	3.81	Highly Motivated

The over-all mean for students exposed to Concept Mapping technique and non-Concept mapping technique was 4.36 (Highly Motivated) and 3.81 (Highly Motivated) respectively. Students are intrinsically motivated to learn Science. They find learning science concepts relevant to their lives and finds it interesting to discover new things about the natural world. Being motivated intrinsically helps in developing confidence and building up interest to perform better in class. Furthermore, Patchen (2010) [5] implies that teachers must move towards a more student-centred approach to teaching, allowing students to take on a more active role in their learning and the classroom in order to increase opportunities for students to investigate, discover, and make sense of science content in personally relevant and meaningful ways.

Table 2: Level of students' motivation between groups under self-efficacy

Self-Efficacy	CMT		NCMT	
	Mean	**Qualitative Interpretation**	**Mean**	**Qualitative Interpretation**
1. I am confident I will do well on science labs and projects.	4.58	Very Highly Motivated	4.39	Highly Motivated
2. I believe I can earn a higher grade in Science.	4.53	Very Highly Motivated	4.2	Highly Motivated
3. I believe I can master science knowledge and skills.	4.49	Highly Motivated	4.44	Highly Motivated
4. I am sure I can understand Science.	4.46	Highly Motivated	4.22	Highly Motivated
5. I am confident I will do well on science tests.	4.4	Highly Motivated	4.44	Highly Motivated
Mean	4.49	Highly Motivated	4.34	Highly Motivated

Based on the findings, students find themselves confident in doing Science, they have high regards that they can perform well in science-related activities while believing that they can successfully comprehend the lessons.

This research finding was noted on the study of Aslam and Ali (2017) [6] on the effect of self-efficacy on students' achievement in Science wherein it showed that when students displayed a strong social self-efficacy, it resulted to stronger academic achievement.

Table 3: Level of students' motivation between group under self-determination.

Self-Determination	CMT		NCMT	
	Mean	**Qualitative Interpretation**	**Mean**	**Qualitative Interpretation**
1. I put enough effort into learning Science.	4.53	Very Highly Motivated	4.2	Highly Motivated
2. I use strategies to learn Science well.	4.45	Highly Motivated	4.47	Highly Motivated
3. I spend a lot of time learning Science.	4.4	Highly Motivated	4.31	Highly Motivated
4. I study hard to learn Science.	4.36	Highly Motivated	3.41	Motivated
5. I prepare well for Science tests and labs.	4.29	Highly Motivated	4.59	Very Highly Motivated
Mean	4.41	Highly Motivated	4.2	Highly Motivated

Table 3 presents level of students' motivation under self-determination for two groups.

The students displayed self-determination towards learning science. Both groups are using different learning strategies that may perhaps be favourable on their own processing of information for easy retrieval. As manifested, the more time they spent in learning the concepts in science, the more likely they can have mastery of the lessons presented in class especially using concept mapping technique.

These findings are supported by Ertepinar and Sungur (2013) which stressed that teaching strategies like student-guided discussions, can help students to further develop or increase autonomy, relatedness, and competence where students are more likely to become engage in connecting to real-life and environmental issues.

Table 4: Level of students' motivation between groups under grade motivation

Grade Motivation	CMT		NCMT	
	Mean	Qualitative Interpretation	Mean	Qualitative Interpretation
1. Scoring high on science tests and labs matters to me.	4.45	Highly Motivated	4.37	Highly Motivated
2. It is important that I get a good grade in science.	4.4	Highly Motivated	4.03	Highly Motivated
3. I think about the grade I will get in science.	4.33	Highly Motivated	3.8	Highly Motivated
4. I like to do better than other students on science tests.	4.31	Highly Motivated	3.37	Motivated
5. Getting a good science grade is important to me.	4.27	Highly Motivated	3.41	Motivated
MEAN	4.35	Highly Motivated	3.8	Highly Motivated

The mean scores of the two groups under grade motivation is shown in Table 4. Based on the findings, CMT group obtained an overall mean score of 4.35 (Highly Motivated) and non-CMT has an overall mean score of 3.8 (Highly Motivated). Krawczyk (2017) [7] stressed that alternative assessment model help to increase students' understanding of how students work correlated to final grade and created opportunities for students to make connections to the learning.

Table 5: Level of students' motivation between groups under grade motivation

Career Motivation	CMT		NCMT	
	Mean	Qualitative Interpretation	Mean	Qualitative Interpretation
1. I will use Science problem-solving skills in my career.	4.56	Very Highly Motivated	4.29	Highly Motivated
2. Learning Science will help me get a good job.	4.42	Highly Motivated	4.32	Highly Motivated
3. Understanding Science will benefit me in my career.	4.38	Highly Motivated	4.34	Highly Motivated
4. Knowing Science will give me a career advantage.	4.33	Highly Motivated	4.27	Highly Motivated
5. My career will involve Science.	4.33	Highly Motivated	4.32	Highly Motivated
Mean	4.4	Highly Motivated	4.31	Highly Motivated

The students' motivation under Career Motivation shows disposition towards science as a vehicle for them to have a good career in the future. Moreover, they envision science as part of lifelong learning even when they had a job and concepts learned in class may still be applied in real-life situations.

The findings are in consonance with the study of Shin Chonbuk, Lee Chonbuk, and Kangwon (2016) that examined the role of career motivation in science learning. The results found out that career motivation has a direct influence on several motivational factors in science learning and helps students to improve their science motivation and promote long-term scientific achievement.

Table 6: Summary table for motivation of the students as exposed to CMT and NCMT

Motivation Indicator	CMT		NCMT	
	Mean	Qualitative Interpretation	Mean	Qualitative Interpretation
1. Self-efficacy	4.49	Highly Motivated	4.34	Highly Motivated
2. Self-determination	4.41	Highly Motivated	4.2	Highly Motivated
3. Career motivation	4.4	Highly Motivated	4.31	Highly Motivated
4. Intrinsic	4.36	Highly Motivated	3.81	Highly Motivated
5. Grade motivation	4.35	Highly Motivated	3.8	Highly Motivated
Mean	4.4	Highly Motivated	4.09	Highly Motivated

Table 6 presents the summary of motivation between students exposed in concept mapping technique and those in non-concept mapping technique. Data table reveals that both groups exhibited an overall mean that translates to highly motivated in its qualitative interpretation. The students' motivation as exposed to Concept mapping technique obtained the highest mean of 4.49 (Highly Motivated) in the self-efficacy, followed by self-determination (4.41), career motivation (4.40), intrinsic (4.36), and grade motivation (4.35). On the other hand, NCMT group achieved highest mean in the self-efficacy (4.34), followed by career motivation (4.31), self-determination (4.2), intrinsic (3.81), and grade motivation (3.8). This finding conforms to the result of Al-Dmour, Gasaymeh, Abuhelaleh and Almi'ani (2017) [9] on utilization of concept map and its effects on students' attitude and motivation wherein it concluded that the learning motivation of students can be improved using this kind of technique. In addition, Zmen, Demircio and Coll (2007) [10] concludes that concept mapping technique found to be more enjoyable to students and helps them to link concepts which reduces misconceptions.

Comparison of Students' Motivation in Science

As shown in Table 7, motivation level of students exposed to concept mapping technique obtained a mean percentage score of 4.40 (SD=.27) while those in the non-concept mapping technique had a mean percentage score of 4.09 (SD=.23) respectively which indicates a highly significant difference at 0.05 level. The null hypothesis is rejected that "there is no significant difference on students' motivation in science as exposed to Concept Mapping Technique and those exposed to non-Concept Mapping Technique".

Table 7: Analysis of Covariance (ANCOVA) of students' motivation in CMT and NCMT

Group	N	MPS	Std. deviation
CMT	55	4.40	.27
NCMT	59	4.09	.23
Total	114	4.24	.29

Table 8

Source	SS	Df	MS	F-value	Sig.
Model	2052.08	3	684.03	11287.51	.000**
Group	13.33	2	6.67	109.97	.000**
Motivation (covariate)	.16	1	.164	2.70	.103ns
Error	6.73	111	.061		
Total	2058.81	114			

ns- Not Significant
**Significant at 0.01 level

The findings imply that students exposed to CMT are highly motivated than those exposed to NCMT. Students perform better when they are well motivated to engage in their own learning process. Thus, teachers should also consider concept mapping technique as strategy in delivering classroom instruction in science because it evidently provide more desire to learn new ideas and new learning experiences.

This data finding is consistent with Otor and Achor (2013) [11] on investigating the effect of concept mapping strategy on secondary school students' attitude towards difficult chemistry concepts. The results revealed that students taught using concept mapping strategy obtained higher attitude rating scores and significantly better than those taught using conventional method. Also, in the study of Kaushik (2017) and Al-Dmour, *et al*, (2017) [9], findings revealed the positive students' attitude and motivation towards the use of concept mapping where it promotes conceptual learning and motivate students to learn Science concepts.

Conclusions

Students' motivation on both groups indicate high motivation towards Science in relation to intrinsic motivation, self-efficacy, self-determination, grade motivation, and career motivation. However, the CMT group had numerically higher than overall mean than non-CMT. Thus, CMT may be incorporated frequently in teaching for students' to be motivated while doing Science. The level of motivation between two groups under study showed significant difference, thus rejecting the null hypothesis. Hence, teachers are encouraged to consider concept mapping technique as a strategy in delivering classroom instruction in Science because it evidently provides positive outcome and can motivate students.

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