A Study on the Relationship between Concept Mapping and Reflective Thinking

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Abstract

Concept mapping is a graphical organising technique, and it also work as a reflective tool for students as well as teachers and teacher educators. In the present scenario, learning outcomes is a big concern for any classroom. In this research paper, researcher wants to investigate the relationship of concept mapping and reflective thinking, and also want to analyse on the basis of gender and how much relationship has shifted in which direction? For fulfillment of this purpose, researcher selected three schools (one government and two private) from Ajmer city and selection was done through the sample purposive sampling. Researcher selected 48 boys' students and 28 girls' students and the total sample was 76 students. Researcher used descriptive statistics and inferential statistics for analysing the data. In inferential statistics, researcher used Pearson's bivariate correlation. Findings of this research paper highlighted that there is a minimal difference in relationship of concept mapping and reflective thinking on the basis of gender, and this difference indicates towards other factors.

Introduction

Concept mapping is a strategy intended to reinforce understanding of concepts and their relationships in a graphic and visual manner. This strategy is also metacognitive in nature because it provides ongoing reflection on the process as well as the relationships among concepts. It helps students to organise and represent their knowledge. The use of propositional concept maps, "using

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two or more concepts connected using linking words or phrases to form a meaningful statement" (Novak, 2006), was developed out of a long-term research project to identify changes in children's understanding of science concepts. The researchers in this study created a means of representing children's knowledge in the form of a concept map.

Concept maps are especially effective when used as an organisational strategy for complex learning tasks and to summarise information. One strength of the use of concept maps lies in the graphic representation to demonstrate growth in understanding (Enger, 1996; Jones and Vesilind, 1994). Visual images help learners understand and remember complex information and abstract concept relationships in a more concrete manner than abstract words (Armstrong, 2003). A study on the use of concept maps as a curriculum development aid for a knowledge-based science teaching model (Romance and Vitale, 2001) indicated that the continual enhancement of concept maps throughout the process provided both teacher and student a means of tracking the development of content acquisition and understanding. The concept maps kept the students focused on the core elements within the content and the hierarchal organisation of the concepts.

Concept Map

The concept map technique was firstly proposed by Joseph. D. Novak during his research programme in Cornell University, where he and his team followed and understood changes in student's behaviour. Novak (1990), said that concept map is a graphical tool for organising and representing knowledge. It includes few enclosed figures like circle and boxes which represent concepts or sub concepts, and these boxes linked with linking lines and nodes and these linking lines and cross links represents the relationship among different concepts (Novak, 1990). Further, concept maps were useful not only to represent the change in a child's understanding of topic, but also as excellent tool for the participating students to express their understanding about their courses.

Concept Mapping

Novak, Joseph and Cañas, Alberto (2007) said that concept mapping is a technique for visualising the relationship between different concepts. When created appropriately and systematically, concept mapping is an influential way for students to touch high levels of cognitive performance. Novak, Joseph and Cañas, Alberto (2007) highlighted that concept mapping tool is also an assessment tool we can use to estimate growth of learning, and it is very helpful for teacher educators. As students generate concept maps, they repeat ideas using their own words and help identify unfitting ideas and concepts; educators are able to see what students do not recognise, and it is helpful to understand the problem in students learning.

Reflective Thinking

The concept of reflective thought is firstly introduced by John Dewey in 1910 in his work designed for teachers named "*How We Think*". Dewey's most important thought was that learning improves to the degree that it arises out of the process of reflection (Dewey, J. 1933). After sometime past on these thoughts known as analytical thinking or critical thinking and some more word ordinated like problem solving and higher level thoughts. Reflective thinking is a meaning-making procedure that leads to a deeper understanding, that is, in an organised, laborious disciplined way of thinking (Dewey, J. 1933). Reflective thinking is important for success in a changeable and multifaceted situations such as working with customers or clients.

Review of Related Literature

Somers (2009) conducted a study on using concept maps to explore preservice teachers' perceptions of science content knowledge, teaching practices, and reflective processes. Gwo et al., (2007) work on application of automatically constructed concept map of learning to conceptual diagnosis of e-learning. Schwendimann (2011) conducted a study on mapping biological ideas: Concept maps as knowledge-integration tools for evolution education. D'Antoni (2009) impirically highlighted relationship between the mind map learning strategy and critical thinking in medical student. Sugihara at al., (2011) conducted a study *Experimental Evaluation of Kit-build Concept Map for Science Classes in an Elementary School*. Derbentseva (2004), conducted a study *Experiments on the Effects of Map Structure and Concept Quantification During Concept Map Construction*. Soleimani at al., (2012) worked on *Fill in the Map Related concept map technique on pre-university students.*

Need of the Study

At secondary level, generally teachers or instructors uses traditional teaching methods in which students learn through memorisation and recitation techniques thereby unable to develop their critical thinking problem-solving skills (sunel et al., 1994). On the other hand, modern or constructivist approach of learning quite famous these days but in real scenario due to lack of training of constructivist approach instructors are unable to implement this approach in the classrooms they are still rely on mostly lecture cum demonstration method of teaching which is less effective way of learning for the students for attaining desirable outcomes in the classroom it is very essential that while students are learning new concepts and they must reflect on ideas which help the student to develop their understanding in meaningful, logical and purposeful way. According to Novak (1998), Hay (2007, 2008) and others, concept maps have the value of 'making learning visible' as the

teacher can actually 'see' what ideas the student has about a particular topic and can evaluate students' learning and acquisition of crucial concepts (threshold concepts in Meyer and Land's language, 2006).

Statement of the Problem

A Study on the relationship of Concept Mapping and Reflective Thinking— Exploring its Significance on the basis of Gender at Secondary Level.

Delimitations of the Study

In the present study, English medium schools affiliated to C.B.S.E. board of district Ajmer have been included. It excluded schools with other medium of instruction like Hindi, Marwari, etc. The present study includes Class IX students of district Ajmer, Rajasthan. Students from other primary and secondary classes have been excluded. It also excludes schools affiliated to Rajasthan Board of Secondary Education (R.B.S.E.) and other boards. In the present study, selection of schools is done through purposive method of sampling technique. This study was conducted in the science subject.

Aim of the Study

The aim of the present study is to find out the relationship between concept mapping and reflective thinking, and check out the difference in this relationship on the basis of gender.

Definition of Operational Terms

While a variety of definitions of the following terms have been suggested, this study will use the definition related to the context of the study.

Concept

Spitzer (1975) highlighted an idea about something that is formed mentally by combining its characteristics; it is generally derived through specific instances and usually formed from a number of simpler elements. Spitzer (1975) said that concepts could be considered the building blocks of knowledge or the basic unit of knowledge.

Concept Map

Novak, Joseph and Cañas, Alberto (2007) implicitly highlighted that concept map is a visual graphic organiser designed to display concepts and the connections between them. Typically, concepts are displayed in the nodes or shapes, while relationships between them are shown with links, often titled with verbs (Novak,1990).

Reflective Thinking

Critical thinking and reflective thinking are frequently used synonymously (Halpern, 1996). Reflective thinking is the use of those cognitive skills or tactics that increase the probability of a needed outcome. Thinking that is purposeful, rational and goal directed — the kind of thinking involved in solving problems, framing inferences, calculating

possibilities, and making conclusions when the thinker is using skills that are thoughtful and effective for the specific context and type of thinking assignment. Reflective thinking is sometimes called directed thinking because it focuses on a desired outcome.

Objectives of the Study

1. To find out the relationship between concept map and reflective thinking at secondary level.
2. To find out the difference in relationship between concept mapping and reflective thinking at secondary level on the basis of gender.

Null Hypotheses

1. There is no significant relationship between concept mapping and reflective thinking in learning science of students at secondary level.
2. There is no significant relationship between concept mapping and reflective thinking for boy students at secondary level.
3. There is no significant relationship between concept mapping and reflective thinking for girl students at secondary level.

Methodology of the Study

The present study is a correlational study, which comes under the survey research and it is a part of Quantitative Research Design. In the present study, researcher established relationship between concept mapping and reflective thinking with the help of bivariate correlation method and draws some conclusion on the basis of this method.

Participants

For this study, the researcher has taken a sample of 76 students of Class IX from three schools of district Ajmer. During the study the researcher took one government school and two private schools as per the availability of classes in those particular schools. Sample was selected by the researcher through Purposive technique. The researcher had also collected a sample of 28 students from Demonstration Multipurpose School, Ajmer, 18 students from Bhagwan Mahavir Public School, Makarwali road, Ajmer, and remaining 30 students from Samrat Public School, Kotra, Ajmer.

Instruments

- Concept Map Achievement Test CMAT (Yadav, P. 2019): This tool consists of five fill in the blanks based on knowledge, understanding and application and later part of this tool based on Concept Map draw Ability skills and critical thinking. Face and Content validity of this tool find by the researcher which is satisfactory.
- Reflective Thinking Scale RTS (Yadav, P. 2019): This tool consist

of 28 items which is based on four dimensions that is concept map, reflective thinking, habitual action and critical reflection and internal consistency reliability (Cronbach Alpha) of this tool found by the researcher is 0.660.

Techniques of Data Analysis

The analysis of the present study was done on the basis of formulated objectives and hypothesis of the study. Since this research is a correlational study that is why the researcher used correlation 'r' coefficient between two variable.

Data Analysis

For analysing the complete data the researcher used IBM SPSS version 25 Statistical software as a tool, and the obtained results are cited below with the help of tables, along with the explanation.

Null Hypothesis 1: There is no significant relationship between concept mapping and reflective thinking in learning science at secondary level.

It is clear from the table below that the mean score of concept map achievement test score is 13.64 and standard deviation is 2.442. And the mean value of reflective thinking scale score is 104.83 and standard deviation is 10.907, where the total sample is 76.

The result shows that there is significant relationship between concept mapping and reflective thinking because value of correlation is .465 at 0.01 level of significance, which is significant and indicates a positive correlation between the variables.

Table 1.1
Sample Distributions

Name of the School	School Type	Boys	Girls	Total
Demonstration Multipurpose School, R.I.E. Ajmer	Government	15	13	28
Bhagwan Mahavir Public School, Makarvali Road Ajmer	Private	15	3	18
Samrat Public School, Kotra, Ajmer	Private	18	12	30
	Total	48	28	76

Table 1.2
Dimensions of Reflective Thinking Scale

Dimensions for Reflective Thinking Scale	No. of Items	No. of Negative Items
Concept Map	11	02
Reflective Thinking	07	01
Habitual Action	07	04
Critical Reflection	03	00
Total no. of Items	28	07

Table 1.3
Descriptive Statistics of Whole Data

	Mean	Std. Deviation	N
CMAT	13.64	2.442	76
RTS	104.83	10.907	76

Correlation is significant at 0.01 level of significance (2-tailed), hence with the above shown results researcher can reject the first hypothesis because there is significant positive correlation between concept mapping and reflective thinking. From the above data it is very clear that concept map and reflective thinking are positively correlated to each other in science subject at secondary level.

Table 1.4
Overall Correlation value of Reflective Thinking and Concept Mapping

Correlations			
		Total	Total
Total	Pearson Correlation	1	.465**
	Sig. (2-tailed)		.000
	N	76	76
Total	Pearson Correlation	.465**	1
	Sig. (2-tailed)	.000	
	N	76	76
** Correlation is significant at the 0.01 level (2-tailed).			

Null Hypothesis 2: There is no significant relationship between concept mapping and reflective thinking for boys students at secondary level.

When we take concept map scores of boys' students and simultaneously the reflective thinking score of boys students, we see that mean score of concept map achievement test of boys is 13.08 and standard deviation is 2.575, while on the other hand mean score of reflective thinking scale of boys is 103.94 and standard deviation is 11.664.

When we correlate the concept map scores and reflective thinking scores of boys students we find that there is a positive moderate 0.471** level correlation which is significant at 0.01 level of significance (2-tailed). Hence, with the above shown result the

Table 1.5
Descriptive Statistics of Boys Students

Descriptive Statistics			
	Mean	Std. Deviation	N
CMATB	13.08	2.575	48
RTSB	103.94	11.664	48

Table 1.6
Correlation of Concept Map and Reflective Thinking of Boys Students

Correlations			
		CMATB	RTSB
CMATB	Pearson Correlation	1	.471**
	Sig. (2-tailed)		.001
	N	48	48
RTSB	Pearson Correlation	.471**	1
	Sig. (2-tailed)	.001	
		48	48
** Correlation is significant at the 0.01 level (2-tailed).			

researcher rejects the null hypothesis because there is significant positive correlation between concept mapping scores and reflective thinking scores of boys students.

Null Hypothesis 3: There is no significant relationship between concept mapping and reflective thinking for girls students at secondary level.

The total no. of girls students is 28, so when we take both score of girls students on the basis of concept map achievement test and reflective thinking scale we found the following descriptive statistics.

Table 1.7
Descriptive Statistics of Girls Students

Descriptive Statistics			
	Mean	**Std. Deviation**	**N**
CMATB	14.61	1.873	28
RTSB	106.36	9.476	28

Mean score of girls students on the basis of concept map achievement test is 14.61 and standard deviation is 1.873, and mean score of girls students on the basis of Reflective thinking scale is 106.36 and standard deviation is 9.476.

When we correlate the concept map scores and reflective thinking scores of girls students we find that there is a positive moderate 0.417** level correlation which is significant at 0.01 level of significance (2-tailed). Hence, with the above shown result the researcher rejects the null hypothesis because there is a significant positive correlation between concept mapping scores and reflective thinking scores of girls students. From the above result, specifically on the basis of gender, we can say that concept mapping scores and reflective thinking scores of girls students correlates to each other.

Conclusions

It may be concluded that—

- If we see the first objective of this study then researcher found there is positive relationship between concept mapping and reflective thinking at secondary level. There is a positive moderate level (r = 0.465**) correlation existing between these two variables.
- After analysis of data gender wise, researcher finds that there is no significant difference between girl and boy students. We can see from the analysis of hypothesis 2 and 3, correlation between concept mapping and reflective thinking on the basis of gender almost same. In both cases, we see positive, moderate level correlation. Since mean score of girls students is high in respect to boys students but this may be because of we take only 28 girls for this study and number of boys is 48. So, there are many factors behind this result.
- The main purpose of this research paper is to identify on the basis of specific gender how much relation shifted in any direction that is may be positive or negative but researcher found on the basis of gender there is no difference in the correlation of Concept mapping and reflective thinking.
- On the basis of mean scores of concept map achievement test and Reflective thinking scale researcher can say ability of making concept map and reflecting over the content in girls is better than boys students.

Table 1.8
Correlation of Concept Map and Reflective Thinking of Boys Students

Correlations			
		CMAT G	RTS G
CMAT G	Pearson Correlation	1	.417*
	Sig. (2-tailed)		.027
	N	28	28
RTS G	Pearson Correlation	.417*	1
	Sig. (2-tailed)	.027	
		28	28
** Correlation is significant at the 0.05 level (2-tailed).			

Discussion

The result of the present study will be helpful to teachers as well as students, policy makers, administrators and head of the department and institutions for improving teaching-learning process and arrangement of learning environment in such a way that will meet the need of meaningful and effecting learning inside the classroom at secondary level.

It will also be helpful to the teacher to meet the challenges of 21st century classroom which is different from 20th century classroom by updating the knowledge of reflective pedagogy by the help of reflective tool in the classroom like concept map.

It will also be very helpful to the students to understand the difficult concept and relate those concepts to the real world experience. Result of the study also helps the students to retain the concepts in their mind in meaningful way and for a long span of time.

The findings of this study will also provide a theoretical background as well as evidence to the researcher to conduct further research. Last but not the least, it will be helpful in teacher training programmes organised by the Government of India, Specially Rastriya Madhyamik Shiksha Abhiyan (RMSA) for quality improvement in the teacher as well as classroom-learning environment at the secondary level.

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