THE COMMUNICATIONS
Journal of Applied Research in Open and Distance Education

Directorate of Distance Education
University of Kashmir, Srinagar-190006

Concept Mapping Instructions in relation to Reflective Thinking on the basis of Government and Private Schools at Secondary Level

Pushpendra Yadav*

Abstract

In Last few decades, a lot of changes have been done in the field of School Education System India. Especially in the transition of knowledge in the active learning classroom new pedagogies, approaches, educational techniques, instruction materials have been discovered. And all these things significantly catalyze the teaching learning process in the active classroom. Nowadays we shift our teaching strategy from Conventional Teaching Approach or Teacher Centered (Content Oriented) Approach to Child Centered teaching approach or Learning Centered Approach. And Many Policy and documents Like NPE-1986, NCF-2000, NCF-2005, Learning Outcomes for Secondary Level 2019 and NEP-2020 advocates to provide such type of learning in Classroom in which learner actively engage in teaching learning process and make their own meaning of concept by participation, collaboration and which leads the learner to learn meaningfully. Concept Map is also a similar kind of tool which fosters learning through active participation and involvement. Concept Mapping is a graphical organizing technique and it also works as a reflective tool for students as well as teachers and teacher educators. If we critically examine the present scenario of the school education system in India then we found learning outcomes are a big concern for any classroom. In this research paper researcher investigated the relationship of concept mapping and reflective thinking and also analyzed on the basis of type of institutions (government and private) how much the relationship 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 analyzing the data. In inferential statistics researcher used Pearson's bivariate correlation. Findings of this research paper highlight that there is minimal difference in the relationship of concept mapping and reflective thinking on the basis of type of institutions and this difference indicates towards other factors.

Key Words: *Concept Mapping, Reflective Thinking, private and government, NEP-2020, NCF-2000*

Introduction

> *'More important than the curriculum is the question of the methods of teaching and the spirit in which the teaching is given'*
>
> - *Bertrand Russell*

At secondary level generally teachers or instructors use conventional teaching methods (Teacher Centered Method or Content Focused Method) in which students learn through

---

*Department of Education, CIE, University of Delhi

memorization and recitation techniques thereby not developing 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 obtaining desirable outcomes in the classroom it is very essential that while students are learning new concepts they must reflect on ideas which help the student to develop their understanding in a meaningful, logical and purposeful way. NCTM (National Council of Teachers of Mathematics) 1989, 1991, and 1995 advocates such types of learning in which learners make meaningful connections between previous knowledge and new knowledge. In this regard NCF (2005) and learning outcomes document for secondary level (2019) also proposed the same kind of suggestions for pedagogy, classroom instructions and curriculum in which students actively participate in the knowledge transition process and make connections easily.

In this regard, Concept Mapping based teaching strategy is very helpful for learners in active participation and Collaboration in the classroom (Baroody, A., & Bartels, B. 2001). Concept mapping is a strategy intended to reinforce understanding of concepts and their relationships in a graphic, visual manner (Davies, M. 2011). 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 organize and represent their knowledge (Andreas Ryve. 2004). The use of propositional concept maps, "using 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 Map

The concept map technique was firstly proposed by Joseph. D. Novak in 1972 during his research programme in Cornell University. Where he and his team follow and understand changes in student's behaviour. Novak (1990) said that concept maps are graphical tools for organizing and representing knowledge. It includes a 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 includes concept maps were useful not only to represent the change in a child's understanding of the topic but also excellent tool for the

participating students to express their understanding about their courses. Novak, Joseph & Cañas, Alberto (2007) said that Concept mapping is a technique for visualizing 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 & Cañas, Alberto (2007) highlighted concept mapping tool is also an assessment tool we can estimate growth of learning with the help of this tool 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 recognize, and it is helpful to understand the problem in students' learning.

Reflective Thinking

The concept of reflective thought was 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 some time, on these thoughts known as Analytical Thinking or Critical Thinking and some more words ordinate like Problem Solving and Higher Level Thoughts. Reflective Thinking is a meaning-making procedure that leads to a deeper understanding that is an organized, laborious disciplined way of thinking (Dewey, J. 1933). Reflective thinking is important for success in changeable and multifaceted situations such as working with customers or clients.

Review of literature

Tseng, S. (2015) Conducted a study on Concept-Mapping Tools and the Development of Students' Critical-Thinking Skills and explains in his research work developing students critical thinking skills recently received attention at all level of education in this article he used web based concept mapping tool- Popplet- and demonstrates for teaching critical thinking skills in classroom. Xie, Y., & Sharma, P. (2011) had work on Exploring evidence of reflective thinking in student artifacts of blogging-mapping tool: A design-based research approach in this research work researchers use concept map as blogging mapping tool in which they allow students to write blog posts and attach up to five keywords to each post and link the keywords on concept map. The aim of this study is to seek the pattern of reflection by using blog posts. Hsiu-Ying Wang, Iwen Huang, & Gwo-Jen Hwang (2016) conducted a study on Effects of a Question Prompt-based Concept Mapping Approach on Students' Learning Achievements, Attitudes and 5C Competences in Project-based Computer Course Activities in this research work

researcher use quasi experimental research design for the investigation and result shows experimental group perform better in comparison to control group. Tanya Chichekian & Bruce M. Shore (2013) had work on Concept Maps Provide a Window onto Pre-service Elementary Teachers' Knowledge in the Teaching and Learning of Mathematics in this research work researcher use collaborative concept-mapping exercise for pre-service teachers and result of this study shows concept maps identified those areas in which pre-service teachers held unsophisticated understanding of mathematics.

Need of the Study

In India, there is a big difference in the quality of education in Government and Private Schools and after more than 70 years of independence this gap increases day by day gradually. National Achievement Survey (NAS) by NCERT 2017 and Annual Status of Education (ASER) 2017 & 2018 are two big independent bodies in India which review our school education system and publish their reports. And, Report shows, in India our government school education system need reform on various aspects. National Education Policy (NEP) 2020 also recommended that reforms in our school education system are very essential that's why they restructure our school education system. We can clearly see at present the overall performance of our Government schools as not good as Private Schools. We have few examples of government schools which perform really well and become a role model for our nation. We know there are several factors which affect teaching and learning like good infrastructure, good Leaders as well as teachers, teaching learning resources, toileting Facilities etc. but in last two decade all these facilities improve significantly in government schools U-DISE Managed by NIEPA provides all these data across nation school level to district level. Inside the schools, if Learning Outcomes in particular subject and class are not as per expectation then several factors may be responsible for that and one of the important factor in that scenario is teaching strategy adopted by teacher since NCTM (National Council Teacher of Mathematics) 2014, NCF-2005, Learning Outcome Document for Secondary Level 2019 and NEP-2020 advocate use of such type of pedagogy or teaching strategy in which learner actively participated in the classroom and understand and modify their concept by own. He is able to reflect over content whatever he teaches and learn in the classroom and connects our thoughts or ideas to outside the world in real life situations. Hay (2007, 2008) explained Concept Maps are a meta-cognitive tool which provides students clear space of thinking and reflection on our own ideas by these students may link their pre-existing knowledge framework to new knowledge with the help of meaningful relationship and further modify this relation as per their new understanding. According to

Novak (1998), 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 & Land's language, 2006). So from a researcher point of view the study of **Concept Mapping Instructions in relation to Reflective Thinking on the basis of Government and Private Schools at Secondary Level** may disclose few new layers in the teaching learning process in schools.

Statement of the problem

Concept Mapping Instructions in relation to Reflective Thinking on the basis of Government and Private Schools at Secondary Level

Delimitations of the Study

The study is restricted to the area of district Ajmer, Rajasthan.

- The study is[i] delimited to the Grade IX students.

- In this study, English and Hindi medium schools affiliated to C.B.S.E. board of district Ajmer, Rajasthan have been included.

- The study excluded schools with other media of instruction like Urdu etc.

- The study excluded schools affiliated to other boards.

- In this study students from other primary and secondary classes have been excluded.

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 type of institutions (government and private).

Definition of the 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 & Cañas, Alberto (2007) implicitly highlighted concept map is Visual graphic organizer 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.

Objective of the study

- To study the relationship between concept mapping and reflective thinking in science of grade IXth students.
- To study the relationship between concept mapping and reflective thinking in science of grade IXth students on the basis of government and private schools.

Null Hypothesis

H_{01}: There is no significant relationship between concept mapping and reflective thinking in Science of grade IXth students.

H_{02}: There is no significant relationship between concept mapping and reflective thinking in Science of grade IXth students of government school.

H_{03}: There is no significant relationship between concept mapping and reflective thinking in Science of grade IXth students of private schools.

Methodology of the Study

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

Participants

For this study, the researcher has taken a sample of 76 students of class 9th from three schools of District Ajmer. During his study researcher take one government school and two private schools as per the availability of classes in those particular schools. Sample selected by the researcher through PURPOSIVE technique. Researcher had 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.

Figure1: Sample Distributions
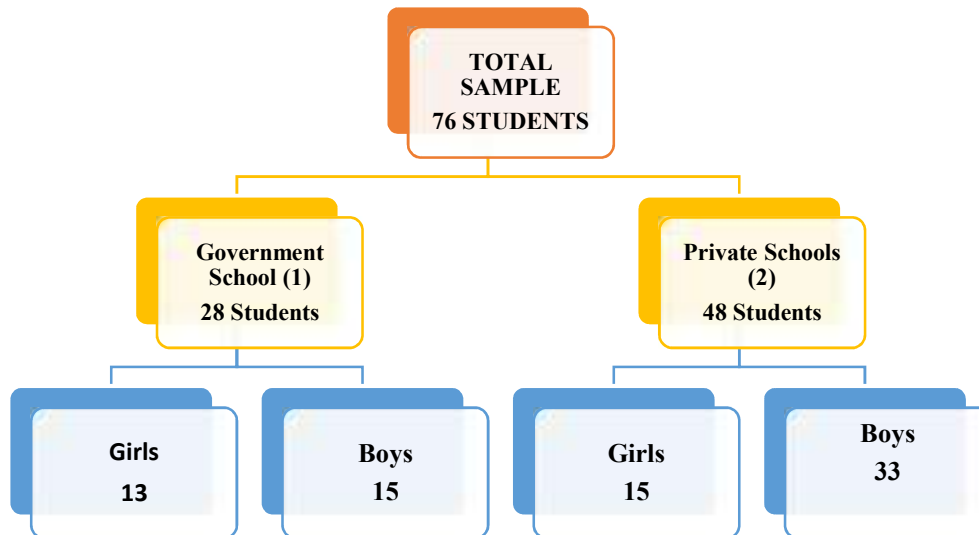
FIGURE 1: SAMPLE DISTRIBUTION

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 found by the researcher which is satisfactory.
- Reflective Thinking Scale RTS (Yadav, P. 2019) states that this tool consists of 28 items which 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.

Figure 2: Dimensions of Reflective Thinking Scale (RTS)
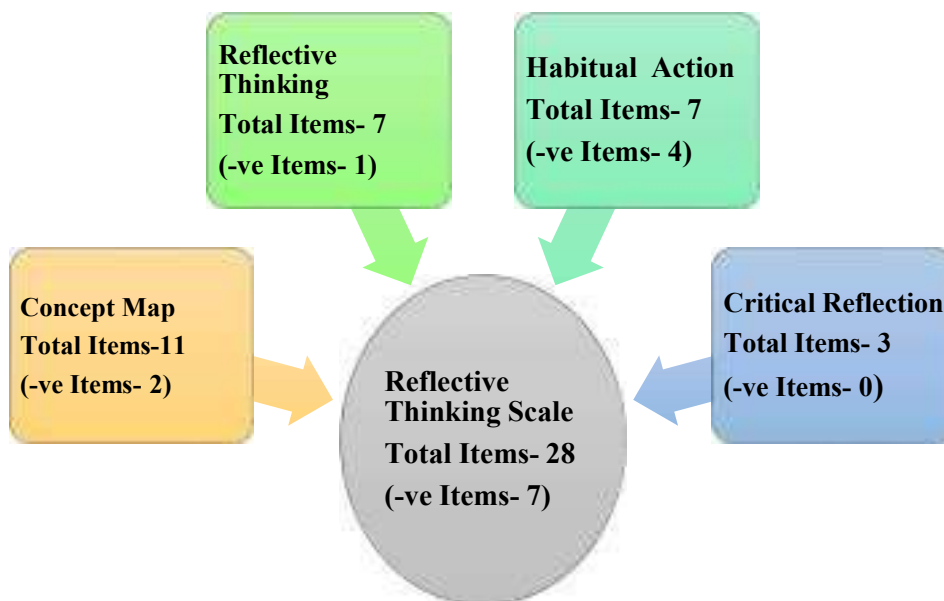
FIGURE 2: DIMENSIONS OF REFLECTIVE THINKING SCALE

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 Correlation Study therefore researcher used Correlation 'r' coefficient between two variables.

Data Analyses and Hypothesis Testing

For analyzing complete data, 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.

H_{01}: There is no significant relationship between concept mapping and reflective thinking in Science of grade IXth students.

Table 1: Descriptive Statistics of Whole Data

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

It is clear from the above table 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 total sample is 76.

Table 2: 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).			

The result shows there is a significant relationship between concept mapping and reflective thinking because value of correlation is 0.465 at 0.01 levels which is significant and indicates a positive correlation between the variables.

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

H_{02}: There is no significant relationship between concept mapping and reflective thinking in Science of grade IXth students of government school.

Table 3: Descriptive Statistics of Government School Students

Descriptive Statistics						
	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Concept Map Score Govt. School	28	9.00	17.00	13.1786	2.27797	5.189
Reflective Thinking Score Govt. School	28	69.00	119.00	100.6071	10.13370	102.692
Valid N (listwise)	28					

When we take concept mapping scores of government school students and simultaneously reflective thinking scores of government school students then we see mean score of concept map achievement test of boys is 13.1786 and standard deviation is 2.27797 and on the other hand mean score of reflective thinking scale of government school is 100.607 and standard deviation is 10.133.

Table 4: Correlation of Concept Mapping and Reflective Thinking of Government School Students

Correlations		Concept Map Score Govt. School	Reflective Thinking Score Govt. School
Concept Map Score Govt. School	Pearson Correlation	1	.343
	Sig. (2-tailed)		.074
	N	28	28
Reflective Thinking Score Govt. School	Pearson Correlation	.343	1
	Sig. (2-tailed)	.074	
	N	28	28

When we correlate the concept map scores and reflective thinking scores of government school students then we find there is positive moderate 0.343** level correlation which is significant at 0.01 level of significance (2-tailed), hence with the above shown result researcher reject the null hypothesis because there is significant positive correlation between concept mapping scores and reflective thinking scores of government school students.

H_{03}: There is no significant relationship between concept mapping and reflective thinking in Science of grade IXth students of private schools.

Table 5: Descriptive Statistics of Private Schools Students

Descriptive Statistics						
	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Concept Map Score Pvt. School	48	9.00	18.00	13.9167	2.51661	6.333
Reflective Thinking Score Pvt. School	48	84.00	134.00	107.2917	10.67899	114.041
Valid N (listwise)	48					

Mean score of Private School students on the basis of Concept map achievement test is 13.9167 and standard deviation is 2.51661, and Mean score of Private School students on the basis of Reflective thinking scale is 107.2917 and standard deviation is 114.41.

Table 6: Correlation of Concept Mapping and Reflective Thinking of Private Schools Students

Correlations		Concept Map Score Pvt. School	Reflective Thinking Score Pvt. School
Concept Map Score Pvt. School	Pearson Correlation	1	.497[**]
	Sig. (2-tailed)		.000
	N	48	48
Reflective Thinking Score Pvt. School	Pearson Correlation	.497[**]	1
	Sig. (2-tailed)	.000	
	N	48	48
**. Correlation is significant at the 0.01 level (2-tailed).			

When we correlate the concept mapping scores and reflective thinking scores of Private Schools students then we find there is positive moderate 0.497** level correlation which is significant at 0.01 level of significance (2-tailed), hence with the above shown result researcher reject the null hypothesis because there is significant positive correlation between concept mapping scores and reflective thinking scores of private schools students. Since from the above result specifically on the basis of private schools we can say that concept mapping scores and reflective thinking scores of 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 a positive relationship between concept mapping and reflective thinking at secondary level. There is positive moderate level (r = 0.465**) correlation exists between these two variables.

- After analysis of data, institutions affiliation wise researcher find that there is no significant difference between government and private schools students we can see from the analysis of hypothesis 2 and 3 correlation between concept mapping and reflective thinking on the basis of government schools lies in the category of positive moderate level correlation but if we see closely the pattern of correlation then we found correlation between concept mapping and reflective thinking of private schools is slightly higher which is obvious because in our country on many aspect private schools different from government schools. In both cases we occur with positive moderate level correlation. Since the mean score of private schools students is high in respect to government school students but this may be because we take only 28 students from government school for this study and the number of students from private schools is 48. So there are many factors behind this result.

- The main purpose of this research paper is to identify the relationship between concept mapping and reflective thinking on the basis of government and private schools and also analyze how much relation shifted in any direction? That may be positive or negative in relation to concept mapping and reflective thinking but researcher found on the basis of government and private schools there is no big 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 of private schools students is better in comparison to government schools students.

Discussions

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

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

- 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 a meaningful way and for a long span of time.

- The findings of this study also provide a theoretical background as well as evidence to the researcher to conduct further research. Last but not least, it will be helpful in teacher training programmes organized 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.

References

1. ASER (2018) Retrieved December 2, 2020 from http://img.asercentre.org/docs/ASER%202018/Release%20Material/aser2018pressreleaseeng.pdf

2. Andreas Ryve. (2004). *Can Collaborative Concept Mapping Create Mathematically Productive Discourses? Educational Studies in Mathematics,* 56(2/3), 157-177. Retrieved January 28, 2021, from http://www.jstor.org/stable/4150280

3. Baroody, A., & Bartels, B (2001) Assessing Understanding in Mathematics with Concept Mapping. Mathematics in School, 30(3), 24-27. Retrieved January 28, 2021, from http://www.jstor.org/stable/30212165

4. D'Antoni, Anthony V., (2009). *Relationship between the mind map learning strategy and critical thinking in medical student* (Doctoral dissertation, Seton Hall University), Retrieved from https://pqdtopen.proquest.com/ doc/ 304996755. html?FMT=ABS

5. Davies, M. (2011) Concept mapping, mind mapping and argument mapping: What are the differences and do they matter? Higher Education, 62(3), 279-301. Retrieved January 28, 2021, from http://www.jstor.org/stable/41477852

6. Derbentseva,Natalia&Safayeni,Frank.(2004). *Experiments on the Effects of Map Structure And Concept Quantification During Concept Map Construction* (Research Article,University of Waterloo, Canada), Retrieved From http://cmc.ihmc.us/papers/cmc2004-125.pdf

7. Dewey, J. (1933). How We Think: A Restatement of the Relation of Reflective Thinking to the Educative Process Vol. 8.

8. Ghanizadeh, A The interplay between reflective thinking, critical thinking, self-monitoring, and academic achievement in higher education. *High Educ* **74,** 101–114 (2017) https://doi.org/10.1007/s10734-016-0031-y

9. Gwo,Lee,Hsiung,Chun. (2007). *Application of automatically constructed concept map of learning to conceptual diagnosis of e-learning* (Research Article), Retrieved from https://doi.org/10.1016/j.eswa.2007.11.049Get rights and content

10. Hsiu-Ying Wang, Iwen Huang, & Gwo-Jen Hwang (2016) *Effects of a Question Prompt-based Concept Mapping Approach on Students' Learning Achievements, Attitudes and 5C Competences in Project-based Computer Course Activities. Journal of Educational Technology & Society, 19*(3), 351-364. Retrieved January 28, 2021, fromhttp://www.jstor.org/stable/jeductechsoci.19.3.351

11. Hwang at al. (2011).*A concept map approach to developing collaborative Mind tools for context‑aware ubiquitous learning* (Research Article), Retrieved from https://onlinelibrary.wiley.com/doi/full/10.1111/j.1467-8535.2010.01102.x

12. Learning Outcome for Secondary Level (2019) Retrieved December 2, 2020 From https://ncert.nic.in/pdf/notice/learning_outcomes.pdf

13. NAS (2017) Retrieved December 2, 2020 From https://ncert.nic.in/NAS.php

14. National Educational Policy (2020) Retrieved December 2, 2020 From https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0 .pdf

15. National Policy on Education (1968) Retrieved December 2, 2020, from https://www.education.gov.in/sites/upload_files/mhrd/files/document-reports/NPE-1968.pdf

16. National Policy on Education (1986) Retrieved December 2, 2020, from https://www.education.gov.in/sites/upload_files/mhrd/files/upload_document/NP E86-mod92.pdf

17. NCF (2005) Retrieved December 2, 2020 From https://ncert.nic.in/pdf/nc-framework/nf2005-english.pdf

18. Nesbit,C.John, Adesope,O.Olusola. (2006). *Learning with Concept and Knowledge Maps: a Meta-Analysis*(ResearchArticle),Retrievedfrom https://journals.sagepub.com/doi/abs/10.3102/0034654307600341

19. Novak, J. D. (1990). Concept mapping: A useful tool for science education. *Journal of Research in Science Teaching, 27*(10), 937–949. https://doi.org/10.1002/tea.3660271003

20. Novak, Joseph & Cañas, Alberto (2007) Theoretical origins of concept maps, how to construct them, and uses in education Retrieved From September 10, 2020, From https://www.researchgate.net/publication/228761562_Theoretical_origins_of_concept_maps_how_to_construct_them_and_uses_in_education

21. Schwendimann, Beat Adrian, (2011).*Mapping biological ideas: Concept maps as knowledge integration tools for evolution education* (Doctoral dissertation, University of California, Berkeley), Retrieved from https://pqdtopen.proquest.com/doc/928947890.html?FMT=ABS

22. Soleimani, Hassan &Nabizadeh, Fatemeh. (2012). *The Effect of Learner Constructed, Fill in the Map Concept Map Technique, and Summarizing Strategy on Iranian Pre-University Students' Reading Comprehension* (Research Article), Retrieved Fromhttps://eric.ed.gov/?id=EJ1079947

23. Somers, Judy L.,Ed.D.,(2009). *Using concept maps to explore preservice teachers' perceptions of science content knowledge, teaching practices, and reflective processes* (Doctoral dissertation, Florida Atlantic University). Retrieved from https://pqdtopen.proquest.com/doc/304922282.html?FMT=ABS

24. Sugihara at al. (2011).*Experimental Evaluation of Kit-Build Concept Map for Science Classes in an Elementary School*(Research Article, Hiroshima University, Japan), Retrieved From https://www.researchgate.net/profile/Tsukasa_Hirashima/publication/288417060_Experimental_evaluation_of_KitBuild_Concept_Map_for_science_classes_in_an_elementary_school/links/56d1708608ae85c8234aac73/Experimental-evaluation-of-Kit-Build-Concept-Map-for-science-classes-in-an-elementary-school.pdf

25. Spitzer, D. (1975) What Is a Concept? *Educational Technology, 15*(7), 36-39. Retrieved September 10, 2020, from http://www.jstor.org/stable/44418021

26. Tanya Chichekian, & Bruce M. Shore. (2013). Concept Maps Provide a Window onto Preservice Elementary Teachers' Knowledge in the Teaching and Learning of Mathematics. *Canadian Journal of Education / Revue Canadienne De L'éducation, 36*(3), 47-71 Retrieved January 28, 2021, from http://www.jstor.org/stable/canajeducrevucan.36.3.47

27. Tseng, S. (2015) Concept-Mapping Tools and the Development of Students' Critical-Thinking Skills. Educational Technology, 55(5), 39-43. Retrieved January 28, 2021, from http://www.jstor.org/stable/44430407

28. West at al. (2002).*Concept mapping assessment in medical education: a comparison of two scoring systems* (Research Article), Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1046/j.1365-2923.2002.01292.x

29. Xie, Y., & Sharma, P. (2011) Exploring evidence of reflective thinking in student artifacts of blogging-mapping tool: A design-based research approach. *Instructional Science, 39*(5), 695-719. Retrieved January 28, 2021, from http://www.jstor.org/stable/23882826