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Effectiveness of Concept Mapping Strategy on Achievement in Biology among Secondary school students

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Abstract

The present study investigates the Concept Mapping strategy on achievement in biology among secondary school students. Concept Mapping would be an excellent strategy to enable the students to think about connections between science terms being learned, organize their thoughts, visualize relationships between key concepts in a systematic way and reflect on their understanding. The design for this study was a two-group Pretest-Posttest quasi-Experimental. The sample consisted of IXth standard students selected from an Aided school of Palakkad District, Kerala. Instructional materials based on Concept mapping strategy was prepared and used to teach the experimental group. The data collected were analysed using t- test and ANCOVA statistical analysis. In this study, Concept mapping was assessed as an instructional strategy for use in secondary school students in learning biology concepts. The result of the present study indicates that Concept mapping strategy is significantly more effective than the Conventional method in the improvement of achievement in Biology.

Key words: Concept Mapping, Achievement in biology

INTRODUCTION

Education is the development of intellectual, emotional and sensory motor domains of the individual. The education process should be entire with all levels which includes from concrete experiences, observation-reflection, abstract concepts to generaliations and implementing concepts in new situations. Thus education environment should be equipped with methods that students can use their sense organs, gain some concrete experiences and learn how to learn. For this reason, activities and teaching methods carry great importance. Providing an attractive learning environment, student's active participation in the activities during the process of students Biology learning makes it

more enjoyable and understandable. Hence Concept mapping strategy is important for students to attain concepts easily.

Concept map was first introduced as a systematic way of learning in 1960's by Novak but was developed as a teaching strategy during early 1980's. His work was based on the Ausubel's assimilation theory of cognitive learning. The fundamental idea in Ausubel's assimilation theory is that learning takes place by the assimilation of new concepts and propositions into existing concepts and propositional frame works held by the learner. This knowledge structure as held by a learner is also referred to as the individual cognitive structure. This theory emphasizes meaningful learning in which the concepts that the learnt knowledge is fully understood by the individual and that the individual knows how that specific fact relates to other stored facts.

A Concept map is a graphical representation of concepts and their interconnections. Research has shown that Concept maps reflect the student's cognitive structure, enabling both teachers and students to determine the level of understanding of material attained before, during or after instruction to be academically successful, science students need to know how to organize data and connect it to previously acquired knowledge.

The important point is that the beginning stage of drawing concept maps not only needs active participation of the learner in the learning process but also paves the way on their understanding of a specific learning area. As a result, such information about learners' understanding empowers facilitators to determine learners' cognitive deficiencies and provide corrective feedback.

Lambiotte and Dancereau (2001) stated that the students that made concept maps have a broader knowledge base and therefore more able to solve problems compared to those students that learned by rote memorization. Lambiotte and Dancereau also found out that, the students with low prior knowledge learned better with concept mapping than those taught lecture method. Concept mapping has also been shown to increase the learners' writing ability (Gorjian, Pazhakh, & Parang, 2002). This improvement has been demonstrated in terms of the quantity and quality of producing, arranging and relating ideas (Pishghadam & Ghanizadeh, 2006).

A concept map can be considered as somewhat similar to a spider chart, an organized chart of a flow diagram. A concept map for teaching and learning is one, arranged in a hierarchical organization in which the more inclusive concepts at the top of the map and the more concrete and specific ones at the bottom. The highly conceptual

nature of Biology makes it particularly difficult for students and the strategies used in the classroom have not sufficiently eased the learning process. Many students showed difficulty identifying the important concepts in a text, lecture or other form of presentation.

In a concept map, concepts are represented by nodes, usually enclosed in circles or boxes, and relationships between concepts are indicated by connecting lines that link them together. The label for most concepts is a single word, although sometimes symbols such as + or % are used. The core element of a concept map is a proposition, which consists of two or more concepts connected by a labeled link. Propositions are meaningful statements about some object or event. In a concept map, propositions are connected to each other to form a hierarchical and branching structure, with the most inclusive, most general concepts at the top of the map and the more specific, less general concepts arranged below, that represents the organization of knowledge in long-term memory.

The Concept Map may pertain to some situation or event that we are trying to understand through the organization of relevant knowledge, thus providing the context for the Concept Map. A concept map for teaching and learning is one, arranged in a hierarchical organization in which the more inclusive concepts at the top of the map and the more concrete and specific ones at the bottom.

Need and significance of the study

In the traditional teaching methods, the students were given lectures and notes and they in turn, learned primarily by rote. This method did not develop creative thinking or problem solving skills. Concept mapping is an organizational strategy that may aid students in critical thinking and the ability to draw the necessary connections among the knowledge realms required to pass the required rigorous national licensing examination and to deliver safe and effective health care.

Research has shown that concept maps reflect the students cognitive structure, enabling both teachers and students to determine the level of understanding of material attained before, during or after instruction to be academically successful. This method helps in the self reconstruction process which result in meaningful learning and engage the learners to develop their thinking skills. It helps in evaluation, identifying slow learners, teacher-trainees, development of reflective skills etc.

Concept mapping is being researched of late as an alternative strategy to teaching and testing. It has been found to be an effective teaching method which enhances meaningful

learning. Feeling like more active learners, concept mappers are empowered to move toward more meaningful learning. Concept mapping appeared to enhance clarity of learning, integration and retention of knowledge. Concept mapping can be a useful strategy in tracking student's evolving constructions of knowledge in a particular subject area and in promoting reflection (Barbara B. and Joyce S). Concept mapping offers a valid and potentially useful technique for documenting and exploring conceptual change in biology. Concept mapping was significantly more effective than the traditional /expository teaching strategy in enhancing learning in biology and reduced student's anxiety towards the learning of biology(especially in males) (Olugbemiro J., Folusho A., 1990). Some studies have showed that the participants hold idiosyncratic concepts not consistently coincident with those of the prescribed curriculum, and that everyday concepts are retained more than are scientific concepts.

Many researchers have studied the concept maps as a research and evaluation tool. The concept map provides a theoretically powerful and psychometrically sound tool for assessing conceptual change in the experimental and classroom settings. Collaborative concept mapping was found to provide a context for teachers in changing their classroom environments from objectivist to constructivist metaphor. It is felt that research on student's facility in using concept maps, on training techniques, and on the effect on teaching is needed if concept map assessments are to be used in classrooms and in large-scale accountability systems.

A few researchers have showed concept mapping to be beneficial for learning, and to support sustained small-group discussion of scientific ideas. Concept mapping/learning cycle and concept mapping treatment groups significantly outperformed from the expository treatment group in conceptual understanding of diffusion and osmosis. Concept mapping as an instructional tool had an effect on the achievements of students who also reflected a positive attitude towards concept mapping as an effective teaching strategy. Some have suggested improvements in constructing the concept maps: concept maps should be construction of concept maps should be based on certain kind of discipline and evaluation of it should also be based on semantics of linking words and not on graphical criteria alone.

Concept mapping strategy helped students in enhancing the retention rate, stimulating creativity among the students. It also helped in motivating them, increasing the level of interest, high level of critical thinking and reducing anxiety. Concept mapping was found

to be an effective alternative teaching and testing strategy for the inclusive science classroom. The researcher wanted to know whether concept mapping will prove to be effective in enhancing conceptual clarity of vernacular medium students in science subject.

Objectives of the study

- To compare the mean pre-test scores in achievement of Biology of control and experimental groups of Secondary school students.
- To compare the Mean post test scores in the achievement of Biology of control and experimental groups of Secondary school students.
- To compare the Mean pre-test scores and post-test score in the achievement in Biology for experimental group of Secondary school students.
- To test the difference in mean gain scores of experimental and control groups.

Hypotheses of the study

- There exist no significant difference between Mean pre-test scores of Biology in control and experimental group.
- There is significant difference in the Mean post-test scores in the achievement in Biology of control and experimental group.
- There is significant difference between the Mean pre-test and post-test scores in the achievement of Biology of experimental group.
- There exist significant difference in the mean gain scores of experimental and control groups.

Method of the study

The design selected for the present study is an experimental design. It is an experimental design with pre-test and post-test non equivalent group design. The design is often used in class room experiment when an experiment and control groups are such naturally assembled groups as in act classes which may be similar.

Sample

The sample selected for the study consist of 100 high school students divided in to control and experimental group consist of 50 students each.

Tools and Techniques

- Lesson Transcript based on constructivist method developed by Investigator and Supervisor.

- Module based on Concept mapping strategy developed by the Investigator and Supervisor.
- Standardized Achievement tests both pre-test and post-test**.**

RESULT AND DISCUSSION

Statistical analysis

For comparing pre-test and post-test scores of experimental and control group the statistical techniques used were student T-Test and ANCOVA.

• Hypothesis 1

Analysis of significance of difference in mean pre-test scores between experimental and control groups.

The test of significance difference was conducted to find out the mean pre-test scores of achievement in biology among the control and experimental group. The investigator analyzes the significant difference between the mean pre- test scores of achievement in biology among the control and experimental group by applying the statistical technique independent sample t test. Data and results of analysis of significant difference between the mean pre-test scores of achievement in biology among the control and experimental group are given in the table 1.

Table 1

Data and results of analysis of significant difference between the mean pre-test scores of achievement in biology among the control and experimental groups.

Post test	N	M	SD	t	P
Control group	50	15.44	2.12	0.77	P>0.05
Experimental group	50	15.78	2.29		

The table1 indicates that the mean obtained from the pre-test scores of achievement in biology of control and experimental groups are 15.44 and 15.78 respectively. It shows that there is a slight difference of mean scores among the both control and experimental groups. In order to test whether this difference is significant or not student's t –test score is computed. The obtained value of 't' for the difference between mean scores of experimental and control group is 0.77. The table value at 0.01 levels and at 0.05 levels are 2.58 and 1.96 respectively. The obtained value of't' is less than the table value and is

not significant at 0.05 level. It means that there is no significant difference between the means of pre-test scores of students in the experimental and the control groups. That is before experiment the students of the two groups do not differ significantly in their achievement in biology.

Discussion of the results: The hypothesis is stating that there is no significant difference in mean pre-test scores of achievement in biology between experimental and control group before the experiment was accepted on the basis of obtained value (0.778) as it is less than the table value at 0.005 levels. It means there is no significant difference between the mean pre-test scores of control and experimental group before experiment.

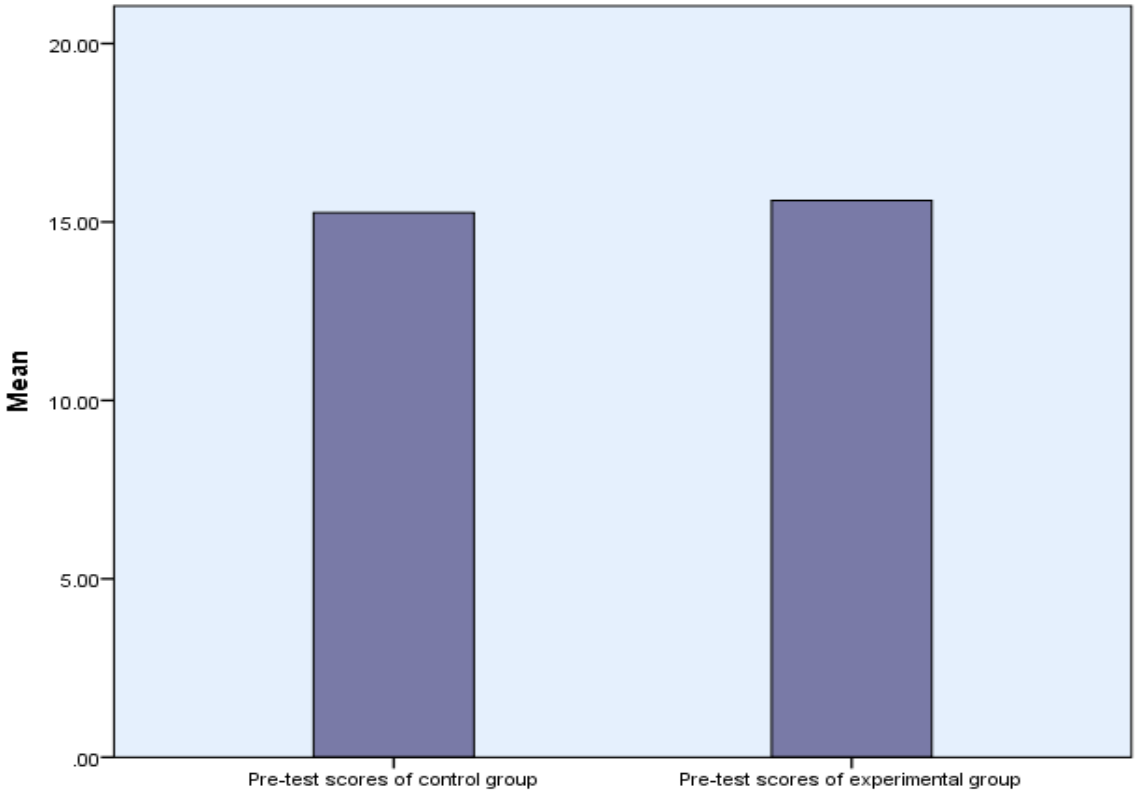

Figure1. Graphical representation of test of significant difference between the mean pre-test scores of achievement in biology among the control and experimental groups.

• Hypothesis 2

Analysis of significance of difference in mean post test scores between experimental and control groups.

There is a significant difference between the mean post test scores of achievement in biology among the control and experimental group by applying the statistical technique independent sample t test. The test of significant difference between the mean post test

scores of achievement in biology among the control and experimental group is given in the table 2.

Table 2

Data and results of test of significance of difference in mean post-test scores of achievement in biology among the control and experimental groups.

Post test	N	M	SD	t	P
Control group	50	29.28	3.77	9.46**	P<0.01
Experimental group	50	35.40	2.60		

** Significant at 0.01 level

The table 2 shows post test mean scores and standard deviation of achievement in biology among the experimental and the control groups. It is revealed that mean post test score of achievement in biology of the experimental group is higher than the post test scores of achievement in biology of the control group. It is evident that the obtained value of the't' for the difference between post test scores of experimental and control group is 9.46. The table value at 0.01 levels and 0.05 levels are 2.58 and 1.96 respectively. The obtained value of't' is greater than the table values and is significant at 0.01 level. It means there is a significant difference between the means of post test scores of students in the experimental and the control groups.

Discussion of the results: The hypothesis is stating that there is significant difference in mean post test scores of achievement in biology between experimental and control groups. After the experiment the hypothesis was not rejected. It may conclude that there is significant difference in the mean post test scores of experiment and control group students after experiment. The statistics shows that there occur a large difference in the mean post test scores of control and experimental groups. The test of significance of difference clearly depicts that using Concept mapping strategy creating significance of difference in mean post test scores of achievement in biology among the control and experimental groups.

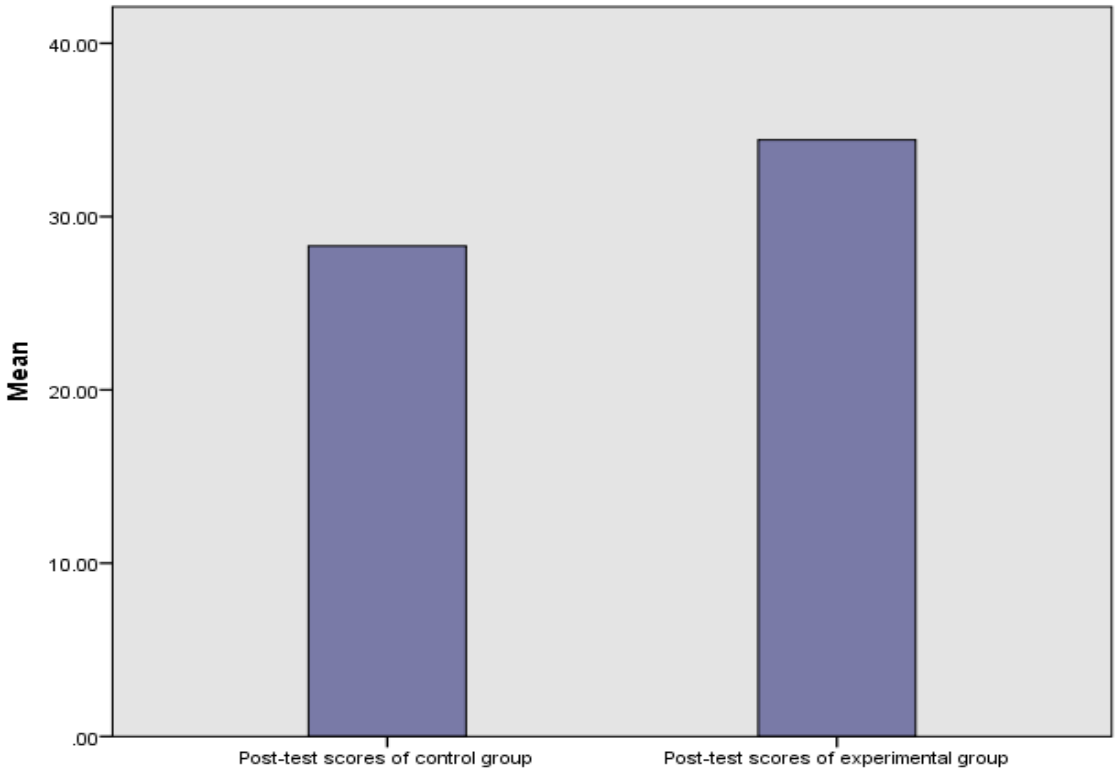

Figure 2: Graphical representation of test of significance of difference in mean post test scores of achievement in biology among the control and experimental groups.

- **Hypothesis 3**

Analysis of significance of difference in mean pre-test and post test scores of achievement in biology among experimental group.

Table 3

Data and results of test of significance in difference in mean pre-test and post test scores of achievement in biology among the experimental group.

Post test	N	M	SD	t	P
Control group	50	15.44	2.12	41.35**	P<0.01
Experimental group	50	35.40	2.60		

**significant at 0.01 level

The table shows pre-test and post test mean scores and standard deviation of achievement in biology among the experimental group. It is revealed that post test scores of achievement in biology is significantly higher than the pre-test score of achievement in

biology. It is evident that the obtained value of't' for the difference between mean pre-test and post test scores of experimental group is 41.35. It means that there is significant difference between the means of the pre-test and post test scores of achievement in biology among students in experimental group.

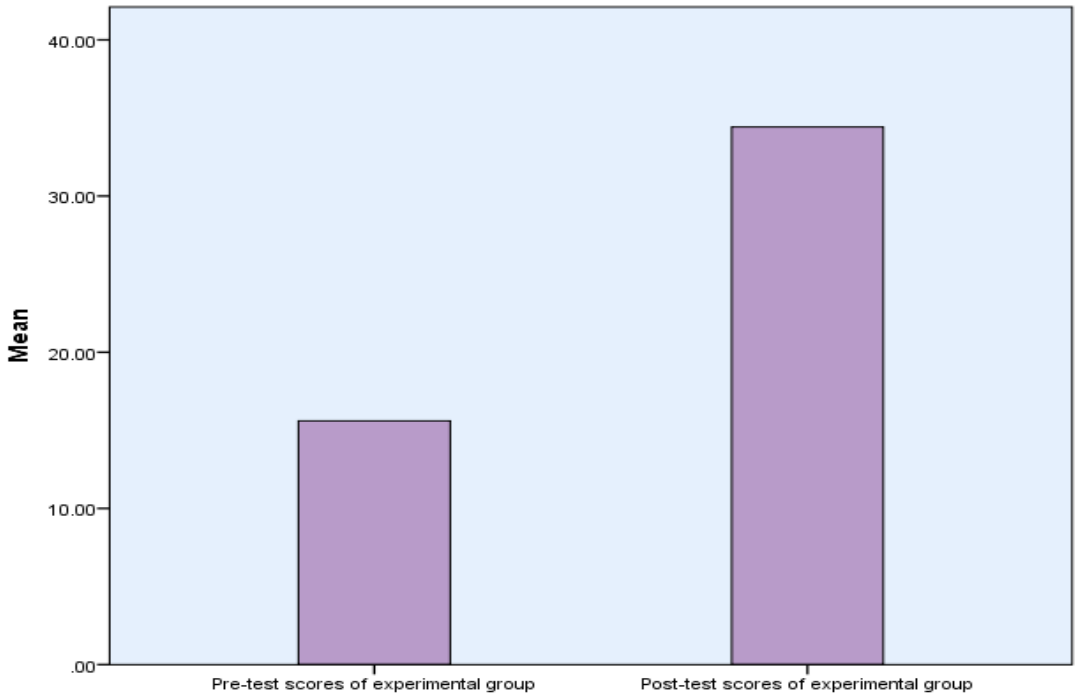

Figure3. Graphical representation of test of significance of difference in mean pre-test and post-test scores of achievement in biology among experimental group.

- **Hypothesis 4**

Analysis of significance of difference between the mean gain scores of achievement in biology among the control and experimental group.

Table 4

Data and results of test of significance of difference in mean gain scores of achievement in biology among the control and experimental groups.

Gain score	N	M	SD	t	P
Control group	50	13.54	2.36	13.11**	P<0.01
Experimental group	50	19.32	2.04		

** Significant at 0.01 level

Table shows the mean gain scores and SD of achievement in biology among control and experimental groups. It is evident that the obtained value of't' for the difference between gain score of control and experimental group is 13.11. The obtained value of't' is greater than the table values and is significant at 0.01 level. It shows that there is significant difference between the means of the gain scores of students in experimental and control group.

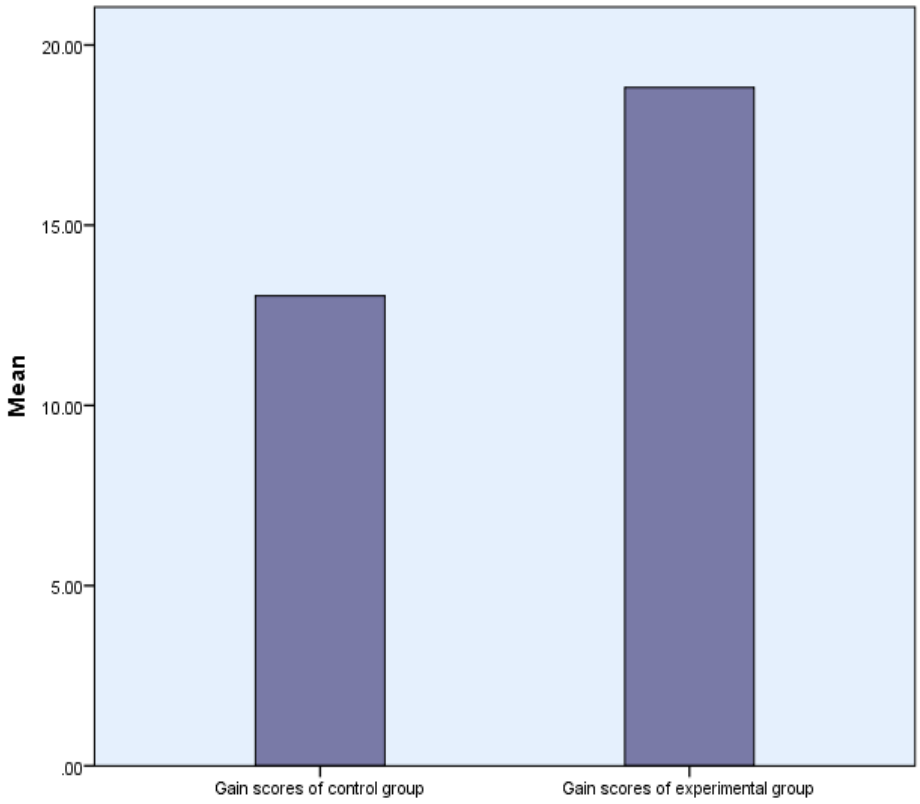

*Figure4.*Graphical representation of test of significance of difference in mean gain scores of achievement in biology among the control and experimental groups.

Major Findings of the study

• The adoption of Concept mapping strategy is necessary to address the current poor performance of students in biology.

- The findings show that Concept mapping method is effective in teaching biology at secondary levels.
- The achievement of students who were taught through Concept mapping strategy in biology was significantly higher than that of the students of control group.
- There is no significant difference between the means of pre-test scores of students in the experimental and the control groups.
- There is a significant difference between the means of post test scores of students in the experimental and the control groups.
- The mean post test scores of experimental group were higher than that of control group.

Conclusion

The present study reveals that, the students performance in biology taught through Concept mapping strategy was significantly higher than those which were taught through conventional teaching strategy. This is because the Concept mapping strategy is more interactive than the conventional method. The investigator found that the Concept mapping strategy was effective on achievement in biology among secondary school students. Concept Mapping strategy encourages the learners to think independently, produce more self confidence. The study recommends the use of Concept Mapping Strategy for better performance of biology students at secondary stage.

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