Assessment of academic achievements and memorisation power of students by concept map strategy and traditional lecture approach

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Abstract

The challenges in the 21st century have made learning a complex process. In this age, new and conceptual learning strategies are being used to compete with the challenges. The concept map learning strategy has shown positive influences on students' academic achievements and quality of education. This learning strategy has also showed a significant effect on students' critical thinking skills. A research study has been conducted to assess the students' academic achievements and memorisation power by concept map learning strategy and traditional learning approach. The students of a primary school studying in fifth grade in general course for section A (concept map learning strategy) and section B (Traditional lecture learning strategy) were assessed. The descriptive statistics and *t*-test analysis were also carried out on the results obtained from the students by concept map and traditional learning strategies. Statistical analysis showed that concept map learning strategy improved the students' academic achievements and memorisation power significantly.

Keywords: Critical thinking skills, learning skills, microbiology, strategies, primary school.

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1. Introduction

Learning is a basic element of education and plays a vital role in the development of a nation (Hafeez et al., 2020). The successful implementation of a learning strategy in the classroom depends on the capability of the teacher using learning approaches, practises and strategies. The traditional learning approach does not develop critical thinking, memorisation and collective problem-solving skills. Effective learning is very essential in the present era to improve academic achievement and to develop critical thinking skills in learners. The teachers must use the modern and useful learning approaches to develop efficient learning skills in all learners to challenge the global society (Saira, Ajmal & Hafeez, 2020). Many countries in the world, particularly developed nations, are applying different modern learning strategies, including computer-based concept mapping. By applying computer-based learning strategies, these countries are developing problem-solving and critical thinking skills in their learners. The level of understanding also affects the learning process and strategies applied to learning (Hafeez, 2021).

Learning through media is an important mode of learning. The teachers use the learning media to prepare the learning materials for the students. The learning media must be useful, interesting and according to the understanding level of learners so that the learners can understand the learning process easily. An effective learning media motivates learners and results in better outcomes. The learning media also increases the presentation, communication and critical thinking skills of the learners when they use it in the learning process. So, teaching–learning strategies demand for such types of curriculum, which may contain learners with particular information building, retaining them as the core of the learning action, as well as a teacher as a helper (Hafeez, 2021).

For many years, instructors have taught students by means of traditional lectures and had pupils follow-up with homework and assignments. The key theory for this process of teaching is that the instructor delivers to the learners his/her overview in the classroom first, then makes available some examples, cases and problems and then the pupils do some course work to consolidate their newly learned information on the paper. If pupils had questions about the homework or assignment, they would carry the work or assignments to the instructor before the next scheduled class. Then, the lecture from the previous day would be revised by the instructor and he would discourse any questions which may have been incited by the assignment or homework during this revision. This is a traditional method of efficiently conveying the knowledge, skills and information to the pupils. Nevertheless, this way of teaching has many disadvantages (Saira & Hafeez, 2021). It obviously makes learners passive receivers of information instead of inventers of it. This apparently hinders useful connections between the course content and transmission of that course content into another context. Knowledge becomes sustainable when there is dynamic participation in the learning process and connections occur between the elements of learning. Knowledge can be made sustainable by using some modern learning strategies like concept map learning strategy (Hafeez, Ajmal & Kazmi, 2021; Li, Gao & D'Agostino, 2019).

2. Problem statement

Determination of right strategy for learning process has always remained a challenge for researchers and instructors. A lot of researches have been carried out on the impacts of learning strategies on students' academic achievement and critical thinking skills (Amin, Corebima, Zubaidah & Mahanal, 2020; Mahanal, Zubaidah, Sumiati, Sari & Ismirawati, 2019). However, no study has been found to find the effects of concept map and traditional learning strategies on the students' academic achievements and students' learning memory. So, the objective of current study is to assess students' academic achievements and memorisation power by concept map and traditional learning strategies.

3. Review of the literature

3.1. Traditional lecture method

The traditional lecture method is one of the oldest learning strategies. It is a useful and economic learning strategy for the transfer of essential information and concepts before a large group of learners. Although traditional lecture method has a lot of advantages, evidences from studies show that this learning strategy is not very effective for the development of teaching–learning skills, and that critical thinking skills are required for higher education, particularly in medical-related fields. This is the reason by which the traditional lecture method is stated as a teacher-centred learning strategy where information is transferred by the instructors and is passively acknowledged by the learners (Samuelson, Divaris & De Kok, 2017).

A lecture teaching method is stated as in which the instructor continuously speaks before a group of students on a particular subject or topic. The group size may vary from 20 to 1,000. The instructor is responsible for delivering whole of the content and subject matter. It is one of the oldest teaching methods used in schools, colleges and universities. The lecture method of teaching is based on the transfer of knowledge from the instructor to the learners (White & Kern, 2018). Many instructors believe that traditional lecture method is not more successful in the cognitive development of learners as traditional lecture method is a passive method of learning. It does not involve the learners to contribute in the educational process. Usually, the instructor presents the whole lecture before the learners. The learners get the notes of the lecture and prepare them for the examination (Jungst, Licklider & Wiersema, 2003). The major reason for adopting the lecture method of teaching is its ability to handle a large number of learners at a time (Marmah, 2014). The important characteristics of lecture teaching method are highlighted and shown in Figure 1.
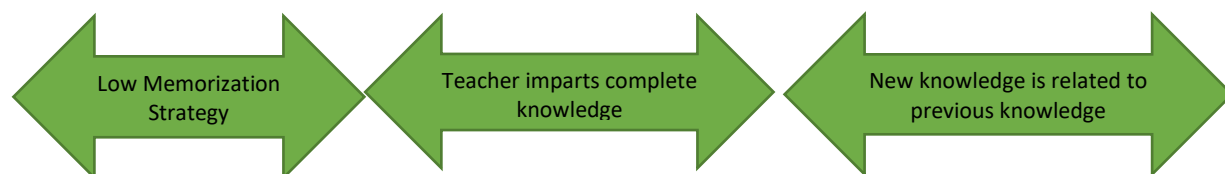

Figure 1. Characteristics of the traditional lecture method

In the current age, the lecture teaching method is considered as a boring method because it does not allow the students to actively participate. However, it can be made effective by blending the information technology tools (Fulford & Mahon, 2018). Gooblar (2019) argued that telling (the lecture method of teaching) is an excellent method for learners as in the lecture method the instructor delivers all the contents with details.

4. Concept maps learning strategy

The main focus of present century learning is to support learners to develop useful and meaningful understanding that can be used for developing and solving real-world problems. The world with all its complications – comprising a fast development of information and learning process along with greater burdens on the learning system – generates a challenge to assist pupils to advance the learning skills to compete these complications. So, the main purpose of the curricula at schools and at universities is to endorse conceptual and theoretical learning that underpins development and learning skills in the students (Rimini & Spiezia, 2016).

Concept maps were first presented by Novak and Gowin (1984). They established this useful tool based on the learning concepts of Ausubel. A concept map is a conceptual diagram that gathers a lot of concepts into one diagram. The concepts are meaningfully related through linking words to make meaningful sentences. In these concept map diagrams, concepts are generally denoted as boxes and

their connections are represented by arrows labelled by linking words (Ausubel & Barberan, 2002). The concept maps are teaching–learning approaches that indicate how learners gain information and make it useful for real-life problems. The concept maps also support the learners to understand the information provided according to the mental level of the learners. The concept maps are two-dimensional diagrams that display the information. In the present era, technology-based concept maps are used in the learning process (Chiou, Lee, Tien & Wang, 2017). The main characteristics of concept map learning strategies are highlighted and shown in Figure 2.
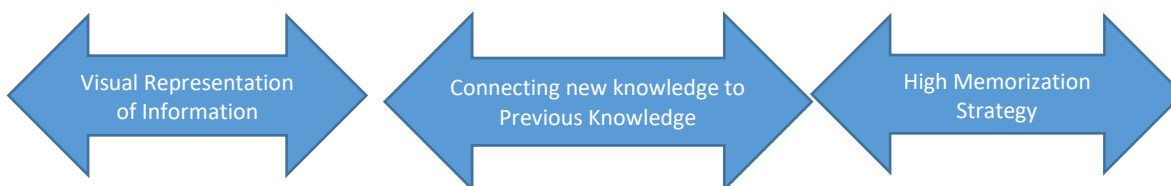

Figure 2. Characteristics of the concept map learning strategy

Concept map is a type of media that can be implemented to show meaningful and useful relationships between concepts in the way of propositions (Senthamarai, 2018). Chen et al. (2014) stated that Novak and Gowin (1984) were the first authors who brought about concept maps in their book. In their book, they said that by using the concept maps the learners can easily understand the learning material taught by a teacher. By using the concept maps, the students show the conceptual diagram in the form of a map. This map can be easily understood and can be kept in mind for a long time. The concept maps are usually represented in a two-dimensional image form. In drawing the concept maps, the complex and difficult concepts are illustrated. These maps can be used in many fields of study like Geography, Mathematics, Home Economics and Physics. A more comprehensive concept is drawn on the top of map and less comprehensive on the bottom of the map (Nugrahani, Prasetyo & Iswari, 2018).

Hwang, Sung and Chang (2017) stated that concept mapping requires learners to suppose a dynamic role paly in their learning process. The concept mapping techniques challenge the traditional lecture strategies of conditioning memorisation and inactive learning. The learners should be trained to reflect organisationally on conceptual maps to build up the connections of theoretic practice by allowing them to form, link and integrate information in various ways, which endorses understanding of essential problems in a profession of learning (Meheux, 2017). Daley and Cervero (2014) proposed that concept mapping can be applied to the learning methodology in the educational system of children. Many studies have been carried out to address the challenges for the implementation of concept maps. Latif, Mohamed, Dahlan and Nor (2016) stated that there is a need to do more researches in the concept maps for the successful implementation of this concept in education. The concept maps develop the critical thinking skills, creativity and communication skills among learners up to their higher education. The application of concept map enables the learners to be practical in learning.

According to Ariagai and Nwanekeziii (2018), the learner-made concept maps should have a wider knowledge base as well as, consequently, be further capable to resolve difficulties likened to those learners who are well-read through rote learning. It was found that learners with little previous understanding learn well with concept mapping than the others. Therefore, the Science teacher can use concept maps to regulate the environment of learners' prevailing views, as well as make obvious the main ideas to be learned as well as propose connections between the innovative knowledge to be learned as well as what the student previously knows about it. The cognitive structure, as well as concept mapping, is greatly individual as every person's knowledge is exceptional. Therefore, concept map is distinctive. However, it does not mean that each and every concept map is accurate. The conceptual view of concept map learning strategy is shown in Figure 3.

Eggert, Nitsch, Boone, Nuckles and Bogeholz (2017) suggested that concept maps can be applied for assessments. Furthermore, they proposed that there are three types of concept maps used in assessment: (i) concept maps having closed propositions; (ii) concept maps having semi-open propositions; and (iii) concept maps having open propositions. Daley, Morgan and Black (2016) conducted a review of the studies published from 2001 to 2014 to inspect the application of concept mappings in the field of nursing education. The results of the studies showed a positive impact on the critical thinking and creativity skills of the learners. Stevenson, Hartmeyer and Bentsen (2017) conducted a study to investigate the effects of concept mapping on low score achievers in science education. The consequences of the study showed that by using the concept of concept maps, the grades and critical thinking skills of low achievers can be improved. Palmer, Boon and Spencer (2014) showed in a study that concept mapping increased the efficacy of learning in disable students. Ciullo, Falcomata, Pfannenstiel and Billingsley (2015) conducted a review of the studies conducted from 2002 to 2010 by selecting 12 studies about concept mappings. The results of the review showed that concept maps improved the comprehension skills of the learners.
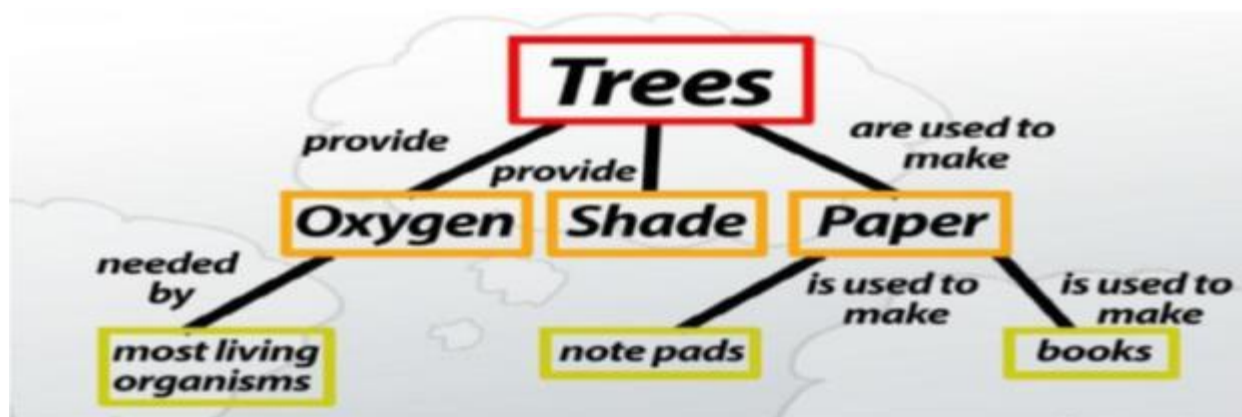

Figure 3. Conceptual view of the concept map learning strategy

5. Learning strategies, academic achievements and memorisation power

The type of learning strategy has a great impact on students' academic achievements and memorisation power. In recent years, several research studies have focused on the impact of traditional lecture and concept maps learning environments on students' academic achievements, critical thinking skills and memory power (Khoshnodifar, Abbasi, Farhadian, Sadighi & Pouratashi, 2020; Maqbool, Ismail, Maqbool & Hassan, 2018). Pishgooie, Abdi, Mazhari and Nazari (2019) conducted a research to investigate the effects of concept mapping and traditional lecture strategies on students' academic achievements, critical thinking skills and memory of learners in basic life support course of undergraduate nursing students. The results of the study concluded that the concept mapping learning strategy improved students' academic achievements, critical thinking skills and memory power.

Amaniyan, Pouyesh, Bashiri, Snelgrove and Vaismoradi (2020) conducted a research on biology students in a secondary school to assess students' academic achievement and memorisation power by concept map and traditional lecture methods. The consequences of the study indicated that the concept map learning strategy increases critical thinking, learning skills and academic achievements. Hsu, Pan and Hsieh (2016) investigated the impacts of concept map and traditional lecture learning strategies in a nursing course studied by the students at the undergraduate level. The study concluded that the concept map learning strategy improved students' learning process and also their critical thinking skills. The outcomes of the studies conducted by various researchers on the impacts of

concept maps and traditional lecture methods on students' academic achievements, critical thinking skills and memorisation power are illustrated in Table 1.

Table 1. Review of previous studies about concept map and traditional learning strategies

Reference	Learning strategy	Mean	SD	*p*	Outcomes	Remarks
Baig, Tariq, Rehman, Ali and Gazzaz (2016)	Traditional	34.56	2.24	0.001	Significant improvement in academic, critical and memorisation skills of the learners	Significant
	Concept map	39.89	2.09			
Anand and Chhabra (2018)	Traditional	16.91	1.10	0.002	Significant improvement in the learning skills of the learners	Significant
	Concept map	19.23	0.79			
Ghani, Ibrahim, Yahaya and Surif (2017)	Traditional	73.89	6.32	0.005	Concept map is the best strategy for learning science subjects	Significant
	Concept map	78.91	5.97			
Islim (2018)	Traditional	3.79	0.67	0.031	Students' academic and memorisation skills significantly improved	Significant
	Concept map	4.01	0.35			
Amaniyan et al. (2020)	Traditional	43.56	11.23	0.010	Significantly improved students' performance in the learning process	Significant
	Concept map	47.82	10.89			

Significance level = 0.05

The outcomes of the studies illustrated in the Table 1 indicated that the concept map learning strategy significantly increases students' academic achievements, higher order thinking skills and memorisation skills. So, by the conclusion of previous researches, it can be suggested that the concept map is a better learning strategy in all the educational fields, especially in science courses (Table 2).

Table 2. Advantages and disadvantages of traditional lecture versus concept maps learning strategies

Learning strategy	Advantages	Disadvantages
Traditional lecture	1. Traditional lecture method can provide materials not available to the learners in the form of book.	1. Traditional lecture method has no feedback of the learners.
	2. Traditional lecture can be organised to meet the requirements of specific audiences.	2. Traditional lecture method is not suitable for teaching complex ideas.
	3. Traditional lecture method can deliver huge information.	3. Students are passive in traditional lecture method.
	4. Traditional lecture method can be arranged to deliver the information before the large audiences.	4. The learners do not focus on the lecture for long time in the traditional lecture method.
	5. Traditional lecture method allows the teacher for maximum governor of the learning process.	5. Knowledge tends to be forgotten rapidly when leaners are passive.
Concept maps	1. Concept map learning helps the learners to grasp the learning materials.	1. Concept map learning makes relative ranking of learners' work tough.
	2. Concept map learning makes the learners active rather than passive.	2. In concept map learning, evaluation is time consuming.
	3. Concept map learning uses the full range of the brain.	3. More skills are required.

6. Hypothesis

Ho_1 = There is no significance difference between the learners' academic achievements learnt by concept map and traditional learning strategies.

Ho_2 = There is no significance difference between the learners' memorisation power learnt by concept map and traditional learning strategies.

7. Methodology of the study

7.1. Sample size

A research was conducted for statistical comparison of academic achievements and memorisation power of students who learned by concept map and traditional learning strategies. The students of fifth grade were divided in two different sections (section A and section B) in a general science course at Government Boys Primary School in district Dera Ghazi Khan. Each section consisted of 20 students. The students of section A were taught by concept map learning strategy and section B by traditional learning strategy. The study lasted for 3 months from 1st September 2020 to 30 November 2020. A test was taken on 10 December 2020 to assess the academic achievements and memorisation power of the students in the general science course learnt by concept map and traditional lecture learning strategies. The scores of academic achievements and memorisation power are illustrated in Table 3. The total scores for each factor (academic achievement and memorisation power) were 50. The obtained scores for each factor are shown in Tables 3 and 4. The memorisation power of the students is judged by providing different conceptual figures on different topics.

Table 3. Results of academic achievement and memorisation power learned by concept map strategy

Sr. no	Academic achievement	Memorisation power
1	47	34
2	43	43
3	49	40
4	41	39
5	46	32
6	42	47
7	45	42
8	43	47
9	47	41
10	48	37
11	45	47
12	42	39
13	41	46
14	49	36
15	48	38
16	45	41
17	47	46
18	43	38
19	48	35
20	47	46

Table 4. Results of academic achievement and memorisation power learned by traditional strategy

Sr. no	Academic achievement	Memorisation power
1	32	28
2	39	33
3	30	21
4	40	23
5	35	31
6	41	32
7	37	29
8	30	34
9	42	36
10	39	29
11	33	21
12	40	32
13	39	20
14	31	39
15	38	29
16	33	33
17	35	36
18	38	39
19	37	34
20	36	37

8. Data collection instruments

The data were collected from the results obtained by the test taken to assess the academic achievement and memorisation power.

9. Statistical analysis

The data were collected by the final term results of both the sections learned by concept map and traditional learning strategy. The academic achievements and memorisation power of the students of both sections were evaluated statistically by using mean, standard deviation and analysis of variance (ANOVA) test. The significance level for ANOVA test was at 0.05.

10. Results

The concept map learning strategy is a useful teaching–learning strategy in all fields of study, especially in higher education. It has been proven by many studies (Musni, 2017). The concept map learning strategy also increases students' academic achievements, critical thinking skills and memorisation power (Ramezani et al., 2020). To find the significance of concept map learning strategy, a research was conducted to assess students' academic achievements and memorisation power taught by concept map and traditional learning strategies in the grade 5 general science course. The results of descriptive statistics and *t*-test are shown in Tables 5 and 6.

According to Table 5, the mean value for concept map learning strategy is 45.30 and 36.25 for the traditional learning strategy. The standard deviation for the concept map learning strategy is 2.609 and it is 3.617 for traditional learning strategy. The *t*-value for concept map and traditional learning is −8.843 and *p*-value for both learning strategies is 0.00001. As the *p*-value is less than 0.05, the hypothesis (There is no significance difference between the learners' academic achievements by concept map and traditional learning strategies) is rejected.

Table 5. Statistical analysis of academic achievements learned by concept map and traditional strategies

Strategy	N	$\bar{X}$	SD	t	p
Traditional lecture	20	36.25	3.617	–	
Concept map	20	45.30	2.609	8.843	0.00001

Significant level = 0.05

The statistical results of memorisation power got by concept map and traditional learning strategies are illustrated in Table 6. According to Table 6, the mean value for traditional lecture is 30.8 and it is 40.7 for concept map learning strategy. The value of standard deviation for traditional learning is 5.688 and it is 4.583 for concept map learning strategy. The *t*-values for both learning strategies are −5.906 and *p*-values are 0.00001. As the *p*-value is less than 0.05, there was a significant increment in the memorisation power of students by concept map learning, and the hypothesis (There is no significance difference between the learners' memorisation power learnt by concept map and traditional learning strategies) is rejected.

Table 6. Statistical analysis of memorisation power learned by concept map and traditional strategies

Strategy	N	$\bar{X}$	SD	t	p
Traditional lecture	20	30.8	5.688		
Concept map	20	40.7	4.583	−5.906	0.00001

Significant level = 0.05

So, in both factors (academic achievement and students memorisation power), students' academic achievements and memorisation power have been significantly increased by concept map learning strategy.

11. Discussion

Concept map learning is thought to be a more effective learning strategy at all the levels of study (Lestari et al., 2019; Whitelock-Wainwright, Laan, Wen & Gasevic, 2020). The traditional learning strategy is useful strategy when there are a large number of learners in the presence of the instructor (Sanaie, Vasli, Sedighi & Sadeghi, 2019). But in most of the studies, it has been concluded that traditional learning strategy does not develop critical thinking skills (Alaagib, Musa & Saeed, 2019), cognitive skills (Harris & Bacon, 2019) and memorisation power. The concept map learning strategy has the ability to increase critical thinking skills and memorisation power of the learners (Putri, 2020).

To assess the students' academic achievements and memorisation power, a research was conducted at a primary school in the general science course of fifth-grade students. The general science course is taught by concept map and traditional learning strategies. The statistical tools are used to evaluate the scores obtained by the learners. The statistical analysis indicated that there was a significant increase in the students' academic achievements and memorisation power by concept map learning strategy. The learners got better scores in academic and memorisation power tests. These results are similar to previous studies conducted (Anzovino & Bretz, 2016; Hardiana, Widoretno & Dwiastuti, 2019; Utami & Yuliyanto, 2020). So, the concept map learning strategy is a better way of learning when compared to the traditional learning strategy.

12. Challenges in using concept maps

For the concept map learning strategy to be used in the classroom, there must be equipment for this strategy. The teachers having no skills for the implementation of concept map learning strategy. Some of the students do not take interest in learning by concept map strategy in the beginning. So, there must be a complete set of equipment, teachers training and students' interest for implementation of the concept map learning strategy.

13. Conclusion

The concept map learning strategy is an instructional strategy in which knowledge is transferred to learners by conceptual diagrams. To evaluate its effectiveness for the students' academic achievements and memorisation power, a research was conducted in a primary school among fifth-grade students in general science course. The results of the study indicate that concept map learning strategy proves to be more significant than the traditional learning strategy for the assessment of students' academic achievements and memorisation power. So, it can be concluded that concept map learning strategy is more effective than traditional learning strategy.

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