The Effect of Concept Mapping Approach on Scientific Attitude and Achievement in Science among Students with Learning Disability

Anu Singh* and Md. Saifur Rahman**

Abstract

Students with dyslexia must be equipped with means to develop their metacognitive capacities especially the 'learning to learn' skills for effective lifelong learning. Concept Mapping is one such teaching approach and this study aims to determine the effectiveness of this approach on scientific attitude and achievement in science among students with dyslexia. A two group, pre-test or post-test, quasi-experimental design was employed, where 35 dyslexic students of Class VI studying in government schools of Chandigarh were selected, and randomly assigned to control and experimental groups. The control group consisted of 18 students, 10 boys and 8 girls, who received conventional teaching whereas the experimental group consisted of 17 students, 8 boys and 9 girls who received teaching via Concept Mapping Approach for a period of 20 days. Their scores were measured on SAS-KAGS by Kaur and Gakhar and SAT by the researcher herself. Analysis of pre- and post-test data revealed that the Concept Mapping Approach is more effective in improving achievement in science, scientific attitude as well as retention of learned knowledge among dyslexic students as compared to conventional teaching method. It was also found that there exists a positive correlation between scientific attitude and achievement in science among these students.

Keywords: *Concept mapping, scientific attitude, achievement in science, dyslexia*

**PhD Research scholar,* Department of CEDS, Punjab University, Chandigarh.
***Assistant Professor,* Department of CEDS, Punjab University, Chandigarh.

Introduction

Introducing metacognitive strategies early in education helps to shift the focus from 'rote learning' to 'meaningful learning' which helps to inculcate high order thinking and learning skills in the students, which in turns promotes development of scientific temperament and sound intellect. Science education is seen as a vehicle for training child to think logically, reason and analyse systematically, nurture the natural curiosity, cultivate objectivity and scientific attitude in the students (Panditrao and Panditrao, 2020).

Concept Mapping is one such metacognitive approach which presents knowledge in a systematic and hierarchical manner which specially helps the dyslexic students as they are more comfortable when information follows some structured pattern. Also concept maps helps to reduce the cognitive load by removing the clutter of conventional textbooks and notes (Hwang, Kuo, Chen and Ho, 2014). Thus, this tool can be of immense value for the dyslexic students helping them to construct causal-effect connections between concepts and to think about their own thinking or if put in the words of Novak, 'learning how to learn' (Novak and Gowin, 1984).

Concept maps were first developed in 1972 in the course of Novak's research programme at Cornell University, where his team came up with the idea of transforming the interview transcripts into a hierarchically arranged picture showing the concepts and proposition revealed in the interview. They called the resulting drawing a concept map (Novak and Canas, 2009). Soon this tool became popular among educationists as it has its roots in the age old, well-established educational theories developed by well renowned educationalists like David Ausubel (Assimilation Theory) and Jean Piaget (Constructivism).

This tool came as a boon for special educators and curriculum designers around the world as it serves as a blueprint to maximise the learning environment through multiple representations of concepts (Kachhap, Devi and Mane, 2021). Although this approach has been studied by Indian researchers under mainstream education domain like (Thomas and Thakur, 2011; Sharma and Singh, 2012; Cheema and Mirza, 2013; Aziz and Rahman, 2014; Chawla and Singh, 2015; Marutirau and Dr. Patnakar, 2016; Kumar and Singh J., 2017; Hajare, 2018) as well as in special education interventions like visual disability (Kachhap and Mane, 2019) or diverse learning needs (Kachhap, Devi and Mane, 2021) or children with disabilities (Madan and Sharma, 2013). Its potential is not fully tapped in the area of dyslexic students in Indian scenario. Hence, the researcher got motivated to study the use of concept mapping in developing scientific attitude and improving achievement in science among dyslexic students.

Review of Related Literature

Concept Mapping and Dyslexia

Studies show that concept mapping approach can help dyslexic students to organise their thinking (Lahti, 2020), improve reading performance of students with reading difficulties (Undalok and Salbabro, 2022) and expository text comprehension in students with dyslexia (Hendi, 2015; Calvin, 2022) as well as in poor readers (Morfidi, Mikropoulos, and Rogdaki, 2018). Teaching dyslexic students via concept maps facilitates their knowledge acquisition, rewards memorisation and learning, and promotes autonomy in study and revision (Lami and Locatelli, 2008). Studies also show that it helps in achieving accurate acquisition of science content among the students with dyslexia by making use of computer-based concept maps (Ciullo, Falcomata, and Vaughn, 2015) or concept maps based evaluation sheets (Vlachos and Zamfirov, 2017 and 2019), better acquisition of factual knowledge (Sperling, Grünke, and Cöppicus, 2019) and improved performance (Ferentinou, Papalexopoulos and Vavougios, 2009).

Concept Mapping and Achievement

Studies reveal that concept mapping helps in improving achievement as well as retention in subject areas that are closely related to the natural or exact sciences such as physics (Agube, Ntibi and Neji, 2021); social studies (Sharma and Singh, 2012); genetics (John, Sani, Ranccas and Maskawa, 2019); science (Hajare, 2018; Aziz and Rahman, 2014; Thomas K and Thakur R, 2011; Stevenson, Hartmeyer and Bentsen, 2017); chemistry (Jack, 2013); biology (Marutirao and Dr. Patnakar, 2016; Akintola and Odewumi, 2023); nursing (Roshangar, Azar, Sarbakhsh and Azarmi, 2020; Lin, Han, Huang, Chen and Su, 2022); dental sciences (Gil and Lee, 2023). Some other studies confirmed the positive effect of concept maps on achievement among low performance cases (Kumar and Singh J., 2017) and even low achievement motivation cases (Chawla and Singh G., 2015) as well as low ability students (Zubaidah, Mahanal, Sholihah, Rosyida and Kurniawati, 2020).

Outcome of the Review

Thus, it can be inferred that concept mapping approach can be utilised to cater to the heterogeneity presented by the diverse group of learners especially the ones presenting with reading disability across all the science subjects including biology, physics or genetics, etc. Also, the approach has varied applications covering different areas of education including teaching, learning and retention of knowledge as well as for evaluation.

Rationale for the Study

The majority of the research work has been done internationally for special education but the same cannot be said

about the studies in Indian context where its potential is not tapped completely. Although this approach has been used nationwide in the area of mainstream education, and some in other disability areas such as, children with visual disability (Kachhap and Mane, 2019) or diverse learning needs (Kachhap, Devi and Mane, 2021) or children with disabilities (Madan and Sharma, 2013), there is a dearth of researches where this approach has been used for students with dyslexia. Hence, the proposed study appears to be fully justified in assessing the effect of concept mapping approach on scientific attitude and achievement in science among students with dyslexia.

Objectives

1. To determine the effect of concept mapping approach and conventional teaching method on scientific attitude of Class VI students with dyslexia.
2. To analyse the effect of Concept Mapping Approach and conventional teaching method on achievement in science of Class VI students with dyslexia.
3. To study the effect of concept mapping approach and conventional teaching method on retention of achievement in science of Class VI students with dyslexia.

Hypotheses

1. There will be significant improvement in scientific attitude among Class VI students with dyslexia in the Concept Mapping approach group as compared to conventional teaching method.
2. There will be significant improvement in achievement in science among Class VI students with dyslexia in the Concept Mapping Approach group as compared to conventional teaching method.
3. Students with Dyslexia in the Concept Mapping approach group will show more retention of knowledge than those in the conventional teaching method group.

Method and Procedure

A randomised two group pre-test or post-test quasi-experimental research design was adopted where a total of 35 dyslexic students identified by the SSA, were selected as sample of the study. Out of the total 16 units from the NCERT Science textbook for Class VI, 5 units were selected and were further divided into a total of 10 topics (2 from each unit) for maximum coverage (Table 1). Hence, a total of 10 concept maps were constructed following a 6-step routine laid by Joseph Novak himself (Novak and Cañas, 2006). These concept maps were then verified by the subject experts as well as the CWSN in-charge of the schools for content validation. Suggestions from the experts were included into the concept maps. Later lesson plans for the experimental group were prepared using these

Table 1: Division of Selected Content Area into Topics

S. No.	Unit Number	Unit Name	Topic Number	Topic Name
1	2	Components of Food	I	Major Components
			II	Minor Components
2	3	Fibre to Fabric	III	Natural Fibres
			IV	Synthetic Fibres
3	5	Separation of Substances	V	Sieving, Straining, Churning, Handpicking, Threshing
			VI	Winnowing, Sedimentation, Decantation, Filtration, Evaporation
4	7	Getting to Know Plants	VII	Categorising the plants
			VI	Parts of plants
5	8	Body Movements	IX	Muscles, Bones, Joints
			X	Patterns of Movements

concept maps, where the construction was divided into 3–4 tasks in each lesson plan along with instructions for the students on how to construct a particular concept map.

The common steps used in all concept maps are as following:

Step 1: Identifying the "Focus Question"
Step 2: Listing the key concepts
Step 3: Creating "Parking Lot"
Step 4: Adding cross links
Step 5: Refinement
Step 6: Revision

One of the concept map for the VI Topic, Parts of Plants is given in Fig. 1 for illustration.

Also Science Achievement Test (SAT) was constructed and standardised before obtaining the baseline measurements for all the students in the pre-test phase in terms of their level of scientific attitude and achievement in science.

Data Collection: The post-test measurements (post-test I scores) were taken immediately after the intervention phase and the mean gain scores or the two dependent variables, served as a numerical index employed to compare the success rates of two teaching methods. In the last phase of the study, the students were again tested for achievement scores (post-test II scores) after a gap of six weeks to measure their information retention.

Variables of the Present Study

There were two independent variables in this study, the conventional teaching method (Book reading and

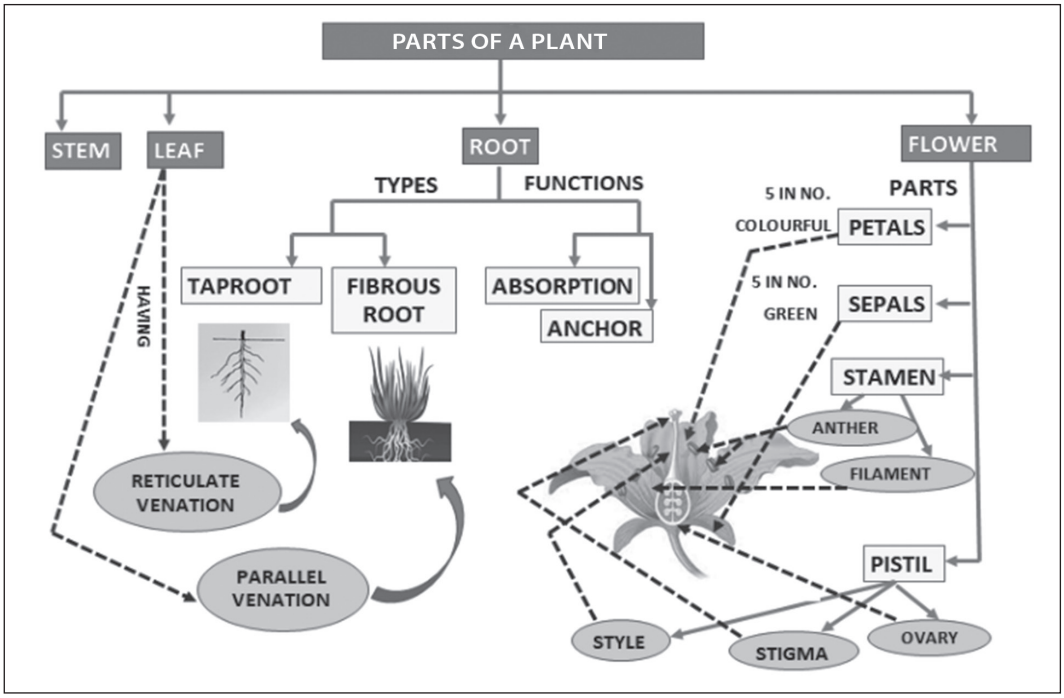

Fig. 1: Concept map for the topic: parts of a plant

discussion) and concept mapping approach whereas, scientific attitude and achievement in science were the two dependent variables. The mean gain scores or the difference between the students' post-test and pre-test scores on the achievement test in science and scientific attitude scale, were used to evaluate the effectiveness of the two teaching approaches.

Control

To keep the 'noise' in the data to a minimum, control was exercised for extraneous variables by holding them constant for both the groups such as, age (14–16 years), grade (VI), disability (Dyslexia), testing and learning environment (government schools), subject and topics covered (5 units of science), duration of intervention (20 days) as well as the objectives of intervention were same for both the groups. The researcher herself played the roles of instructor, evaluator as well as examiner for both the groups thus, reducing bias to a minimum. In order to counteract the impact of pre-existing subject knowledge, the evaluation was conducted on the gain scores.

Sample of the Study

For the present study a total of 35 dyslexic students enrolled in Class VI in government schools of Chandigarh for the session 2022–23,

were selected via purposive sampling method. The record of these dyslexic students was obtained from the Assistant Project Coordinator, Inclusive Education SSA, U.T., Chandigarh along with a formal permission to carry out the investigation. The students were then randomly assigned to experimental (N = 17, 8 Boys + 9 Girls) and control groups (N = 18, 10 Boys + 8 Girls).

Experimental Group

Students were introduced to the concept of Concept Mapping, its advantages as well as the construction process by help of some simple concept maps in the orientation phase. Students were provided with the materials required to draw maps by the researcher. Thereafter, lectures were conducted where the students made concept maps of all the topics under the guidance of the researcher who explained the concepts, links and the overall structure of the map to the students. The content of the lectures was recapitulated at the end of every lecture.

Control Group

Lectures were conducted for the students using the lesson plans constructed with the help of Herbartian Approach by the researcher herself. NCERT Science Textbook for Class VI was used to read and explain all the topics, although the students were given the same recapitulation exercises at the end of every lecture as the other group.

Thus, a total of 450 minutes or 7.5 hours of instructions were delivered to each group at the rate of 45 minutes for each lesson plan.

Tools of the Study

Two tools were used for the present study which were used both pre-intervention as well as post-intervention, namely:

(i) Scientific Attitude Scale (SAS-KAGS) by Kaur and Gakhar (2004, 2014): A standardised tool to measure the scientific attitude of the students. Constructed via Thurston technique, this scale has 61 statements and items which were distributed dimension wise, out of which 42 items were positive type and the rest 19 items were negative type. Z Scoring method is used to assign the grades corresponding to the level of scientific attitude.

(ii) Science Achievement Test (SAT): Constructed by the researcher herself to measure the achievement in science among the students. A preliminary draft of SAT consisting of 240 items was constructed in accordance with the blue print framed after considering the weightage for content, objectives and difficulty level. This draft was tried out for item analysis in which only 120 items having difficulty value in the range of 20–80 per cent, and discrimination index ranging from 0.3 to 0.6 were selected for the final SAT.

Validity of SAT was established by a panel of experts consisting of pedagogy experts, CWSN in charge as well as the resource teachers who took active participation in the decisions regarding the objectives of the test, distribution of weightage given to objectives and content areas. Their suggestions were incorporated and thus, content validity was established for SAT.

Reliability of SAT was established by test-retest method. The final SAT was administered twice on 60 students of Class IX within a gap of 20 days. The scores of test-retest method were tested by applying Pearson Correlation. The "r" value came out to be 0.75 (N = 240) which was significant at 0.01 level of significance.

Results and Discussion

Statistical tests were applied to both pre-test data as well as post-test data.

1. Pre-test data

The two groups were tested with the help of independent t-test to establish their equivalence in terms of level of scientific attitude and science achievement scores of students before the intervention. The results are depicted in the below given Table 2:

Discussion

Table 2 reveals that mean scores and standard deviation of the control and experimental group for scientific attitude before intervention were 178.94, 4.929 and 179.29, 5.133, respectively. The t-value came out to be 0.206 which is non-significant ($p>0.05$). Also the mean scores and standard deviation of the control and experimental group for Science Achievement before intervention were 63.94, 6.476 and 63.94, 6.759, respectively. The t-value came out to be 0.001 which is non-significant ($p>0.05$). Thus, there exists no significant difference in both the groups in level of scientific attitude of students and Science Achievement, i.e., groups were equivalent with respect to level of scientific attitude of students as well as achievement in science.

2. Post-test data

Hypothesis 1: There will be significant improvement in scientific attitude among Class VI students with Dyslexia in the Concept Mapping Approach group as compared to conventional teaching method.

Table 2: Matching the groups on the basis of pre-test scores

Variable	Group	N	Mean	SD	t-value	p-value
Scientific Attitude	Control	18	178.94	4.929	0.206 (N.S.)	0.838
	Experimental	17	179.29	5.133		
Science Achievement	Control	18	63.94	6.476	0.001 (N.S.)	0.999
	Experimental	17	63.94	6.759		

Table 3: Comparison of the two groups for mean gain scores in level of scientific attitude

Variable	Group	N	Mean Pre-test Score	Mean Post-test I Score	Mean Gain	SD	t-value	p-value
Scientific Attitude	Control	18	178.94	181.72	2.78	1.59	30.823	0.000*
	Experimental	17	179.29	195.00	15.71	0.77		

**'p' value significant at 0.01 level*

To test this hypothesis, paired t-test was utilised on the mean gain scores of scientific attitude attained by the students of experimental and control groups. The results are shown below in Table 3.

Discussion

Table 3 and the Fig. 2 reveal that the mean gain scores of students in scientific attitude for control and experimental groups comes out to be 2.78 and 15.71, respectively and the

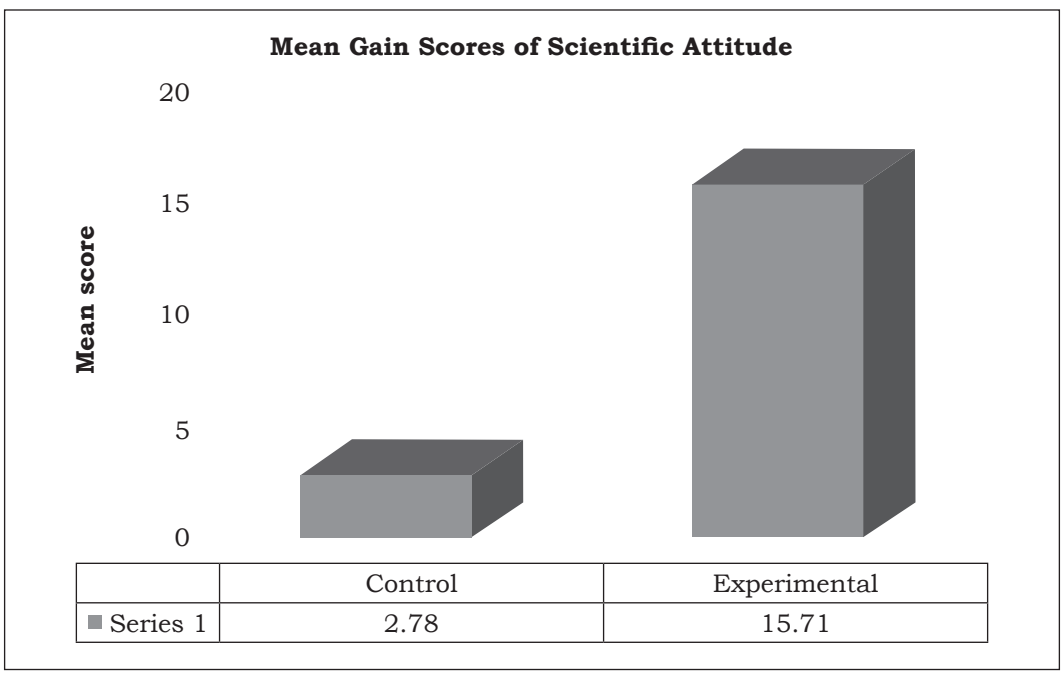

Fig. 2: Graphical representation of the mean gain scores of students in scientific attitude for control and experimental group

't'-value is 30.823 which is significant at 0.01 level of significance. This implies that there exists a statistically significant difference among the two approaches in improving scientific attitude among student with dyslexia. Thus, Hypothesis 1 stands accepted which means that the Concept Mapping Approach is better than the conventional teaching method in improving the scientific attitude of students with dyslexia.

Hypothesis 2: There will be significant improvement in achievement in science among Class VI students with dyslexia in the Concept Mapping Approach group as compared to conventional teaching method.

To test this hypothesis, paired t-test was utilised on the mean gain scores of Achievement in Science attained by the students of experimental and control groups. The results are shown below in Table 4.

Table 4: Comparison of the two groups for mean gain scores in Achievement in Science

Variable	Group	N	Mean Pre-test Score	Mean Post-test I Score	Mean Gain	SD	t-value	p-value
Achievement in Science	Control	18	63.94	74.61	10.67	4.19	7.788	0.000*
	Experimental	17	63.94	85.12	21.18	3.80		

**'p' value significant at 0.01 level*

Discussion

Table 4 and Figure 3 reveal that the mean values of gain score of achievement in science for control and experimental groups are 10.67 and 21.18. The reported 't'-value is 7.788 which is significant at 0.001 level. This implies that there exists a statistically significant difference among the two approaches in improving achievement in science among student with dyslexia. Thus, the Hypothesis 2 stands accepted which means that Concept Mapping Approach is better than the conventional teaching method in improving the Achievement in Science of students with dyslexia.

Hypothesis 3: Students with dyslexia in the Concept Mapping Approach group will show more retention of knowledge than those in the conventional teaching method group.

To test this hypothesis the mean gain scores (retention) were calculated by deducting the pre-test scores of achievement in science from the post-test II scores (delayed post test scores) for all the students. These scores then underwent paired t-test in order to find the significance of difference between the two groups. The values are as shown in the Table 5.

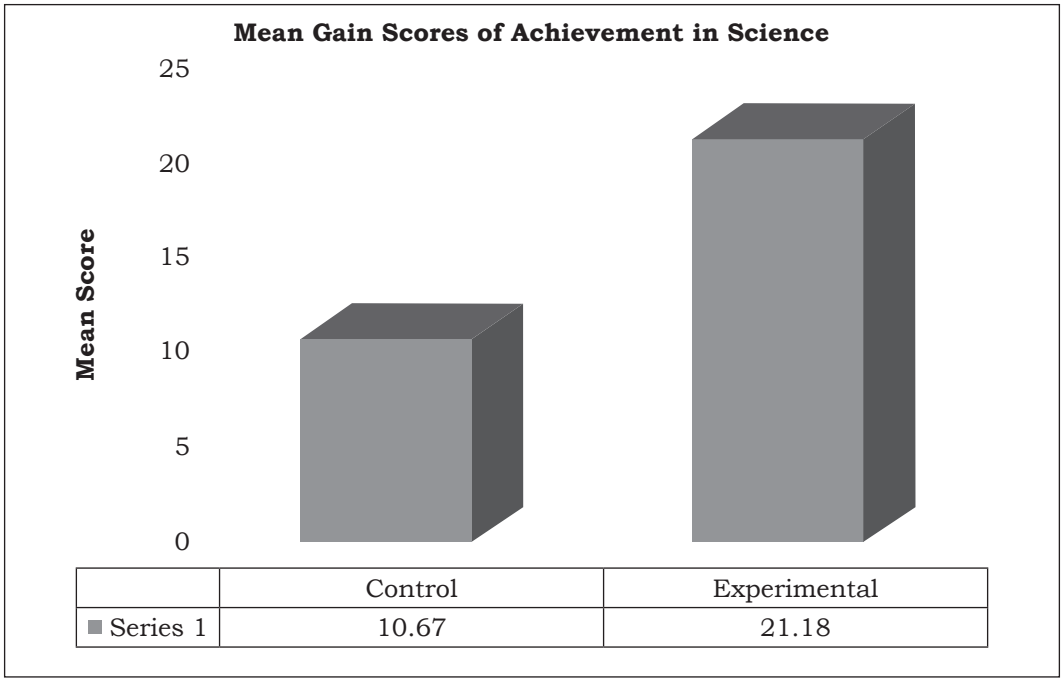

Fig. 3: Graphical representation of the mean gain scores of students in achievement in science for control and experimental group

Table 5: Comparison of the two groups for mean gain (retention) scores of students

Groups	N	Mean Post-test II Score	Mean Pre-test Score	Mean gain (Retention) (Post test II – Pre test)	SD	t-value	p-value
Control	18	70.38	63.94	6.44	3.99	9.110	0.000*
Experimental	17	83.53	63.94	19.59	4.54		

**'p' value significant at 0.01 level*

Discussion

Table 5 and the Figure 4 reveals that the mean scores of students on retention of learned information for control and experimental groups comes out to be 6.44 and 19.59, respectively and the 't'-value is 9.11 which is significant at 0.01 level of significance. This implies that there was statistically significant difference in the effect of both the approaches on retention of learned knowledge.

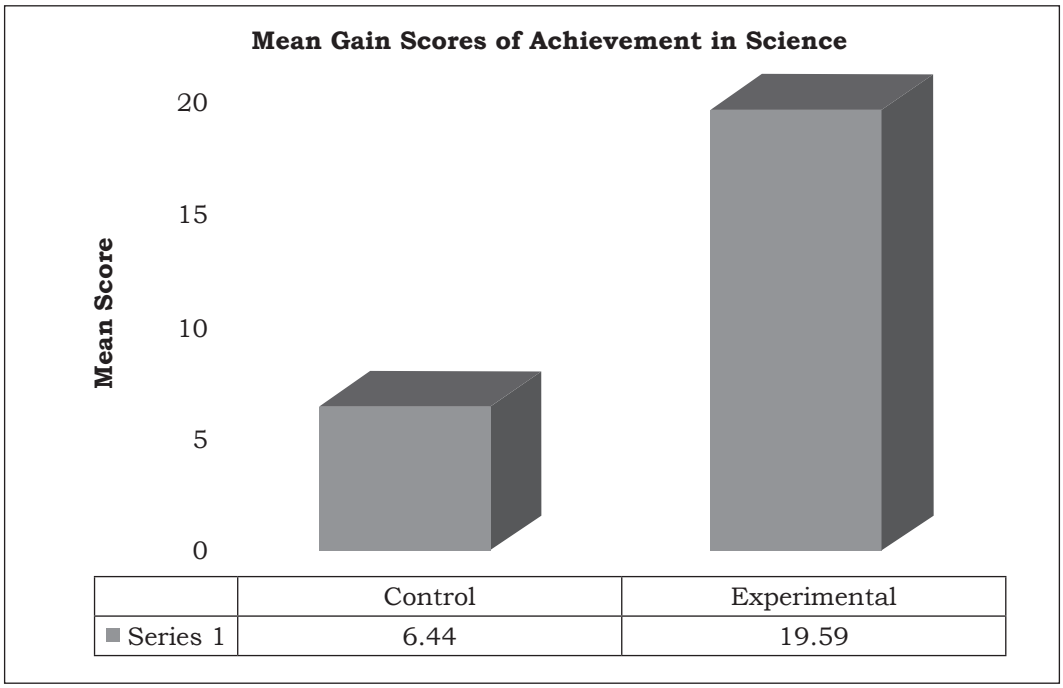

Fig. 4: Graphical representation of mean gain scores (retention) of students on achievement in science for control and experimental group

Thus, the hypothesis 3 stands accepted which means that Concept Mapping Approach is better than the conventional teaching method in terms of retention of learned information among students with dyslexia.

Implications

Results of the present study supported that students with dyslexia can benefit tremendously from the Concept Mapping Approach as it helps in reduces the burden of language by reducing wordiness and organising the content to be learned in a pattern following a hierarchical structure. Also incorporating concept maps in classroom settings encourage critical thinking and development of scientific attitude among students with dyslexia. Hence, this approach is strongly recommended for teaching science to students with dyslexia.

Conclusion

Thus, it can be concluded that teaching via Concept Mapping Approach is more effective in enhancing achievement in science as well as scientific attitude among students with dyslexia as compared to conventional teaching method.

In other terms, it can be said that those students with dyslexia who received teaching instructions via

Concept Mapping Approach gained significantly more than those students with dyslexia who were taught via traditional method of teaching in terms of scientific attitude, achievement in science as well as retaining the learned information. Consequently, the efficacy of the Concept Mapping Approach in teaching science to students with dyslexia can be determined (Aziz and Rahman, 2014; Chawla and Singh, 2015; Marutirau and Dr. Patnakar, 2016). Also supporting evidence is found claiming improvement in scientific attitude with the use of Concept Mapping Approach for teaching (Jatmiko et al., 2018; Khan, Shah, Mahmood and Zareen, 2012; Agnafia, Anfa, and Rizkia, 2022). Concept Mapping Approach leads to more meaningful learning of difficult concepts and hence, enhances retention (Jack, 2013), also construction of maps helps the students to retain more knowledge as they are in control of their thought process involved in connecting the working memory with the long term memory as new knowledge is being received (Anderson, 1992).

References

Agnafia, D. N., Q. Anfa and A. Rizkia. 2022. Improvement of Science Attitude Through Scientific Approach in Environmental Science Courses. *Journal of Biology Learning*, Vol. 4, No. 1, pp. 156–164.

Agube, C. C., J. E. E. Ntibi, and H. A. Neji. 2021. Towards Enhancing Physics Students' Academic Achievement through Concept Mappimg Instructional Approach. *European Journal of Social Sciences*, Vol. 61, No. 4, pp. 250–259.

Akintola, D. A., and M. O. Odewumi. 2023. Effects of Concept Maps on Senior Secondary School Students' Achievement in Ecological Concepts in Ogbomoso South, Nigeria. *Journal of Education*, Vol. 203, No. 1, pp. 3–9.

Anderson, O. R. 1992. Some interrelationships between constructivist models of learning and current neurobiological theory, with implications for science education. *Journal of Research in Science Teaching,* Vol. 19, No. 10, pp. 1037–1058.

Aziz, T., and A. Rahman. 2014. Effect of concept mapping approach on students' achievement in science at secondary level. *Research Gate. Available online: https://www. researchgate. net/publication/281848894 (accessed on 17 September 2015).*

Calvin, K. L. 2022. *Improving Expository Text Comprehension in Adolescent Spanish-English Bilingual Learners with Learning Disabilities using a Graphic Organiser, Doctoral dissertation,* Arizona State University.

Chawla, J. and G. Singh. 2015. Effect of concept mapping approach on achievement in chemistry of IX graders in relation to achievement motivation. *Asia Pacific Journal of Research*, Vol. 1.

Cheema, A. B. and M. S. Mirza. 2013. Effect of Concept Mapping on Students' Academic Achievement. *Journal of Research and Reflections in Education (JRRE)*, Vol. 7, No. 2.

Ciullo, S., T. Falcomata and S. Vaughn, 2015. Teaching social studies to upper elementary students with learning disabilities: Graphic organizers and explicit instruction. *Dyslexic Quarterly*, Vol. 38, No. 1, pp. 15–26.

Ferentinou, A., P. F. Papalexopoulos and D. Vavougios 2009. Teaching Mechanics To Students With Learning Disabili-Ties: A Case Study In Greece. *Problems of Education in the 21st Century*, Vol. 15, pp. 78.

Gil, Y. M. and B. D. Lee 2023. Concept map-based learning in an oral radiographic interpretation course: Dental students' perceptions of its role as a learning tool. *European Journal of Dental Education*, Vol. 27, No. 1, pp. 201–208.

Hazare. 2018. Mini Review Curr Trends Biomedical Eng and Biosci Self-Explanatory Under Funded Project Study of Biology Concept Mapping Instruction as an Activator of Students' Performance in the Teaching and Learning of Excretion. *Current Trends in Biomedical Engineering and Biosciences.* 14. 10.19080/CTBEB.2018.14.555900.

Hendi, W. F. A. 2015. The Effect of Concept Maps on Reading Comprehension Skills of Elementary School Students with Reading Disabilities. *Psycho-Educational Research Reviews*, Vol. 4, No. 2, pp. 46–51. Retrieved from https://www.perrjournal.com/index.php/perrjournal/article/view/331

Hwang, G. J., F. R. Kuo, N. S. Chen and H. J. Ho. 2014. Effects of an integrated concept mapping and web-based problem-solving approach on students' learning achievements, perceptions and cognitive loads. *Computers and Education*, Vol. 71, pp. 77–86.

Jack, G. U. 2013. Concept mapping and guided inquiry as effective techniques for teaching difficult concepts in chemistry: effect on students' academic achievement. *Journal of Education and Practice*, Vol. 4, No. 5, pp. 9–15.

Jatmiko, A., Y. Kartina, I. Irwandani, J. Fakhri, A. Pricilia, and T. Rahayu. 2018. Reading Concept Map-Think Pair Share (Remap-TPS) Learning Model on Cognitive Ability and Scientific Attitude. *Jurnal Keguruan Dan Ilmu Tarbiyah*, Vol. 3, No. 2.

John, F., A. N. Sani, B. M. Ranccas and B. U. Maskawa. 2019. Effects of concept mapping and demonstration method on senior secondary two biology students' achievement in genetics in Jos North, Plateau State. *KIU Journal of Humanities*, Vol. 3, No. 4, pp. 177–182.

Kachhap, S., B. Devi and K. H. Mane. 2021. Concept Mapping for Diverse Learning Needs: Learning with Multiple Representations.

Kachhap, S. and K. H. Mane. 2019. Concept Mapping for Students with Visual Impairment: Practices and Challenges. *Journal of Disability Management and Special Education (JODYS)*, Vol. 2, No. 1, pp. 6–15.

Khan, S. A., S. M. A. Shah, Z. Mahmood and R. Zareen. 2012. Scientific Attitude Development at Secondary School Level: A Comparison between Methods of Teaching. Language in India. Strength for Today and Bright Hope for Tomorrow Vol. 12.

Kumar K. and J. Singh. 2017. Effect of concept mapping approach in mathematics on achievement and mathematical creativity in relation to anxiety in mathematics. *GHG Journal of Sixth Thought* Vol. 4 No. 1.

Lahti, J. M. 2020. *Effective and Ineffective Interventions for Students With Dyslexia* [Master's thesis, Bethel University]. Spark Repository. https://spark.bethel.edu/etd/378

Lami, G., and M. Locatelli. 2008, September. Dyslexia and concept maps: An indispensable tool for learning. In *3rd International Conference on Concept Mapping "Concept Mapping-Connecting Educators,* pp. 152–154.

Lin, C., C. Han, Y. Huang, L. Chen and C. C. Su. 2022. Effectiveness of the use of concept maps and simulated cases as a teaching-learning approach in enhancing the learning confidence of baccalaureate nursing students: A qualitative approach. *Nurse Education Today*, Vol. 115, No. 105418.

Madan, A., and N. Sharma. 2013. Inclusive education for children with disabilities: Preparing schools to meet the challenge. *Electronic Journal for Inclusive Education*, Vol. 3, No. 1, pp. 4.

Marutirao, G. A., and Patankar, P. S. 2016. Effect of concept maps on academic achievement in the subject biology among the higher secondary level school students. *International Interdisciplinary Research Journal*, Vol. 6, pp. 79–85.

Morfidi, E., A. Mikropoulos and A. Rogdaki. 2018. Using concept mapping to improve poor readers' understanding of expository text. *Education and Information Technologies*, Vol. 23, pp. 271–286.

Novak, J. D., and A. J. Cañas. 2009. The development and evolution of the concept mapping tool leading to a new model for mathematics education. *Concept mapping in mathematics,* pp. 3–16. Springer, Boston, Massachusetts.

Novak, J. D. and D. B. Gowin. 1984. *Learning how to learn*. New York: Cambridge University Press.

Panditrao, M. M., and M. M. Panditrao. 2020. National Education Policy 2020: What is in it for a student, a parent, a teacher, or us, as a Higher Education Institution/University? *Adesh University Journal of Medical Sciences and Research*, Vol. 2, No. 2, pp. 70–79.

Roshangar, F., E. F. Azar, P. Sarbakhsh and R. Azarmi. 2020. The effect of case-based learning with or without conceptual mapping method on critical thinking and academic self-efficacy of nursing students. *Journal of Biochemical Technology*, Vol. 11, No. 1, pp. 37.

Sharma M. and G. Singh. 2016. Effect of Collaborative Concept Mapping Approach on Achievement in Economics of IX Graders. *Int. Edu and Research Journal,* Vol. 2, No. 9, pp. 22–24.

Sperling, M., M. Grünke and C. Cöppicus. 2019. Graphic Organizer: An Efficient Tool for Learning-Disabled Students in a Museum. *International Journal of the Inclusive Museum*, Vol. 12, No. 4.

Stevenson, M. P., R. Hartmeyer and P. Bentsen. 2017. Systematically reviewing the potential of concept mapping technologies to promote self-regulated learning in primary and secondary science education. *Educational Research Review*, Vol. 21, pp. 1–16

Thomas, M. B. K., and M. G. R. Thakur. Effectiveness of pictorial concept mapping in the teaching of science.

Undalok, J. M. B. and J. R. Salbabro. 2022. Dolch Sight Words in Concept Mapping as a Tool in Learning Word Recognition Skills for Learning Difficulty Learners. *International Journal of All Research Education and Scientific Methods*.

Vlachos, A., and M. Zamfirov. 2017. Using Concept Maps to Teach Dyslexic Students Science: The Educators' Approach. *Open Journal for Educational Research*, Vol. 1, No. 2.

Vlachos, A., and M. Zamfirov. 2019. Evaluation sheets that contain concept maps in science classes of secondary education for dyslexic students. *Young Researchers Conference Proceedings 2018,* p. 361.

Zubaidah, S., S. Mahanal, M. A. Sholihah, F. Rosyida and Z. L. Kurniawati. 2020. Using remap RT (Reading-concept mapping–reciprocal teaching) learning model to improve low-ability students' achievement in biology. *CEPS journal*, Vol. 10, No. 3, pp. 117–144.