Journal of Science Education
Vol. 7, Issue 2, 2025, 29-42

Effect of Graphical Advance Organizers on the Applying Skills of Grade Nine Biology Students

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Abstract

In the dawn of twenty-first century, the science content becomes increasingly complex, especially at secondary level, therefore, the need for cognitive tools to enhance comprehension and application becomes crucial. This research study seeks to find out the graphical advance organizers effect on the "applying" skills of grade nine biology students. This study involved two intact groups that is experimental and control. Quasi-Experimental design was used to compare and find out the achievement of the sample groups. The sample size of the study was 57 students. The total duration of study was eight weeks. Graphical advance organizers teaching method is employed for experimental group. Effect of the graphical advance organizers on the applying skills, was found by conducting a biology achievement test comprising of short questions and MCQS for measuring application skills as pre and post test which was taken by both groups at a specified time before and after the intervention. The validation of the tool was done by ten science experts and then reliability was measured by using Cronbach's Alpha which was 0.79. Data was analyzed by using t-test to determine whether the mean scores of both groups differ significantly or not. It was found from collected data that experimental group has more applying skills as compared to the control group in grade nine biology. Hence, it can be concluded that the use of graphical advance organizers in biology instruction positively influences students' ability to apply learned concepts. Therefore, it is recommended that Educators should integrate graphical advance organizers into biology teaching strategies to enhance students' applying skills and overall academic performance.

Keywords: Applying Skills, Biology, Graphical Advance Organizers (GAO), Academic Performance

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Introduction

In Pakistan, the subject of biology is introduced from ninth grade, and is a foundational science subject that introduces science students to the complex phenomenon and life processes of living organisms. Biology at the high school level is essential because it helps students to understand living organisms, the human body, and their surroundings. It raises awareness about health, cleanliness, and diseases while also demonstrating how to care for the environment. It fosters scientific thinking and problem-solving abilities while also connecting classroom instruction to real world applications. Although biology is a very important subject but, many secondary-level students struggle to grasp and apply its concepts. This difficulty stems not only from the abstract nature of some biological concepts, but also from adopted classroom teaching approaches (Luft, Jeong, Idsardi, & Gardner, 2022).

Among many other instructional approaches using graphical advance organizers (GAOs) appears to be an effective method to bridge this comprehension gap. This approach was first introduced by David Ausubel in the 1963. Advance organizers are tools used before learning to give students a conceptual foundation for new information. Graphical organizers, knowledge with existing cognitive structures. When these graphical organizers are used in biology courses, they help to explain complex concepts of biology, establish logical links between concepts, and improve the ability to recall information.

In current situation various new and very engaging teaching strategies have been introduced that enhances capabilities of students (Kalyani & Rajasekaran, 2018).Graphical advance organizers is one of the most important teaching strategy in context of education and psychological effect as it helps to enhance students efficiency by motivating them to participate in class (educationally).Information is transferred in the form of chunks so students feel relaxed and grasp ,more knowledge without any burden(psychologically).

According to Bulut (2022), graphical advance organizers assist students by providing a clear visual structure for the material, making it simpler to comprehend the essential ideas and the relationship between ideas. The cognitive burden on students reduced through visual representation of complicated information in the form of chunks, activating existing knowledge, and facilitating recall during learning.

A meta-analysis on effects of graphical organizers on student outcomes investigated at how graphic organizers (GOs) effect academic and behavioral results in K-12 children. It revealed overall favorable impacts across several research, implying that Graphical organizers boost both learning results and improve application skills (Urton et al 2024).

Higher order thinking skills are grounded in bloom's taxonomy which enable science students to progress and promotes deeper learning beyond simple memorization of concepts. HOTS encourage students to think creatively, solve issues, and better understand science curriculum. These skills also help the students in terms of their self-motivation, ability to work independently, and able to assess their progress by themselves, all of which are useful in everyday life. Higher order thinking allows students to grasp subject effectively, communicate their own ideas, build decision power and apply knowledge (Mehmood, Anwer, & Tatlah, 2017).

Rationale

As there is a need to optimize the engagement of biology learners on appropriate task, and to polish their cognitive and thinking skills; graphical advance organizers proved fruitful for boosting students' cognitive level to achieve higher level of knowledge and to increase the academic achievement. These organizers facilitate student engagement by effectively linking existing knowledge to new information, thereby fostering the development of applying skills and promoting deeper, more meaningful learning compared to reliance on rote memorization. The graphical depiction of concepts and ideas is thus expected to be a useful idea for advancing science learning and increasing application skills of biology students (Komenda,2023). The main objectives of study was to find the effect of graphical advance organizers on applying skills of nine grade biology students.

Problem Statement

Biology taught at the secondary level has many critical concepts and natural phenomena which are difficult to understand by students when taught merely by conventional teaching methods in which students become passive learners and unable to develop their application skills(Barta, Fodor, Tamas, & Szamoskozi, 2022).For better learning biology concepts are needed to be incorporated into students' cognition very effectively by polishing their higher order thinking skills so that they can better grasp the idea of the whole concept taught (Awan & Hussain,2020). Application skills of the secondary level students is low as rote memorization method is involved in traditional method of teaching that lacks in application of knowledge, graphical organizers may be among that teaching strategy that helps to improve application skills of students. As a result, it is needed to investigate, adopt teaching strategies that can be helpful in promoting cognitive thinking and increase application skills. This study intends to assess whether the use of graphical advance organizers can improve secondary biology school students' application skills.

Theoretical Framework

The present study is rooted in cognitivism. It is an epistemological approach explaining what is the nature of knowledge? It explains the ways by which human learns. Jean Piaget is the proponent of cognitivist theory and the core ideas of this theory is that how thinking develops over time and how this process influences our behaviors', attitudes, beliefs, and suppositions as we go through life. Advance organizers models is one of the type of cognitive models of teaching and this model was proposed by David Ausebel in (1963).It is based on theory of meaningful verbal learning. The theory focuses on concept that how students absorb and learn considerable amount of information from text or visual sources. Three concerns have been addressed by his theory of meaningful verbal learning: (1) how knowledge (curriculum content) is structured; (2) how the mind processes new information; and (3) how teachers might use these concepts about curriculum and learning when they introduce new material to learners (instruction). According to Han-Chin & Hsueh-Hua (2017),In this teaching strategy teachers provides an advance organizers having different forms which assist in scaffolding of ideas in students minds and helps to arrange the concepts and information that will be covered in their lesson and in this way students cognitive skills enhanced.

Figure 1

Advance organizer model by David Ausebel

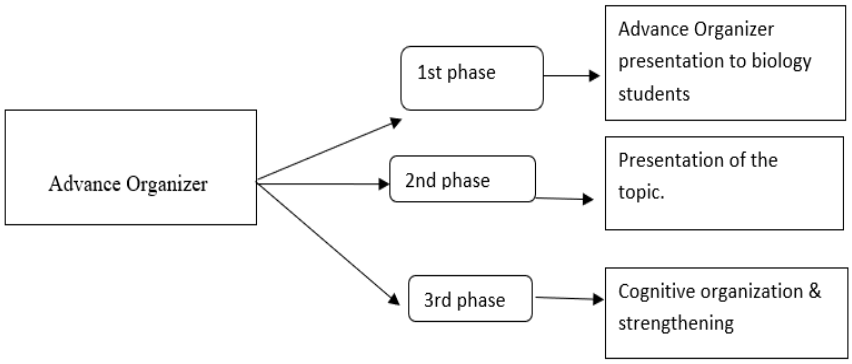
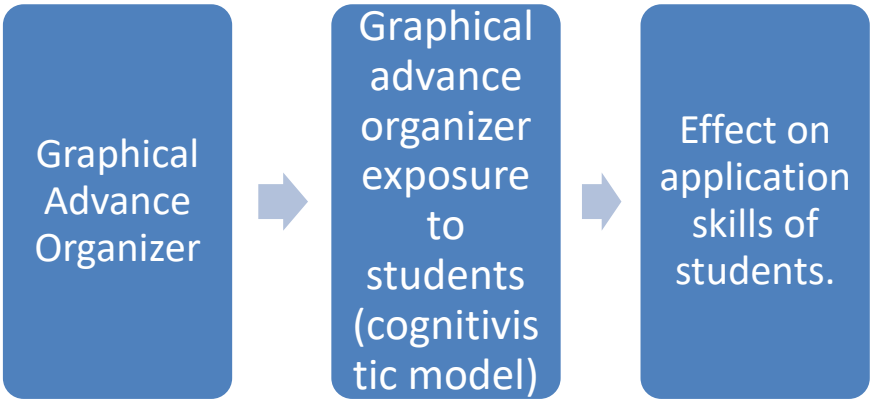


Figure 2
PTIVE Model Of Study



This theoretical lens explain why graphical organizers which combine spatial layout, labels, and linking relations are particularly promising for biology instruction where conceptual hierarchies, processes (e.g., cellular respiration), and systems relationships must be grasped by students. Graphical advance organizers may reduce extraneous cognitive load as it provides advance schema and offer accommodation and assimilation of knowledge that support deeper encoding and learning (Bryce, 2024).

Literature Review

Teaching and learning process began with the creation of the human being. Allah granted five senses. These senses are used by human beings to gain knowledge. The knowledge expanded over time and took on new dimensions. Due to the expansion and diverse nature of the knowledge, a systematic strategy is required. Aim of education is to achieve certain targets, and within specified time frame it can only be possible by employing effective teaching techniques. The extremely important and disturbing state of current science education highlights the need for reform (PEAS,2022). A significant shift in the structure of thinking skills might considerably reduce the problems that the world is currently facing, such as terrorism, global warming, depletion of resources, atomic dangers, etc. For this goal we will need to alter the way of science teaching. It is clear that the main purpose of the schools must change from being knowledge generation and transmission to being an institution capable of meeting the skill requirements of the future, i.e., teaching students to communicate effectively across cultural, technological, and linguistic

boundaries (Awan & Hussain,2020). There is a need for an educational method that supports students' growth in application skills. A glint of hope seems to be provided by graphical advance organizers. This variable have been examined in related literature by the researcher in order to have a thorough understanding of this approach.

A substantial body of quasi-experimental and experimental research reports positive effects of graphic organizers and GAOs on students' achievement and retention in science and biology specifically. Studies across diverse contexts (secondary biology, elementary science, and higher secondary chemistry/biology units) typically find that learners exposed to GAOs perform better on post-tests and delayed retention tests than peers taught using traditional lecture or guided notes. These effects are often most pronounced for conceptual understanding and for items requiring organization of knowledge rather than rote memorization for example, field studies in secondary biology have shown improved immediate post-test scores and retention after instruction with graphical advance organizers compared to conventional instruction(Kpiranyam, Ode, & Ajio, 2023).

Kaur & Kamini (2018) examined advance graphic organizer impact on students achievement by using achievement science test and the results of the studies showed that the achievement level of students increases. Idiong, Eyenaka, & John, (2019) studied the effect of graphical advance organizers on performance and retention of physics secondary students ,the results shows a significant difference in the performance and achievement of students when taught with the help of GAO.

Effect of graphical advance organizers on higher order thinking skills is also reported in several studies GAOs externalize relationships and causal chains, enabling learners to manipulate and interrogate the structure of knowledge. When combined with prompts and guided questioning, GAOs have been associated with gains in scientific reasoning, argumentation, and problem solving in biology contexts (Pepple,2024).

Recent studies from Nigeria, the Philippines, and other contexts demonstrate GAOs' applicability in resource constrained environments. These studies often adapt GAOs to local curricula and teacher capacity, reporting positive effects on performance and retention when teachers receive even modest training in GAO design and use (Vekli, & Çalik 2023; Pepple, 2024).The consistency of positive findings across settings bolsters external validity for application in Pakistan, though local adaptation and teacher professional development are emphasized.

After a thorough search, there are very few evidences for the utilization of graphical advance organizers to improve nine grade biology students application skills. The researcher therefore inspired to work in this relevant topic

of research according to the current needs of the science educational system. These related research literature' in depth study provides a perspective of the current state of the variable under inquiry very few of the aforementioned studies mention graphical advance organizer to improve application skills of students. This gives a platform to researcher to work in the relevant field.

Research Hypothesis

H_{O1}: There is no significant difference of applying skills between the groups taught by using graphical advance organizers and traditional instructional method.

Research Methodology

This study is based on post positivist paradigm and it is quantitative in nature, experimental research method adopted in this study to find out the independent and dependent variables relationship in the form of cause and effect.

Experimental Research Design

There were two intact groups involved which are termed as control and experimental group. Therefore, *Quasi-Experimental* pretest-posttest control group design *was used to make a comparison between applying skills of sample groups.* After collecting the data, a test of statistical significance that is t-test was applied on the mean test scores of both the groups after the intervention.

Population

The population for this study included all of the Government Girls High Schools in Tehsil Rawalpindi that met certain parameters (biology students, biology class rooms and laboratories, availability of biology teachers). This study's population consisted of all biology students enrolled in the 2023-2024 academic session. According to the source total no of students enrolled in female schools in public schools of Tehsil Rawalpindi are 8,7659 (Punjab School Education Department SED,2024).

Sample

One public school was chosen purposively from the population, having biology subject at secondary level and have two sections of grade 9 biology. Already formed sections of grade 9th were randomly assigned as control and experimental groups. The study sample size was 57 ninth grade biology students.

Tool of the Research Study

A biology achievement test having application level questions was developed to measure the applying skills of biology secondary level students. The reliability coefficient of the test was 0.79.Test was constructed in three phases which involves planning of test, the preparation phase involving table of specification and item generation of a test and in the last administration phase lies and the means to evaluate the test after administration. Validation of test done and then finally used as pretest and posttest and both groups, (experimental and control) were administered to this test at a specified time.

Validation of the Tool

The research tool was discussed with the experts in the light of face, construct and content validity and amended according to their useful suggestions. Pilot testing was performed and item analysis done to ensure reliability of the test.

Experimental Procedure

Experimental group was taught by using graphical advance organizers for 8 weeks. Lesson plans were made, validated by experts for intervention on graphical advance organizer method while control group was taught by traditional method of teaching. A pre test of applying skill was conducted prior to intervention and post test conducted after intervention of 8 weeks on both groups at the same time. Hence, the students were taught by using graphical advance organizers to find its effect on applying skills after the experimental period. Applying skill measuring biology achievement test was made according to the prescribed content selected from the grade ninth biology text book. Key and rubrics were made for marking.

Results

The data were analyzed using the t-test to see whether there was a significant difference between the means of the two groups.

Table 1

Comparison of Pretest and Posttest Results of "Applying Skills" of Both Groups

Level of Knowledge	Pre-Test & Post Test Diff.	No. of students	Mean	S.D	t-test	df	Sig (2-tail)
Application	Experimental Group	30	7.63	1.75	6.08	55	.000
	Control Group	27	4.14	2.53			

A t-test was performed to determine whether there was a difference in scores between the groups of study at the "application" level. Students who were exposed to graphical advance organizers scored significantly higher (M = 7.63, SD = 1.75) than those who taught by using standard teaching methods (M = 4.14, SD = 2.53), t(55) = 6.08.

Experimental group mean score (23.8) is higher than control group mean score ,which depicts that there is clear difference in applying skills of students due to treatment .Hence null hypothesis leads towards rejection. Hence, there is strong evidence that the experimental intervention significantly improved students' application-level higher-order thinking skills more than the method used with the control group. The standard deviation (S.D) values further support this conclusion. The experimental group's lower S.D. of 1.75 compared to the control group's 2.53 indicates a more consistent improvement in the experimental group. This consistency suggests that the intervention may have provided a more uniform learning experience, leading to similar advancements across participants.

Discussion

The findings from all the above mentioned studies inform educators about the utility of graphical advance organizers in promoting critical thinking, problem-solving, and application skills. Therefore, teachers can then incorporate these advance organizers (tools) into their teaching practices to foster deeper understanding and promoting application skills. These findings align with existing literature on the efficacy of structured interventions in promoting application skills.

Research by Khan (2021) on the application of a Higher Order Thinking Instructional Model in science education revealed significant gains in students' scientific reasoning and learning activation, further corroborating the positive effects of targeted instructional strategies. The abovementioned results shows consistency with the result of Bulut (2022). That advocate for the use of graphical advance organizers enhanced learning environments to promote

application skills. The results of the provided study align with their argument, revealed that the applied experimental procedure helps to promote students' ability to apply knowledge in practical contexts.

The findings of this study are consistent with the study of Djudin and Amir (2018); Hanchin, & Hsuehua, 2017).Zaman, Choudhary, & Qamar, (2015) found that advance organizers help in enhancing academic achievement and retention in the subject of chemistry is aligned with this study. According to Chanshi, & Daka, 2020, students' cognitive abilities are heavily influenced by their analytical and reasoning skills by using graphical advance organizers According to Samba et al. (2019), who concluded that actively involving students in teaching and learning activities by graphical advance organizers fosters critical thinking. All these studies indicate that the advance organizers, improve students' achievement, enhance learning outcomes, and address educational challenges.

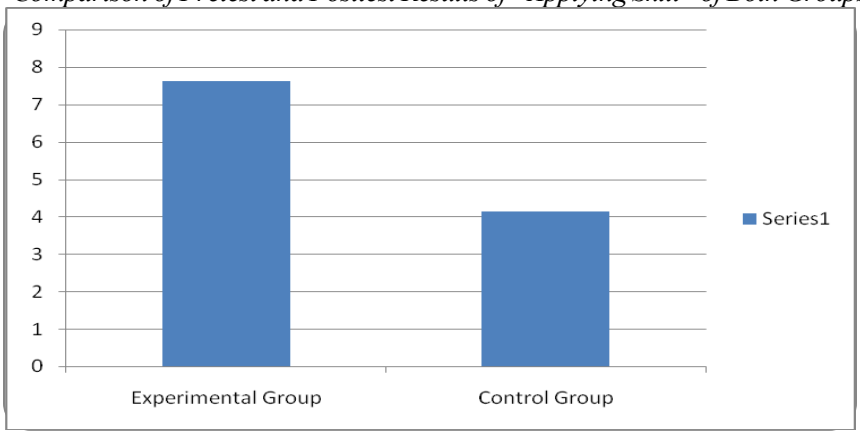
Globally, studies have proved the effectiveness of GAO in teaching scientific concepts. Studies (Omondi, Keraro & Anditi, 2018; Ugwoke & Ude, 2022) show that students who were taught by using graphical advance organizers performed better in science than those who were taught conventionally. Studies by Idiong, Eyenaka, and John (2019), Chanshi and Daka, (2020) found that students taught using GAO had significantly higher retention rates than those taught by using traditional method of teaching Some researchers found that advanced organizers had little effect on students' performance and cognitive skills (Samba et al., 2019;Kpiranyam et al,,2023) Kpiranyam et al,2023 study found that students performed better after receiving direct instruction i.e. traditional teaching methods rather than graphic organizers. it is concluded that above mentioned researchers has proved that graphical advance organizers are very effective in different disciplines and promote critical thinking among students but few studies showed that it may not effect application skills. Therefore, this study led us to conclude that GAOMT is effective for promoting application when used for nine grade biology students.

Conclusion

The findings from all the above mentioned studies inform educators about the utility of graphical advance organizers in promoting applying skills, problem-solving, and application skills. Therefore, the teachers can incorporate these advance organizers (tools) into their teaching practices to foster deeper understanding and promoting applying skills. It is concluded that the use of graphical advance organizers utilization helps to develop application skills among biology students and, this study could have implications for teaching practices, suggesting strategy to improve students application skills.

Figure 3

Comparison of Pretest and Posttest Results of "Applying Skill" of Both Groups



Recommendations

1) The findings emphasize the potential effectiveness of the intervention used in the experimental group for enhancing application skills. It is recommended that teachers should use graphical advance organizers such as concept map ,mind map, flow charts, KWL charts etc in biology classrooms to enhance applying, skills of biology students.
2) Educators and practitioners may consider incorporating similar interventions or strategies to promote deeper levels of understanding and for promoting applying skills of students.
3) By considering the comparative effectiveness of this experimental approach, its highly recommended that teachers can improve their educational practices by incorporating this graphical advance organizers method that promote application skills to enhance students' abilities in application of learned knowledge.
4) Long term impact of graphical advance organizers should also be studied on other cognitive domains of blooms taxonomy in future.

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Citation of this Article:

Gulzar, S. (2025). Effect of graphical advance organizers on the applying skills of grade nine Biology students. *Journal of Science Education,7(2*), 29-42.