

## Science Learning Strategies at Secondary Level Schools in Nepal

Tika Ram Gautam <sup>a</sup>, Kamal Prasad Acharya <sup>b</sup>

<sup>a</sup> Mahendra Ratna Campus, Tribhuvan University

<sup>b</sup> Central Department of Education, Tribhuvan University

Email: tikaram.gautam@mrc.tu.edu.np

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**ABSTRACT:** This study explores the strategies for teaching and learning science at secondary-level public schools in Nepal. A descriptive quantitative research design was adopted and non-random convenient sampling techniques were adopted in this study. An observation form and a closed-ended survey questionnaire were used for the data collection. It was found that the majority of science teachers used lecture and demonstration methods and 55% of teacher select the teaching methods on the basis of the subject matters rather than the student's interest and classroom environment. Only 2 schools out of 11 were conduct science exhibition program and students enjoyed to participation science exhibition. Also, students used internet websites and applications including YouTube, and Facebook for learning. It is recommended that the use of student-centered approaches while teaching and learning science at secondary public schools in Nepal will have positive impact.

### Introduction

Teaching is different rather than transforming information for the students. Teaching is not only a job rather it is complicated (Huang et al., 2022). Science teachers frequently use diverse strategies to explore the potentiality of students. Inquiry, discovery, group discussion, teamwork, field visit, experimentation are major activities that helps to exploring students' potentiality (Garrett, 2008) Traditionally, teachers are the mediator of knowledge-transmission agents. Students are the silent receivers of knowledge. Sources of knowledge are teachers and books only (Mason, 2000). But in present days, this process can easily replaced by ICT tools and techniques. So, there should be a transformation in teaching from traditional teacher-centered learning to student and activity-centered strategies. Transformation in teaching from teacher-centered to student-centered, lecture to activity centered is a necessity (Ordu, 2021; Garrett, 2008; Catalano & Catalano, 1997). Progression in ICT and transformation in teaching is also adopted by the Nepalese education system. Child-friendly environment, equitable classroom practices, exploring the inherent potentiality of child-centered activities strategies are the major consideration of teaching (Curriculum Development Center [CDC], 2021). To achieve this goal, the teacher needs to adopt student-centered methods in teaching.

Science teaching means not just handling out facts and information of science (Acharya, 2009). Science teachers should encourage and provide opportunities to pupils for the development of their expected abilities. Science is no doubt, full of facts, principles, and concepts but besides motivating and presenting things in an interesting way; the teacher must be able to create a situation for their all-round development. Teaching methods are the process of delivering knowledge and skills to the students which must be in an interesting way. It helps for gaining fruitful and meaningful learning (Munna & Kalam, 2021).

Huba and Freed (2000), as cited in (Ahmed, 2013) described teacher-centered learning as; students passively receiving information with emphasis on the acquisition of knowledge, and the teacher's role is to be primarily an information giver and primarily an emulator. The teacher gives brief explanation of topics, and demonstrate the figure, charts, and experiments. Students copy down the notes and memorize what the teacher says and provide notes. There is no room for students' personal development. Teacher centered approach to teaching is mainly an expository type in which the focus is on telling, memorization, and recalling information.

Teaching environment is very much formalized and teacher occupies a central position in the classroom in Nepalese classrooms Lecture methods, demonstration methods, lecture cum demonstration methods, etc. are examples of teacher centered method (Acharya, 2009). In teacher-centered education, students pay focus on teacher. The teacher talks, while the students exclusively listen. During such activities, student work alone, and collaboration is discouraged (Monika, 2012). Livquido and Liu (2006) as cited by (Khaled, 2013) report that while the learner center has been advocated in higher education in recent years, teacher center teaching style may be still dominant in actual practice. The study showed that instructors still use traditional teacher-centered styles in classrooms the despite a call for paradigm shift to learner-centered strategies. Monika, (2012) states that it has a fluidity and liquidity of using different methods in teaching. The classroom atmosphere is highly flexible and informal. It focuses on the discovery of scientific concepts and generalizations through methods of inquiry and problem-solving, rather than cramming and role memorization. More emphasis is laid on group participation and group decision-making. The teacher does not adopt an authoritarian attitude but rather played a democratic role. He provides freedom to students to discover, inquire, discuss, clarify doubts, investigate, explore and conduct activities.

Students have a great and active role or students are at the center of a students' centered method of teaching. Cooperative learning, inductive learning, expeditionary learning, active learning, and flipped classroom are the common types of learner centered methods (Olugbenga, 2021). Inquiry methods, project methods; co-operative learning, heuristic method, a problem-solving method, laboratory method, and computer-assisted instruction Think Pair and Share, directed learning activity, directed listening and thinking activity, jigsaw, pens in middle, and walk in to know are some students' center teaching methods. The secondary science curriculum (classes 9 & 10, science curriculum) suggested the various strategies of teaching and learning like discussion, observation, lecture, pen in the middle, project work, peer reading and peer summarizing, pointing out important ones, critical thinking, and brainstorming. School science curricula incorporate information communication and technology content in the science curriculum weightage 14 teaching hours (Curriculum Development Center [CDC], 2021). Weimer (2000) as cited in (Ahmed K. , 2013) purposed five areas that need to change in order to achieve learner-centered teaching (i) choice of content; (ii) instructor's role; (iii)

responsibilities for learning; (iv) the process of assessment and (v) power of the relationship between teacher and learner. Students needed to have ownership of their own learning, contribute to the design of the curriculum and have responsibilities for some levels of instruction. Karmacharya (2001), has conducted research on classroom democracy and the results was a lack of democracy and anxiety in learning. The teaching must be learner-centered and activity-centered which can help in the development of student potential.

### **Methodology**

A quantitative research design was used in the research. In comparison to the community school, the institutional schools had better performance (Thapa, 2012; Dhakal & Timalina, 2021). So, six community and five institutional schools were selected with convenient sampling methods. At the time of research, researcher have been also working one of the community school in Pokhara Municipality and have a close relationship to the head teacher and science teacher. Furthermore, Researcher himself, being a science teacher at a public school, conducted school wise science exhibition program in the locality of rural area, it makes closer relation to science teachers. Due to this reason, researcher have choosen schools from the Pokhara municipality of Kaski district. Each science teacher was taken from selected 11 school and sixty students were selected using a random sampling method. A questionnaire for teachers and students and a class observation form was used for data collection. For the reliability of the tools, pilot testing was conducted in a school in Kaski district. Descriptive data analysis techniques were used for data collection. Percentile was adopted for the data analysis process.

### **Results**

On the basis of the collected data from primary sources and analyzing following results are displayed according to the used research tools.

#### ***Planning Conditions of Teachers and Activities While Teaching***

Teachers' readiness is one of the prime factors of effective teaching. Planning reflects the readiness. It was assumed that a planned teacher seems happy, review the previous lesson, confident in subject matters, motivate students and promote students to active participation and also concern about homework. If teacher uses students' book while teaching and ask students about the subject to be taught, they will be unplanned. On the basis of the researcher's observations in class following results were found.

Table 1. *Planning conditions of teachers and activities while teaching*

Happy mood and activities	Yes	
	No.	Percentage
Is the teacher entrance position happy?	11	100
Preparation of the subject matter	8	73
Preparation of the lesson plan	5	45
Review of the previous lesson	9	82
Motivation of student	10	91
Participation of student	10	91
Group work/ Group discussion	8	73
Evaluation based on objectives	7	64
Homework	10	91
Use of student's book	9	82
Teacher start the lesson with motivation	9	82

Table 1 shows that all of the teachers were entered in a classroom with smiling face and happy mood. 73 % of teachers had already prepared their subject matter and confidently taught during a whole lesson. 45% of teachers had not prepared their lesson plan, although they taught through course content. Only 82 % of the teachers reviewed the previous lesson and motivated the student at the beginning of the lesson. The participation of the students in the lesson was good. Ninety one percent of the teachers were motivate students and actively participate in learning. Seventy three percentage of the teacher applied group work and discussion. Similarly, sixty four percent of teachers evaluated their student by asking questions based on objectives. Ten teachers asked the students to do some homework. One of the interesting cases was acquired that eighty percent of teacher did not take their own book and asked the student to use in classroom. Similarly, another interesting cases were found that hundred percent of teacher were in happy mood while entering the class but it is found that only forty five percent of teacher were preparing their lesson plan. On analysis of above results, teacher concern about the motivation, reviewing previous lesson, and use to provide homework based on their experience but there is no written lesson plan and few of them show weak performance in subject matters. So, regular habit of planning should be developed.

### ***Applied Teaching Practices by Secondary Science Teacher***

Activities are the heart of the teaching method. Learner-centered methods of teaching are helpful for the increment of student achievements (Kassem, 2019). Teaching methods directly affect the students learning, so the researcher wanted to know the present practices of teaching science.

Table 2. *Applied teaching practices on the basis of researcher observation*

Applied practices	No. of teacher
Lecture method	11
Group discussion	5
Question answer	3

Table 2 shows the various teaching methods show which were applied in the classroom by the science teachers while the researcher observed their classes. all teachers used the lecture method and also mixed some other activities. 5 teachers used group discussion methods and 3 used questioning methods with lecture method. Most of the time was spent on lecture method. Very few teachers less than 2, used problem solving, home assignment, game play, brainstorming, TPS, and demonstration. None of the teachers used characterizing, summarizing peer summarizing, pointing out important ones, critical thinking, brainstorming, T-chart, M-chart, Gallery walking, thinking watch, and sharing. Learner-centered approaches help to increase the achievement of students but observations show that the majority of teachers used teacher-centered methods. So, the major problem of low achievement of the students is pedagogy or way of teaching focusing on the teacher-dominant method.

At opposition to these results teacher themselves claimed that they used discussion and practical methods very frequently shown in table 3 and accept that they use project work and field visit very less.

Table 3. *Classroom practices of teaching of science teacher on the basis of teacher's response*

Practices	No. of practices	Frequently used method	Most effective method
Lecture method	3	3	
Discussion method	6	4	2
Question answer / problem solving	4	1	3
TPS /jigsaw	6	2	2
Practical	9	3	3
ICT Based method	3		1
Project work/ Home Assignment	1		
Demonstration	4	2	
Field Visit	1		1

Table 3 shows that, the researcher asked every teacher the view of their classroom practices of teaching science. According to them, the largest number of teachers used to apply practical methods including some mixed methods. Three of them also use to apply other three different methods too. The discussion method was used by six teachers and they also focused on question-answer, TPS, and practical methods. Similarly, three teachers have seemed to use modern technology ICT-based methods. They used to use mobile, internet, data pack, computers, projector, and smart board while teaching science. The above table shows that demonstration methods were also used by the science teachers while teaching science. This number was three out of eleven. Four teachers out of eleven use the discussion method mostly and about twenty-seven percentage of teacher used to use practical and lecture methods mostly. According to three science teachers out of eleven, "Question answer, problem-solving, practical methods are more effective in teaching." About eighteen percent of teachers found that the discussion method was more effective. Similarly, the TPS method was found more effective by the same percentage of teachers. Only, one/ one teacher said that ICT based method and Field visit method were more effective than other methods. It reflects that still teacher were not aware of the pace of real situation teaching and the creativity of the students.

### ***Most Used Methods in Teaching Science***

We use multiple methods or various methods in learning activities over the course of time. Students' achievement is highly affected by the repetitive methods or frequently used methods in the classroom. To identify the most repeated methods of teaching in a science class researcher asked the closed-ended questionnaire to students how their teacher used to teach in science class. The researcher provided four options for questions related to lecture method, demonstration and practical methods, and exhibition method.

Table 4. *Most repeated methods in teaching*

Adopted methods	No. of students	Percentage
Lecture	28	46.67
Demonstration and practical	24	40
Exhibition	2	3.33
Others	6	10

Most of the teachers use to repeat teaching methods while teaching a single period though the researcher wants to know the most repeated methods. The question is asked among the sixty students. 46.67% of students said that lecture method was the most repeated method, 40 % of students said demonstration / practical methods and only 3.3 % students said exhibition. Similarly, 10 % students answered many other questions answer, discussion methods. Students feel that the demonstration and practical methods are the best methods for learning but from the above table No. 4, it is clear that still teachers were focused on the lecture methods. This result shows that there should have teacher training and repeated supervision of the teaching-learning process.

### ***Major Ways of Selecting Method***

The fruitfulness of the teaching depends on the quality of learning strategies used in the classroom. The learning strategies are dependent on how they used to chooses the strategies. If the teacher chooses the teaching methods on the basis of the students' interest and capability, the classroom may become more learner-centered and outcomes become fruitful. To identify, whether the teachers used to teach according to the student's interests and levels or not, the researcher asked the questions are they used to select the present teaching method. The responses are shown figure 2.

Table 5. *Major way of selecting method*

Ways of selecting teaching methods	No. of teachers	Percentage
According to subject matters	6	54.54
According to students' interests	3	27.27
According to the number of students	1	9.095
According to physical environment of classroom	1	9.095

Table 5 shows that how the science teachers select the different teaching methods which suits in their lesson content. According to them the large numbers of teachers, 54.54 percent respondents that the methods were selected according to subject matter. The second highest percent, 27.27 percent of the teachers answered that the methods were selected according to the student's interest. Similarly, 9.095/ 9.095 percent of the teachers said that the methods were selected according to the number of students and management of the class. The teacher actively focused on subject and content to teach and place the students in the second category. Teachers should select the learning methods firstly by the learner's interest and capability.

### ***Position of Teacher in Classroom***

Student's access to the teacher has a vital role in their achievements. If the teacher equally and equitably provides attention towards the students and finds out the students' need and support them. The positions of the teachers were different in different teaching methods. In this study, the researcher wanted to know the position of the teacher in the classroom while teaching and where should be the position teacher in the classroom was show in table 6.

Table 6. *Position of teacher in classroom*

Position of teacher	Numbers	Percent	Where should be position
Walk around the classroom	20	34	30
Stay in front	15	24	10
Stay at the last of the class	5	8	0
Mixed	20	34	20

The researcher wanted to know where the teacher stays in the classroom while teaching. The closed ended questionnaire provides with options; walk around the classroom, stay in front class and others two. Sometimes teacher provides the notes on white board and stay at last. Other options is about the mixed position of teacher s/he sometimes walk around class, or stay at last while providing notes or stay in front of class. 34 percent of students said that their teacher does not use to stay in a fixed place. He/she walks around the classroom. Twenty-four of the teacher stays in front of the class. This result is satisfactory according to forty-four percent of teachers who used the lecture method. Eight percent of the student said that their teacher used to stay at the back of the classroom. Similarly, thirty-four percent gave a mixed answer. Large numbers of students respond teacher should walk around the classroom. Here most of the teachers were moved around the classroom which meant teachers try to equally participate and focus on the students.

### ***Trends of Conducting Group Discussion, TPS Methods***

Science is a practical subject there should be more classroom activities. Group discussion and TPS methods are totally student center methods. So, the researcher wanted to how the trend is conducting group discussions and TPS according to students response.

Table 7. *Trends of conducting group discussions, tps methods according students response*

	Numbers	Frequency	Numbers
Yes	42	Always	9
		Sometimes	33
		Never	18

Table 7 shows that nine of the students were used to conduct the group discussion and TPS related to science topics as well as thirty-three students use to conduct sometimes and eighteen students respond that they never conducted those activities in their science class. From this, it can be concluded that teachers are well known about student-centered methods but the frequency of adopting student-centered methods is limited.

### ***Status of Using Internet***

Science is a technical subject. It is useful to learn science through the Internet. Technologies are wide spreading in the present days. Use of internet has the positive impact in the students achievements (Affum, 2022). So, the researcher wanted to find out how is a status of using the internet was among the students. The status of students using the internet for solving science problems indicated the present practices of the teaching-learning process were based on ICT and electronic media.

Table 8. Status of using the Internet to search science problems

Using of internet	Numbers	Internet website
Yes	27	Google, E- MIDAS, Education Sansar, Tube mate, Twitter,
No	33	Wikipedia, World science, Kullbas.com, <a href="http://www.masnple.com">www.masnple.com</a> , Face book, <a href="http://www.epizmba.com">www.epizmba.com</a> , <a href="http://www.Factmonster.com">www.Factmonster.com</a>

Table 8 shows that twenty-seven students out of sixty used to use the internet and search the useful content for science learning. But the large number of students thirty-three had never used Internet to search the problems although they had run their Facebook accounts.

The students who used to search problems through internet were familiar on the following websites (i) [www.Google.com](http://www.Google.com), (ii) [www.Tube mate.com](http://www.Tube mate.com); (iii) [www.You tube.com](http://www.You tube.com); (iv) [www.kullbus .com](http://www.kullbus .com); (iv) [www.facebook.com](http://www.facebook.com); (v) [www.Emidas .com](http://www.Emidas .com); (vi) [www.twiter .com](http://www.twiter .com); (vii) science Wikipedia; (viii) [www.factmonoster.com](http://www.factmonoster.com); (ix) [www.educationsansar.com](http://www.educationsansar.com) and (x) world science.

Result also matched to the results from flash I report 2022 concluded that only 1.4 % from 11 and 1.5 % of grade 12 are beneficial from remedial instrument offer by NCERT. The percentage students that use or learned from you tubes only 2.9% and 3.4 % in class 9 and 10 respectively (Center for Education and Human Resource Development [CEHRD], 2022).

### **Field Trip in their Science Class**

Field trip is the one of the student-centered methods of teaching. Students got a chance to interact with real object and generalized ideas through interaction among friends, teachers, parents, and others contact persons while visit. The researcher wanted to know the status of field trips in science class.

Table 9. Numbers of students who had visited or field trip in science class

Have you ever went for field trip?	No. of students	Percentage	Explore materials and knowledge
Yes	23	38.33	Pond ecosystem, producers and consumers of ecosystem,
No	37	61.67	working model of hydropower, hydraulic lift, pollutions in river , dc motor fan, projector prepared with bulb

The above table 9, shows that 38.33 percent of the students had visited field trips in their science class to observe and do some practical work but the large numbers of students, 61.67 percent had not visited anywhere. Students are exploring the different organism, and rocks and observe the different working models of hydropower, hydraulic lift, electromagnet, dc motor fans, projectors make with bulbs and solar system models in the science exhibition program. Students learned to characterize and categorize components of an ecosystem (Pond & land ecosystem). Another important topic they observed on the field visit is classifying the plant and animals according to the five-kingdom system of classification.



### **Status Asking Questions and Answering**

Motivations is the one of the key techniques to increases the students achievements (Özen, 2017). Positive response towards the student's question is the one prime motivation factors of teaching. So researcher, observe the class of 11 teachers and displayed the following results.

Table 10. *Teacher's responses towards students on asking questions*

Responses of teachers	Numbers of teacher	Percentage
Very good	7	63.64
Good	1	9.09
Satisfactory	3	27.27
No attention	0	0

Table 10 shows that 63.64 % teachers provide the positive attention towards the questions asked by the students. This reflect majority of teacher were concerns about the students participations and discussion in class. Similarly, no one teacher was found who couldn't pay any attention towards the student's questions. This result shows, if the teachers were in a happy mood, they at least pay attention to a student's questions. Three of the teachers respond with satisfactory answers while the students were asking. The responses were taken from observation by the researcher while teaching during forty-five minutes a single period.

### **Status of Practical Work During a Year**

Science is a practical subject. All of the facts were generalized through the practical work. The numbers of practical work done in a year at the respective level have a significant role in science teaching. The researcher asked the students to mention any ten practical works which are done in a year.

Table 11. *Frequency of doing practical work during a year*

Frequency of doing practical work	Numbers	Percentage
Below four	15	25
Between four and seven	14	23.33
Above seven	21	35
None	10	16.67

This results shows that 65% of students were just only conduct the less than seven practical works in a year which is very less as mention in curriculum. Formally, there is 25 practical works in curriculum but there should necessary to conduct more than 50 experiments and activities in science teaching (Curriculum Development Center [CDC], 2021). In table 11, it shows that 35 % of students respond that their science teacher used to perform above seven practical works during a year. 23.33% students made a view towards their science teacher he/she organized between four to seven times. Fifteen students respond their teacher organized the practical work only four times and ten numbers of students made a view towards their teacher he or she did not used to organize any practical work during a whole year. This shows that the teaching methods used by the teacher were not student center. Those students who are engage in practical works listed 35 practical ( including demonstration by teacher) in whole academic year from class 9 and 10.

### Science Exhibition Program and Students' Feelings

Science exhibition program is the way to developing scientific literacy and developing creativity (Bozdoğan, 2009). Science exhibition helps to make students very curious which leads the students to scientific innovation. So, science exhibitions has a vital role in teaching science. To identify the student's feelings on science exhibitions and practices of them, the respondents are asked whether they had any science exhibitions at their school and how they feel. The response given by respondents is presented in table 12.

Table 12. *Number of science exhibition program students' feelings*

Conduct in School	Participate in other schools	Use of students made materials in classroom	Feelings of students
2	5	7	Proud, Happy and proud, Exciting, Interesting, Good and interesting, Curious, Happy and gland, Grateful

Table 12 shows that only two schools out of eleven had organized a science exhibition program at their school. But nine of the schools had not organized the exhibition in their own schools. Although they had taken part in the exhibition program the other schools or institutions held such programs. The students, in whom their schools had organized and participate in science exhibition programs, respond to their feelings by proud, happy, excited, interesting, curious and grateful. It shows that in present practices Lesley focused on the creativity of the students. 7 teachers response that they were used to use students made materials in teaching. It reflects that teachers engage and give concern about the construction of improvisation materials and science exhibition program. To motivate teachers and students to actively participate to construction of materials motivations and stimuli should be provided from concern authorities.

### Discussion

Teachers who have prepared the lesson plan motivate students by asking questions related to the previous lesson. Most of the teachers 9 out of 11 use students' books which indicate they were not well prepared for teaching. Planning and assessing helps in student achievement (Aada, 2020) but it is found that only 45% of teachers prepared lesson plan before teaching so the low achievement of students in science is the results not preparing plan for action in classroom. Arguing this result, König et al., (2020) said that teachers claim that they used practical works mostly but this result was contradicting to the students' response frequently used methods was lecture and demonstration whereas TPS, brainstorming, game play, problem solving and experiments (Beyer & Davis, 2009; John, 2006; ). Teacher suggest problem solving, field visit, questions answer, ICT based learning, and discussion methods were most effective methods in teaching science (Kavanagh & Danielson, 2020; Nagro, Fujii, 2019; Nurtanto et al., 2021; Yang, 2020). Low ICT skills in teacher affect the students learning and use of ICT helps to shifting the teaching strategies to student centered learning but limited resources and clear IT policy teachers' are still inconvenient to using ICT in classroom ( Rana & Rana , 2020)There is no any specific way or better way which is the most effective ways of selecting teaching methodology however classrooms diversity, learning environment, students' capacity, resources and time are the basic parameter of selecting methods. But most of the

teacher. Fifty-five percentage reflects that they choose the teaching methods according to the subject matter rather than the students' interests and capacity (Masita, et al. 2021). More than half of the students use internet to solve the related problems but flash report (Acharya, Acharya & Magar, 2023; Ruys, et al., 2012) reflect very few students are engaged in online reading and YouTube from official sites like National Center for Education Development [NCED]. From comparing this result students may randomly search learning videos on YouTube. So, if the teacher unfamiliar to the use of the ICTs this will be the greater challenge for teachers. Less number of students 38% reflect that they rarely used to go field visit rest of them were not go for field visit. This is curious issues about the teaching pedagogy practiced in Nepal in teaching science because project based learning, problem solving strategies, co-operative learning promote students in deep understanding and helps in building skills (Lombardi, 2018) Secondary education curriculum of science offered 34 practical works in each classes of nine and ten but it was found that students use only 4 to 10 practical works in a year. This shows that still teaching and learning process of science was conducted teacher-centered methods that is researched by a number of researchers (Bennett, 2003; Chen & Yu, 2019; Muganga & Senkusu, 2019). Ndiokubwayo et al., (2018), conducted research on the topics of the use of improvised experiment material to improve teacher trading college students' achievement in physics Ruwand also emphasized group activity, the use of improvised materials helps students to the development of analyzing skills Teacher who loves to conduct experiments is highly beneficial to students and also, they obtained a higher grade in the exam. Herewith, students also feel very happy and active participation in learning if they have the chance to engage in science exhibitions.

## Conclusion

Teaching is very technical subject, there is needed multiple skills as like acting, experimentation, guidance and counseling, explorer etc. The ways of teaching are shifting from teacher centered to student centered methods as well there is the higher effect of ICT in teaching and learning. Science itself the practical subjects but the in inadequate practices on; experimental works, field visit, group discussion, problem solving, planning before class, science exhibition programs, selecting methods of teaching just focusing on subject matters, or randomly used lecture method from the results the low achievement in science. Not only effect achievement in the final examination may also impact on skills development which is the key factor of learning in 21<sup>st</sup> century. Practices of a single method or specific method may not be suitable for all lessons and subjects. We can adopt multiple strategies in teaching in a single class one by one or in fused form. So, to make the learning fruit fully learner-centered method should be adopted in a planned way to be the better option in science teaching. Focusing on students' activity is the key factor for the transformation of teaching.

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