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Effectiveness of Constructivist Methods of Science Learning at Secondary Schools in Nepal

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Abstract

This paper explores the prominence of student-centered (constructivist) method over teacher-centered (lecture) method in public schools in Nepal. A quantitative research relying on experimental design was carried. Simple random sampling technique was employed to select the schools and the participants for the research. Students were randomly selected from the Kathmandu district, were grouped as experimental and control. The study was carried in 30 students of each school. Experimental group was taught by using constructivist method and control group was with traditional method. The pretest- post test design were administered to both the groups .The arithmetic mean, variance and standard deviation were calculated for data analysis. It is found that students' achievement level of experimental groups were far better than control group. Constructivist method of learning was effective in comparison with the traditional lecturing in learning science. It is recommended that the concerned authorities especially Nepal Government and Curriculum Development Center would use it in framing curriculum development and accentuation on prioritizing the constructivist method of teaching and learning.

Keywords: *Achievement, student-centered method, traditional lecturing, science learning*

Introduction

Science is hands-on subject based on coherent activity and experiment which concerns on the systematic study of the composition. Though science is interesting and captivating subject in today's world but some of students like to get away from the science curriculum in school level with mental preparation that they choose no more science subject in future due their perception of science as most difficult subject in the world. The attentiveness and enthusiasm of student in science rely on methods of teaching practice as well (Shirazi, 2017). The student-centered teaching methodology introduced to surmount the drawbacks of established conventional teaching methodology has played vital role to produce high level of academic performance. Among them, constructivist teaching method can address the problems and various issue associated with students as it emphasize on collaborative learning with active participation of students with self-construction of knowledge relying on prior knowledge (Adak, 2017). The constructivist-based instructional model succeeded to bring progressive consequence on the academic attainment of chemistry students. It is highly advised to adopt constructivist-based instructional mode for better academic achievement of students in chemistry (Samuel et al., 2024).

The participants who get an opportunities to learn in smart classroom through means of problem solving skills emphasizing on development of critical thinking can enhance their academic performance. Students should be highly motivated for peer collaboration, cooperative mode of learning and peer assignation for positive impact on learning attitude among the students. The prime factor to bring positive response on academic achievement and interest of students are motivation, cooperativity, peer interaction, peer engagement and a smart classroom environment (Almulla, 2023). Students have key role in learning activities rather than teacher. Teacher play a role of scaffolder whenever students seeks help during their learning activities. Students construct their own knowledge on the basis of interaction. The constructivism method is student-centered method rather than traditional approach of learning. The student learn in their own style according to their abilities but must be facilitated whenever they face difficulties on understanding the subject matter (Wibowo et al., 2025).

Knowledge is constructed by the learner through their interaction with the substantial world in collaborative manner in learning environment without any sort of imposition on them. Learners build up their own understanding with the facilitating environment provided by teacher (Taber, 2006). Social constructivism is valuable and significant in learning if overall activities takes place in collaborative manner with social interaction. Learning is not possible if students are isolated form social and cultural environment. Students must be engaged in collaborative work with active participation for construction of their own acquaintance that they achieve through social interaction and prior knowledge (Mohammed & Kinyo, 2020). Learning is not subjective rather it is objective in nature which is obtained through external world. Thus, obtained knowledge is mentally constructed among the learner. This shows that leaning is not passive process, in fact it is active process which involves in intellectual construction of knowledge by learner themselves (Doolittle, 2014). The amendment in teaching strategies and pedagogy with the mentality of applying collaborative teaching approach can lead to achieve the learning goal in the science classroom (Demirdaga & Seyithan, 2014). Constructivist-based teaching strategy exposed that it had greater influence in their academic performance as students taught by constructivist-based teaching had higher scores compared to those taught by lecture method. Constructivist-based teaching had greater influence on learning activities of students in the terms of achievement (Bimbola & Daniel, 2010).

The only teacher centered method cannot bring noticeable effect in learning. Students must equally participate for insightful learning so the learning will be meaningful. The combination of student centered method and teacher centered method can produce significant achievement on students' academic performance (Costabile et al., 2024). In order to better the learning attitude of students, they must be motivated extrinsically and intrinsically. This motivation on students can build positive impact in their learning by introducing new strategy in learning outline and style. It is only possible to motivate students extrinsically and intrinsically by providing constructivist learning environment (Do et al., 2023). Constructivist learning design and learning analytics are benefitted to both teachers and students by fetching positive transformation in student's

engagement in learning activities which help to enhance student academic outcome (Banihashem et al., 2022).

Overall, learning science can be more expressive and perceptive if student-centered methods can be adopted effectively. Traditional lecture method can be hindrance for learning and teaching activities of students. Such hindrance can be problematic factor for academic achievement level of student in secondary level. Learning should not be limited within the textbook and syllabus rather it must help to construct own understanding and meaning so that it can upgrade their academic and intellectual status in pronounced way. This study investigates the importance of constructivist methods while teaching science subject. The academic performance of the student in science is not pronounced in secondary level. The application of constructivist method in science learning and teaching can better the understanding level of student is the matter of great concerned as it is student-centered method. Jean Piaget theory of constructivist was approach applied to promote the learning activities as this theory predominantly accentuate the effective learning with pronounced academic achievement. The relentless altercation of ideas in the zone of proximal development permits each learner to gain new way of interpretation of knowledge and obtain new understandings through the effective interaction with peers. The theory of constructivist provide appropriate guideline throughout the learning and teaching activities which was applied in this study for effective research.

The entire study is based to investigate the consequence of constructivist approach in teaching science on the accomplishment level of students. This entire study highlighted the impact of constructivist method over traditional teaching method in teaching science with respect to the achievement level of students.

Methodology

This quantitative study was conducted relying on experimental design to carry out the research. The study was further proceeded by pretest- posttest design for statistical analysis of study. This study was carried on the schools of Kathmandu district located in Baniyatar, Tokha municipality and Tarkeshwor municipality. The population of the study was the students of grade ten of sampled schools of Tokha municipality and Tarkeshwor municipality, Kathmandu valley. Simple random sampling method was used to select the sample from these schools. The selected students were classified as experimental group

and control group. The entire study was conducted in selected samples. The basic tools used to evaluate the performance of the student's achievement was achievement test items. The achievement test paper was used to evaluate the academic performance of students. A set of 20 multiple choice questions was constructed and pretest and posttest were administered to students which were regarded as experimental group and control group. The achievement test paper was used to evaluate the academic performance of student

Result

The scores obtained by the control group and experimental group of pretest was compared with the scores of post-test which revealed the dominancy of experimental methods over traditional method in learning in science. It established that the experimental method played prominent role to better the understanding level of students in science in gratified way. This study showed that there was significant difference between controlled group and experimental group students' achievement in science on post-test.

Analysis of Pre-test scores of Students of School A

Table 1

Pre -test scores of students before Treatment

Group	Sample size	Mean	S.D.	Variance value	t-value	Remarks
Controlled group	15	8.73	1.48	2.19	0.39	0.39 < 2.048
Experimental group	15	8.93	1.43	2.04		
$t_{0.05, 28} = 2.048$	0.05 level of significance					

Table 1 shows that the mean score, standard deviation and variance obtained in pre-test of controlled group of School. The mean score, standard deviation and variance obtained in pre-test of controlled group of School A were 8.73, 1.48 and 2.19

respectively. Similarly the mean score, standard deviation and variance obtained in pre-test of experimental group were found to be 8.93, 1.43 and 2.04 respectively. The calculated t-value was found to be 0.39 which was less than the tabulated t-value (t=2.048) at 0.05 level of significance using two tailed test with degree of freedom 28. This study revealed that the academic performance of control group and experiment groups were almost equivalent and homogenous in nature before implementing treatment process. Thus, pre-test scores showed that the academic performance of control and experiment group students were almost at the same level before treatment.

Analysis of Pre-test scores of Students of School B

Table 2

Pre-test scores of students before Treatment

Group	Sample size	Mean	S.D.	Variance	t-value	Remarks
Controlled group	15	6.00	1.81	3.27	0.17	0.17 < 2.048
Experimental group	15	6.13	2.35	5.52		
$t_{0.05, 28}$ = 2.048						0.05 level of significance

Table 2 displays the mean score, standard deviation and variance obtained in pre-test by controlled group of School B as 6.00, 1.81 and 3.27 respectively. Similarly the mean score, standard deviation and variance obtained in pre-test by experimental group were found to be 6.13, 2.35 and 5.52 respectively. The calculated t-value was found to be 0.17 which was less than the tabulated t-value (t=2.048) at 0.05 level of significance using two tailed test with degree of freedom 28. This study showed that the both groups were equivalent and homogenous in nature before the application of treatment.

Analysis of Post-test of Students of School A

Table 3

Post-test score of students after treatment

Group	Sample size	Mean	S.D.	Variance	t-value	Remarks
Controlled group	15	8.93	1.38	1.90	9.93	9.93 > 2.048
Experimental group	15	13.6	1.29	1.66		
$t_{0.05, 28}$ = 2.048			0.05 level of significance			

The table 3 displays that the mean score, standard deviation and variance obtained in post-test of controlled group of School A as 8.93, 1.38 and 1.90 respectively. Similarly, the mean score, standard deviation and variance obtained in post-test of experimental group were found to be 13.6, 1.29 and 1.66 respectively. The calculated t-value was found to be 9.93, which was greater than the tabulated t-value (t=2.048) at 0.05 level of significance using two tailed test with degree of freedom 28.

This showed that there was significant difference between controlled group and experimental group on academic achievement level in science on post-test. The difference between mean scores on pretest and post-test was notable. Those students who were taught by constructivist method had noticeable improvement in academic achievement whereas the students taught by traditional lecture method showed no changes in their academic performance. When student were encouraged for group discussion, collaborative approach and cooperative method they were able to enhance their academic performance. The students in experimental group taught by student-centered teaching method showed superior accomplishment than the students in controlled group. This anticipated that the null hypothesis was rejected and alternative hypothesis was accepted.

Analysis of scores of Post-test of School B

Table 4

Post-test score of students after treatment

Group	Sample size	Mean	S.D.	Variance	t-value	Remarks
Controlled group	15	9.06	0.88	0.77	19	19> 2.048
Experimental group	15	15.33	0.97	0.94		
$t_{0.05, 28}$ = 2.048			0.05 level of significance			

Table 4 shows the mean score, standard deviation and variance obtained in post-test of School B of controlled group and experimental group. The mean score, standard deviation and variance of controlled group were 9.06, 0.88 and 0.77 respectively. The mean score, standard deviation and variance obtained in post-test by experimental group were found to be 15.33, 0.97 and 0.94 respectively. The calculated t-value was found to be 9.35 which was greater than the tabulated t-value (t = 2.02) at 0.05 level of significance using two tailed test with degree of freedom 28.

This study showed that there was significant difference between controlled group and experimental group in achievement level of students in science on post-test. This study exhibited that those students who were facilitated by student-centered method achieved distinct academic performance in their achievement level. The students of experimental group taught by constructivist method with the involvement of active participation in learning activities attained far better outcome than traditional method. Thus, the null hypothesis was rejected and alternative hypothesis was accepted.

This study demonstrated that experimental group performed improved academic enactment than control group due to the operational teaching method through constructivist method in which learning activities was emphasized on student-centered approach. Students were encouraged for interaction and collaboration for insightful learning in the classroom. The learning attitude of students were more definite when students were taught by constructivist method which was verified by the academic achievement of students. The result displayed that those students who were assisted by concerted, supportive and student-centered method achieved evident consequence in their achievement level.

Discussion

This study showed that students who were facilitated by collaborative, cooperative and student-centered method achieved manifest effect in their achievement level. This study is in line with Hijazi (2009) argued that constructivist method is remarkable in learning activities of the students as it enhance academic achievement and creative thinking among students. Qarareh (2016) claimed that the constructivist learning method

encouraged students to take appropriate steps to construct their own knowledge and understanding when they were taught by constructivist method.

The finding of study is in the line with Adak, (2017) highlighted the significance of co-operative learning, peer interaction, group conversation and experimentation over traditional teaching method. This study is in line with Noureen, et al. (2020) who put forward that student-centered method was able to actively participate the students in learning activities with better academic performance. Bogar et al. (2012) recognized that learning from constructivist teaching model had higher score in science than the students taught and guided by traditional methods. Teacher-centered education does not create the environment for collaborative learning rather it emphasize on individual work discouraging the group learning which is worthless in today's context. Concerning this perspective Mohammed and Kinyo, (2020) stated that students must be engaged in collaborative work with active participation for construction of their own acquaintance to achieve better academic performance.

Bimbola and Daniel, (2010) exposed that the constructivist teaching methods had greater influence in academic performance of students. Knowledge is constructed by the learner through their interaction with the substantial world in collaborative manner in learning environment without any sort of imposition on them (Acharya et al., 2023; Taber, 2006). Demirdaga and Seyithan, (2014) claimed from their research findings that the amendment in teaching strategies and pedagogy with the mentality of applying collaborative teaching approach can lead to achieve the learning goal in the science classroom**.**

The finding of this study supports the findings of (Mahapatra, 2020) claimed that constructivist method was very effective in self-construction of knowledge for the students as it was centralized to active learning activities. Brau (2020) noted that the influence of collaborative mode of learning is pronounced which is concerned with building the learning attitudes among the students. In a similar line Boghossia (2006) suggested that learning is dynamic process which must be conducted in collaborative environment.

Previous exploration supports that student-centered educational methodology progresses the quality of science education through noticeable academic achievement of students which exactly coincide the finding of this study. Regarding this perspective (Firdausih & Aslan, 2024; Wibowo et al., 2025) stated student learn in their own style according to their abilities if student centered method is enforced in their class which facilitates for interactive mode of learning. The study conducted by (Samuel et al., 2024) claim that constructivist-based instructional model have prominent role for better academic depiction which exactly confirms the findings of this study as well. Foregoing study (Banihashem et al., 2022) concluded that constructivist learning design and learning analytics play essential role to enhance student academic outcome whose findings exactly corresponds with the finding of this study.

The outcomes of this study supports the findings of Almulla, (2023) claimed that cooperative mode of learning have direct influence on learning attitude among the students. Constructivist, inventive and cooperative methods are keys to bring positive impact on teaching activities (Karwasz & Wyborska, 2023). The conclusion of this study supports the findings of (Lee & Ahn, 2025) which showed that constructivism act as a bridge for active learning to materialize interest on study and motivate students for scrutinized learning. The findings of (Do et al., 2023) confirmed that constructivist learning environment is essential for development of students as such environment plays prominent role in motivating students for better learning which is the core findings of this study as well. The finding of this study supports the study of (Ayaz & Sekerci, 2015) which concluded that the constructivist learning approach is remarkable method than traditional teaching method to produce notable and captivating academic performance of students.

The findings of Aydisheh and Gharibi, (2015) endorsed that constructivist teaching helps to produce improved academic accomplishment which is the main conclusion of this study in addition. The findings of the study (Umayrah et al., 2024) highlights that educational values of constructivism can be a oriented for teachers to guide students for construction of their knowledge autonomously so that it assist to improve the quality of learning which precisely supports findings of this study. This study is in line with (Barman & Bhattacharya, 2015) forwarded that constructivist teaching method marks

teaching learning process insightful and meaningful to the students consequently they will achieve evident academic performance compared to traditional teaching approach.

Conclusion and Implication

This study showed that the students were attracted towards constructivist method rather than traditional approach. The interactive mode of learning sound far better than the lecture method. The interaction between student-student and teacher-student produced meaningful and insightful learning rather than rote memorization. When students were encouraged for active participation with collaborative and cooperative method then the learning was discerning and evocative. It showed that the result produced on the experimental group was incredible than control group. Those students who were allowed to interact and engage in participation method headed to astonishing academic performance. The students were permitted to share their glitches and thoughts to make learning more interactive. It is complemented that the constructivist method is in favour of students for better performance. Thus, it is very essential to adopt constructivist method for effective teaching and erudition. There must be strong bond among the curriculum designers, parents, teacher, subject expert and concerned ministry while drafting the science curriculum of secondary level. Synchronization, observation, monitoring and regulation must be done regularly accordance as per policy. The teacher teaching in secondary level must adopt student-centered method to engage students in learning and teaching activities effectively according to curriculum. Teachers should be fortified to systematically organize and prepare teaching materials and student friendly lesson plan effective teaching and learning. The provision of the regular science lab visit, field visit, project work, continuous internal assessment system should be implemented appropriately. Students should be stimulated for active participation in classroom activities. They must be encouraged for collaborative work in class.

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