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Tribhuvan University, Sanothimi Campus, Sanothimi, Bhaktapur

Impact of Project Method on Students' Achievement in Science Learning

Pratima Tamrakar, Ph.D. (Principal Author)
Associate Professor, Department of Science Education
Tribhuvan University, Sanothimi Campus, Sanothimi, Bhaktapur
pratima.tamrakar@sac.tu.edu.np
ORCID iD: 0009-0000-8920-7021

Narayan Prasad Timilsna, Ph.D. (Corresponding Author)
Assistant Professor, Tribhuvan University, Central Department of Education
timilsena.narayan@yahoo.com
ORCID iD: 0000-0003-2064-026X

Krishna Maya Devkota (Co-Author)
Assistant Professor, Department of Science Education
Tribhuvan University, Mahendra Ratna Campus, Tahachal
krishna.devkota@mrc.tu.edu.np
ORCID iD: 0000-0001-5989-6954

Abstract

This study carried out to find the impact of project method on student-centered teaching approach in biology at community schools in Nepal. The research used a quasi-experimental design involving experimental and non-experimental groups to compare achievement outcomes. All 9th grade students were population of the study and 50 students were selected as the sample. Quantitative data from pre- and post-tests and qualitative data from classroom observations and interviews reveal that students taught through the JIGSAW method demonstrated higher academic achievement and greater classroom engagement. The project method fosters essential skills such as leadership, communication, collaboration, and critical thinking, promoting a deeper understanding of biology. The findings highlight the need to shift from conventional to student-centered pedagogies to meet the demands of a modern, science-driven society. This research fills a critical gap by providing empirical evidence on the practical application and impact of project-based learning in Nepalese secondary science education.

Keywords**:** *Project-based learning, JIGSAW method, learning, Biology teaching*

Introduction

Education is the natural, harmonious, and progressive development of an individual's innate power and moral character, enabling them to control their environment and fulfill their possibilities (CDC, 2076 BS). In modern educational contexts, traditional teaching methods in Nepal have predominantly been teacher-oriented, where students are expected to be passive receivers of knowledge rather than active participants in the learning process (Pandit, 2070 BS). As an integral part of human society, science education requires systematic observation and practical application to develop critical knowledge and skills necessary for modern living

(English Dictionary, 2016). The project method, a student-centered approach focused on asking meaningful questions, offers a revolutionary alternative to conventional teaching methods by emphasizing "learning by doing," "learning by living," and "learning through association, cooperation, and coordination" (CDC, 2076 BS).

This research specifically examines the effectiveness of the JIGSAW method as a collaborative project-based learning approach in teaching biology in community schools, where the current science curriculum divides learning into 75% theoretical and 25% practical components (CDC, 2072 BS). Despite sufficient evidence supporting the effectiveness of project-based learning in enhancing students' understanding and knowledge application, educators face challenges in providing concrete proof of student learning achievements in an education system that primarily emphasizes traditional assessments (Pandit, 2070 BS).

Implementing project-based learning through the JIGSAW method creates opportunities for students to interact meaningfully with content, develop critical thinking skills, and construct their understanding through active engagement inside and outside the classroom (Mevrill et al., 2004). Unlike the lecture method popular among Nepalese teachers for its ease of implementation, the JIGSAW method fosters the development of essential project skills, including leadership, decision-making, trust-building, conflict management, and effective communication (English Dictionary, 2016). This research employs a comparative methodology involving experimental and non-experimental groups to measure achievement scores and evaluate the impact of the JIGSAW method in biology education at school A (CDC, 2072 BS).

Through structured questionnaires and field observations, this study investigates how project-based learning addresses the limitations of traditional teaching approaches by providing students with real-life experiences and opportunities to solve problems related to natural and scientific phenomena (Mevrill et al., 2004).The findings from this research will contribute valuable insights into how educational practitioners can effectively transition from teacher-centered to student-centered methodologies to enhance learning outcomes and prepare students for the demands of our rapidly evolving, science-driven society (CDC, 2076 BS).

Theoretical Underpinning

This study is grounded in multiple theoretical perspectives that explain how students learn and how teaching methods influence achievement. From the realist learning theory**,** it is understood that the mind operates like any other material entity, with mechanical functioning and without intrinsic reactive ability; its development is seen as a consequence of changes in the material world (Charles & Akilesh, 2016). Educational productivity theory**,** proposed by Walberg, emphasizes that learning outcomes are a function of personal attributes, instructional quality, and environmental influences, integrating findings from thousands of studies to support its validity. Walberg identified nine key factors influencing learning: student ability, motivation, instructional quantity and quality, and supportive environments like home, peers, and classroom climate (Walberg, Fraser & Welch, 1986). These variables were categorized as personal, instructional, and environmental, highlighting the complex interplay of student characteristics and contextual influences on learning outcomes. In addition, the constructivist learning theory posits that learners actively construct knowledge based on their experiences, mental models, and social interactions (Elliot et al., 2000). Constructivism holds that teaching should facilitate experiential learning, promote critical thinking, and emphasize the relevance of learners' prior knowledge.

Furthermore, Vygotsky's social constructivism underscores the role of social interaction, scaffolding, and the Zone of Proximal Development (ZPD) in cognitive development, suggesting

that students can achieve higher learning outcomes through guided support. This research also draws on John Dewey's pragmatism**,** advocating for "learning by doing" and emphasizing hands-on, experiential, and project-based learning to make education meaningful and democratic. These theories provide a comprehensive foundation to explore how instructional methods, personal attributes, and social contexts influence science learning, especially in diverse sociocultural environments.

The project is an activity done by learners to complete a specific learning experience, and it is an integral part of the school curriculum. The project is a method of learning and teaching where the teacher guides the student to visit certain places with the internal to learn. It is different from a tour, where people go for a relationship. Cheeap (2008) also supports that the project method is a way of presentation by taking the students to study outside the class environment. Using the environment as a learning natural resource stimulates the students' creativity, information can be more comprehensive and real-time, and students can seek and process the data by themselves.

Empirical Insight and Research Gap

Empirical evidence suggests that student-centered teaching methods such as inquiry-based, project-based, cooperative, and heuristic learning significantly enhance student participation, self-regulated learning, and academic performance. Studies by Shrestha (1975), Budhathoki (2004), and Ghimire (2016) demonstrate the superiority of these methods over traditional lecture-based instruction in science and mathematics education. Research by Koirala (2019) and Akkus et al. (2007) further indicates that heuristic and inquiry-based approaches lead to deeper conceptual understanding and improved scientific literacy. The role of teachers as facilitators, as emphasized by Monika (2012) and Brandies et al. (2013), supports the development of critical thinking and problem-solving skills in student-centered classrooms. According to Mulyasa (2005), projects and fieldwork connect classroom learning with real-world experiences, fostering students' observational and analytical abilities. However, studies like Prasart (2017) reveal inconsistencies between teacher expectations and actual classroom practices regarding inquiry-based instruction. Despite the broad examination of student-centered strategies, limited research has focused explicitly on the effectiveness of the project method in biology education in the context of Nepal. Current literature does not provide adequate evidence on how the project method impacts students' achievement in secondary-level biology classes. Moreover, contextual factors such as curriculum design, school infrastructure, and teacher preparedness necessary to implement such methods remain underexplored. Therefore, a significant research gap exists in understanding the effectiveness and practical application of the project method in enhancing biology learning outcomes in the Nepalese education system.

Methodology

The research methodology employs a Quan-qual design focused on a quasi-experimental design involving both experimental and non-experimental groups to assess the impact of the JIGSAW method in biology education at School A. Participants include students from 9^{th} grade allowing for a diverse representation of the student body. Using the JIGSAW method, data is collected through structured questionnaires that measure student achievementtest. Additionally, field observations are carried out to provide qualitative insights into the implementation process and student interactions during project activities.

To ensure reliability and validity, the questionnaires are pre-tested and refined based on feedback from educational experts. Descriptive and inferential statistical analyses will be utilized to analyze quantitative data, measuring achievement scores before and after the intervention.

Qualitative information from observations were thematically analyzed to identify common patterns and insights regarding student experiences. The study also involves interviews with teachers to gather information on their instructional practices and challenges in implementing the JIGSAW method. Ethical considerations, including informed consent and confidentiality, are prioritized throughout the research process. Ultimately, the findings intend to provide actionable recommendations for educators looking to enhance student-centered learning in science

Results and Discussion

The analysis process focuses on the impact of the intervention. First, the pre-test results were analyzed to understand the baseline data, followed by a similar analysis of the post-test results to evaluate changes over time. A comparison was made using a bar graph to illustrate the mean achievement scores of both the experimental and non-experimental groups, highlighting any differences in outcomes. Additionally, the pre-test and post-test results were analyzed to determine whether the project method yielded better results than traditional methods. Finally, the T-values for the pre-test and post-test comparisons between the experimental and non-experimental groups were calculated to provide statistical insight into the significance of the observed changes.

Table 1. *Analysis of the achievement scores of the project and the non-experimental group in a pre-test.*

Groups	No. of students	Scores	Mean	S.D.	Variance	Coefficient of variation
Experimental group (group A)	25	373	14.92	4.09	16.79	0.27
Non-experimental group (group B)	25	375	15	4.37	19.12	0.29

From the above result, achievement scores of experimental and non-experimental groups of students were found to be equivalent and homogeneous in the pre-test.

Table 2. *Analysis of the achievement score of a project and the non-experimental group in the post-test*

Groups	No. of students	Scores	Mean	S.D.	Variance	Coefficient of variation
Experimental group(group A)	25	515	20.6	5.38	29.04	0.26
Non-experimental group(group B)	25	425	17	5.03	25.36	0.29

There was some variance in the achievement of the project method and lecture method, whereas these two groups of equivalent groups were from the governmental school. They have children from different ethnical, socioeconomic backgrounds, different learning environment casts, cultures, family environments, different instructional materials, and different academic levels. The project method is an innovation and a student-centered approach. It helps to create self-contained, self-facing, and self-learning instructional material with minimal positive support from the teacher.

Table 3. *T-value of the pre-test result of the experimental and non-experimental groups*

Group	Mea	Standard	varianc	Mean	Calculat	Degree	Level of

	n	deviation	e	difference	e t-value	of freedom	significance
Experimental group (group A)	14.92	4.09	16.79	0.08	0.67	48	0.05
Non-experimental group (group B)	15	4.37	19.12				

The null hypothesis is accepted. Hence, there is no significant difference between the two mean pre-test scores, i.e., the two groups were homogeneous and equivalent.

Table 4. *T-value of the post-test result of the experimental and non-experimental groups*

Group	Mean	Standard deviation	variance	Mean difference	Calculate t-value	Degree of freedom	Level of significance
Experimental group	20.6	5.38	29.04	3.6	2.44	48	0.05
Non-experimental group	17	5.03	25.36				

The null hypothesis is rejected. Hence, there is a significant difference between the two mean scores of the post-test, i.e., the achievement score of the experimental group is greater than that of the non-experimental group.

Table 5. *Achievement number and percentage of students in the pre-test.*

Group	Total no. of students	Achievement no. of students (Above 40%)	Achievement percentage of a student (Above 40%)	Achievement no. of students (below 40%)	Achievement percentage of student (Below 40%)
Project group	25	22	88%	3	12%
Non-experimental group	25	21	84%	4	16%

According to this data, there was a narrow difference in the achievement rate of students in the pre-test of both groups. The Project groups 88% are achievement percentage of student (above the 40%) and 12% are achievement percentage of student (blow the 40%) and non-experimental groups 84% are achievement percentage of student (above the 40%) and 16 percent are achievement percentage of student (blow the 40%).

Table 6. *Achievement number and percentage of students in the post-test.*

Group	Total no. of students	Achievement no. of students	Achievement percentage of the student	Achievement no. of students	Achievement percentage of students

		(Above 40%)	(Above 40%)	(below 40%)	(Below 40%)
Project group	25	24	96%	1	4%
Non-experimental group	25	22	88%	3	12%

According to this data, there was a difference in the achievement rate of students in both groups in the pre-test. The Project groups 96% are achievement percentage of student (above the 40%) and 4% are achievement percentage of student (below the 40%) and non-experimental groups 88% are achievement percentage of student (above the 40%) and 12 percent are achievement percentage of student (below the 40%).

Data Analysis

The qualitative data analysis based on the theme discussed below:

Active Participation of the Students in the Biology Project Work

Students are active participants in the teaching project method. Most participants express their views that student wants to learn, the learning by doing method, but in this era, to promote the lecture method, it is easy to teach. Project teaching methods are learning by doing. In this method, students are active learners, but teachers are passive. This method only focuses on the student-centered method. In this method, the teacher is only a good facilitator, guide, and provides the essential apparatus and equipment for the student's task or learning activities. Student works in a peer group to solve this problem. This method makes student wants to be more curious. The researcher acted as an observer and perceived their entire activities for the whole teaching learning process. There was discussion about confusing subject matter among students and between students and the teacher. All participating students have good discipline and followed the rules and regulations in the project and the classroom. They showed a good attitude toward positive learning, and all participants followed the researcher. Hence, it also indicated that the teaching process of the project group A is more active and effective in their class.

Regularity of the Students in the Classroom

There was no absence of student in their regular classes. It was proven that the project method's effectiveness as a teaching method and teaching learning strategy in the classroom regarding classroom attendance. The techniques and strategies enhance the regularity of students. These indicate students are developing positive thoughts towards their learning activities, which is reflected in their regular attendance. Participants' views suggest that students were excited to perform their task through experiments. Due to the project, teaching and learning activities have constant regularity.

Views of participants on the impacts of the Project Teaching Method

Participants strongly appreciated the student-centered teaching method, highlighting how it fosters engagement and excitement through hands-on activities and experiments. They noted that this approach facilitates active participation and enables students to identify and solve problems collaboratively. Many participants emphasized:

> *The opportunity to conduct experiments and engage in group discussions allows them to discover results independently, enhancing their understanding and retention of knowledge.*

Additionally, they remarked on the development of a scientific attitude and increased self-confidence as significant benefits of this method compared to traditional teaching

approaches. Participants feel this interactive and inquiry-based learning environment significantly contributes to their educational experience.

Discussion of Findings

The study's findings reveal significant insights into the impact of the project method compared to traditional teaching in science education. Both groups demonstrated similar mean scores in the pre-test, indicating a comparable baseline knowledge. However, the post-test results showcased a notable improvement for the experimental group, with a mean score of 20.6 compared to 17 for the traditional group, highlighting the project method's positive impact on student learning. The t-test results further substantiate these outcomes, showing a significant difference in achievements post-intervention. Students engaged in the project method exhibited improved academic performance and increased creativity and scientific skills. The achievement percentages in the post-test reveal that 96% of the experimental group scored above 40%, compared to 88% for the control group, underscoring the method's effectiveness.

Additionally, the greater mean difference from the project method compared to the heuristic method indicates its superior impact on learning outcomes. It suggests active, hands-on approaches foster deeper understanding and retention of scientific concepts. Overall, the findings emphasize incorporating innovative teaching methodologies like project-based learning to enhance student engagement and success in the classroom. The results support a broader adoption of such methods in educational settings to fulfill diverse learning needs.

Conclusion

The findings of this study suggest that the project teaching method significantly enhances student achievement in biology education compared to traditional lecture methods. The notable improvement in post-test scores indicates that engaging students through collaborative and hands-on activities fosters a deeper understanding of the subject matter. This approach promotes academic success and cultivates essential skills such as teamwork and a scientific mindset. Consequently, incorporating project-based learning in science education could be a necessary strategy for enhancing student engagement and performance.

References

Best, J.W. and Kahn. J.V. (2013). A Framework of Research Design: *The Relationship between Dependent and Independent Variables. Proquest. LLC, Ed. D. Dissertation, University of San Francisco.*

Budhathoki, T.B. (2004). A study of the effectiveness of the cooperative teaching method in teaching mathematics at the secondary level. *Unpublished M.Ed. Thesis, Department of Education, Tribhuvan University, Kathmandu.*

CDC. (2072 B.S.). *Science curriculum for school education*. Curriculum Development Centre, Government of Nepal.

CDC. (2076 B.S.). *National curriculum framework*. Curriculum Development Centre, Government of Nepal.

Charles, V., & Akilesh, K. B. (2016). *Managing knowledge in strategic alliances*. Springer.

Cheeap, K. (2008). *Project-based learning and its application in school education*. Bangkok: Asian Academic Press.

Creswell, J.W. (2014). Research Design: Qualitative, Quantitative, and Mixed Methods Approach*. (4th ed.). Thousand Oaks, California: SAGE Publications.*

Dewey, J. (1938). *Experience and education*. Macmillan.

Elliot, S. N., Kratochwill, T. R., Cook, J. L., & Travers, J. F. (2000). *Educational psychology:*

Effective teaching, effective learning (3rd ed.). McGraw-Hill.
English Dictionary. (2016). *Definition of science education and project skills*. Oxford University Press.
Kelly, G. J. (2008). Inquiry, Activity, and Epistemic Practice. In R. Duschl& R. Grandy (Eds.) Teaching Scientific Inquiry*: Recommendations for Research and Implementation (pp. 99-117; 288-291). Rotterdam: Sense Publishers*
Khanal, P. (2073). Educational Research Methodology, *Sunlight Publication, Kirtipur, Kathmandu.*
Khanal, P. (2074), Research Methodology in Education, 1st Edition, Kathmandu*: Sunlight Publication, Kirtipur.*
Koirala S. (2019). Effectiveness of the heuristic teaching method in school science teaching. *Unpublished M.Ed. Thesis, Department of Education.Tribhuvan University.Kathmandu.*
Kothari. (2008). Research methodology: methods and techniques (2nd Ed.). *New Delhi: New age international pvtthari, R. C.*
Mevrill, A., Smith, J., & Johnson, T. (2004). *Collaborative learning and project-based strategies in science education*. New York: Routledge.
Monika, D. (2012). Student Centered Approach*. In D. Monika, Teaching of Science (pp. 117-119). New Delhi, India: PHI Learning Pvt. Ltd.*
Nurnberg & Denae (2009). The effects of using the science Writing Heuristic to increase scientific Literacy, *Proquest. LLC, Ed. D. Dissertation, University of San Francisco*
Pandit, D. R. (2070 B.S.). *Modern trends in science teaching in Nepal*. Kathmandu: Sajha Prakashan.
Shrestha, B.K. (1995). A comparative study of the effectiveness of the discovery and traditional teaching methods. *An unpublished M.Ed. Thesis, Department of Education, Tribhuvan University, Kathmandu.*
Textbook of Grade 10 (2074). *Curriculum Development Centre,* Sanothimi, Bhaktapur.
Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes* (M. Cole, V. John-Steiner, S. Scribner, & E. Souberman, Eds.). Harvard University Press.
Walberg, H. J., Fraser, B. J., & Welch, W. W. (1986). *Educational productivity and science learning: A synthesis of research*. *Educational Leadership*, *43*(5), 7–14.
Wright, G.B. (2011). Student Centered Learning in Higher Education*. International Journal of Teaching and Learning in Higher Education, 23, 92-97.*