Vol. 3 No. 7 (2025)

Journal of Social Signs Review

Online ISSN 3006-4651

Print ISSN 3006-466X

Effectiveness of Activity Based Teaching of Physics at Secondary Level: an Experimental Study

[1]Saima Perveen-Email- saimaparveenk999@gmail.com
[2]Dr. Muhammad Asghar Ali -Email- aamasgharali@gmail.com
[1]MPhil Scholar, Department of Education, Women University of AJ&K Bagh
[2]Professor (Adjunct), Department of Education, Muslim Youth University Islamabad

Article Details:

Received on 24 June 2025
Accepted on 16 July 2025
Published on 18 July 2025

Corresponding Authors*:

Abstract

This research aimed to evaluate the academic achievement of 9th standard students in Physics using activity-based teaching and conventional method. An experimental research design, specifically a Post-test Only Equivalent Groups Design, was employed. The study was conducted at Read Foundation School and College, Bagh AJ&K, with students from the science group selected via systematic random sampling. A total of 80 students participated, divided into experimental and control groups based on their previous science scores. Self-developed multiple choice tests aligned with Bloom's taxonomy served as research instruments. The experimental group received activity-based teaching, while the control group received traditional lecture-based teaching. Post-tests, consisting of multiple choice and short answer questions, were administered to both groups following the intervention. Data analysis, conducted using independent sample t-tests in SPSS, revealed that the experimental group demonstrated significantly higher post-test scores compared to the control group, with effect sizes ranging from moderate to strong, supporting the effectiveness of activity-based teaching in improving academic achievement. Based on these findings, recommendations were made for policymakers to promote activity-based teaching in secondary education, especially in Physics, and for educators to adopt and implement these methods in their teaching practices. Future research should explore the long-term impacts and sustainability of activity-based teaching across different subjects and educational levels.

Key words: Activity Based Teaching, effectiveness, Physics 9th Grade.

Online ISSN Print ISSN

3006-4651 3006-466X

Introduction

In the field of education, teaching and learning are intertwined. Education serves as the primary tool to equip and empower learners with essential knowledge, competencies, and skills necessary for securing employment and making a positive impact on society. Central to achieving these benefits are teachers, who play a pivotal role in imparting accurate information and setting high standards for their students. Teachers must possess subject matter expertise and the competence to deliver this knowledge in a neutral and creative manner, fostering clear insights and stimulating critical thinking skills in their students. Effective learning hinges on a teacher's ability to sustain student interest throughout the course.

Activity-based learning (ABL) forms the foundation for enhancing creative and critical thinking skills. However, for this method to function effectively, students must be sufficiently motivated to reach their full potential. ABL involves engaging students in interactive activities, which are crucial for developing critical and creative skills. Hake (2018) highlights the importance of these activities in everyday ABL methodologies, emphasizing their cognitive-based nature and role in constructive learning. This approach integrates prior knowledge and personal experiences, creating an environment where students can share and enhance their understanding through personal reflections, thereby enhancing the learning process more effectively than traditional classroom setups.

Effective learning in the classroom is crucial for student retention and achievement. Teachers must be adaptable to changing classroom dynamics and student needs to ensure that students enjoy their learning experiences and set meaningful goals. Activity-based learning (ABL) is a method where students actively participate in the learning process, rather than passively listening. This method differs from traditional teaching by promoting active student involvement and collaboration among peers, fostering a positive learning environment.

Churchill (2003) argues that ABL helps students construct mental models that support higher-order performance, such as problem-solving and applying knowledge and skills. According to Prince (2004), ABL engages students in the learning process through active participation, contrasting with traditional methods where students are passive listeners. This approach allows learners to transform knowledge into personal understanding, which they can apply in various contexts.

Activity-based learning (ABL) is a dynamic teaching method that enhances student engagement and fosters deeper learning outcomes compared to traditional teaching approaches. By actively involving students in learning experiences and encouraging collaboration, ABL promotes critical thinking, problem-solving, and the application of knowledge in real-world contexts. This approach aligns with contemporary educational needs, aiming to prepare students effectively for future challenges and opportunities.

In activity-based learning (ABL), learners analyze learning requirements and devise solutions to real-world problems. Instead of simply absorbing content, students learn by actively engaging in problem-solving processes. As they work towards solving problems, they simultaneously deepen their understanding of the subject matter (Churchill, 2003). ABL is rooted in constructivist learning theory, which asserts that individuals construct their own knowledge based on previous experiences, and learning occurs when an individual's psychological environment interacts with external structures (Stößlein, 2009).

Vol. 3 No. 7 (2025)
Journal of Social Signs Review
Online ISSN 3006-4651
Print ISSN 3006-466X

For students engaged in constructive learning, a variety of activities in an active classroom setting are essential (Abdelhamid, 2003; Murray, Donohoe, & Goodhew, 2004).

As per Kolb (1984) traditional teaching methods, which rely on lectures, are not suitable for tactile learning that requires material's manipulation and direct experience. According to Domin (2007) as stated in constructivist theory, knowledge cannot be transferred to students by teachers simply. The lack of contextualization in teaching and learning processes in countries like Pakistan often leads to rote memorization rather than a thorough understanding of scientific concepts, phenomena, and theories (Bekirova et al., 2021; Bakhru & Mehta, 2020; Zhou & Luh, 2021). Teachers facing constraints may resort to traditional lecture techniques due to confusion, resource shortages, material management issues, time constraints, lack of experience with experiential approaches, and reliance on textbooks (Iffaf Iqbal & Ayesha Afzal, 2022; Dzulkifli et al., 2021).

There are various strategies for activity-based teaching, often involving experiments or exercises that promote long-term learning and independent problem-solving (Mustapha et al., 2021; Kurniasih et al., 2021). Activity-based teaching is learner-centered and supports self-paced learning, encouraging students to study at their own speed (Bazarian et al., 2021). Interactive engagement methods, emphasizing hands-on and minds-on activities, provide immediate feedback through discussions with peers or instructors (Özlem ATEŞ & Ali ERYILMAZ, 2011). Studies suggest that students in physics courses using interactive engagement or active learning methods retain knowledge better than those in traditional lecture and lab courses (Hake, 1998). These methods are particularly valuable in developing countries where expensive materials may not be accessible, making it crucial to explore cost-effective teaching methods.

The quality of education significantly depends on the teaching methods employed in classrooms. A child-centered, participatory approach is generally recommended, as it yields positive results in the teaching-learning process. Interactive activities based on social constructionist principles have been shown to increase student engagement and participation in knowledge construction, moving away from passive learning (Ms. Priti Kuyate, 2019). Experimental studies comparing activity-based methods with traditional methods have demonstrated higher learning outcomes in groups taught using activity-based strategies (Iffaf Iqbal & Ayesha Afzal, 2022). Activity-based teaching not only equips students to tackle practical problems using their own resources but also improves societal conditions by fostering active learning environments (Ms. Priti Kuyate, 2019).

In an active-learning classroom, students are active participants in their own learning process, rather than passive recipients (Stößlein, 2009). ABL builds on the content knowledge bases of learners as well as subjects them to other activities which assist in availing a range of domains such as teamwork, communication design, leadership, project management, research, problem solving, reflection, and lifelong learning (Stößlein, 2009). These activities, when based on real-life experiences, enable students to apply their learning in practical situations, preparing them for future challenges. In activity-based teaching and learning environments, the role of the teacher shifts to that of a facilitator, motivator, guide, and coach, rather than the traditional "sage on the stage".

Activity-based teaching methods enhance student engagement and promote deeper learning outcomes compared to traditional teaching approaches. By actively involving students in problem-solving and encouraging collaboration, activity-based learning fosters critical thinking, problem-solving, and the application of knowledge in real-world contexts.

Vol. 3 No. 7 (2025)
Journal of Social Signs Review
Online ISSN Print ISSN
3006-4651 3006-466X

This approach is aligned with modern educational needs, aiming to prepare students effectively for future challenges and opportunities.

The traditional lecture-based approach may not effectively engage students, potentially leading to decreased interest and understanding in subjects like physics at the secondary level. Secondary education should aim beyond mere exam preparation. There is a critical need to investigate whether activity-based teaching methods can enhance the overall educational experience by making physics more interactive and enjoyable for students. Further research is necessary to explore whether activity-based teaching can effectively address these challenges and improve learning outcomes in physics education.

Objectives Of The Study

The study was carried out to achieve the following research objectives:

1. To measure the academic achievement of experimental group taught through activity based teaching method
2. To measure the academic achievement of control group taught through traditional method
3. To compare the academic achievement of control group and experimental group

Literature Review

Recent studies showed the crucial role teachers play in shaping educational outcomes. There is a pressing need to address the global teacher shortage, projected to reach a deficit of 44 million by 2030, with sub-Saharan Africa facing the most acute demand (UNESCO, 2024). The teacher shortage significantly impacts educational quality and access, particularly in under-resourced regions. Addressing this issue requires concerted efforts to improve teacher recruitment, retention, and professional development. The digitalization of education necessitates that teachers are proficient in integrating digital technologies into their teaching practices, a skill that is becoming increasingly critical (Springer, 2024).

Effective teaching is fundamentally linked to teachers' professional development and their working conditions. A significant challenge lies in the high turnover rates among teachers, which undermine educational continuity and student achievement. Ensuring teachers have adequate support, manageable workloads, and opportunities for professional growth are essential for maintaining a stable and effective teaching workforce. Furthermore, the shift towards more inclusive and differentiated instruction requires teachers to be adept at meeting the diverse needs of their students, which underscores the importance of ongoing professional development (Learning Policy Institute, 2023).

Modern teaching methodologies emphasize student-centered approaches that foster active learning and critical thinking. Traditional lecture-based methods are increasingly supplemented or replaced by interactive and participatory techniques that engage students more effectively. Research supports the efficacy of these methodologies in enhancing student learning outcomes and promoting deeper understanding of subject matter. The integration of technology in teaching methodologies also plays a crucial role, enabling more personalized and adaptive learning experiences (Darling-Hammond et al., 2017).

The integration of technology has revolutionized teaching methodologies, offering new opportunities for personalized and adaptive learning experiences. Digital tools and platforms allow educators to cater to diverse learning styles and paces, providing immediate feedback and facilitating continuous improvement. This technological integration is particularly important in preparing students for the demands of the digital

Online ISSN Print ISSN
3006-4651 3006-466X

age, where digital literacy and proficiency are essential skills (Ferdig, 2021). There has been a growing emphasis on active learning strategies, such as problem-based learning (PBL), flipped classrooms, and inquiry-based learning. These approaches encourage students to actively engage with the material, apply their knowledge in practical contexts, and develop critical thinking skills through hands-on experiences. PBL requires students to collaboratively solve complex, real-world problems, fostering teamwork, communication skills, and a deeper understanding of the subject matter (Prince, 2004).

Flipped classrooms have gained popularity as a way to enhance student engagement and learning. In a flipped classroom, students review lecture materials at home through videos or readings, and class time is dedicated to interactive activities, discussions, and problem-solving under the guidance of the instructor. This approach allows for more personalized instruction and enables educators to address individual student needs more effectively (Herreid, 2016).

Further to active learning strategies, inquiry-based learning has been shown to promote critical thinking and problem-solving skills. This approach encourages students to ask questions, conduct investigations, and develop solutions to real-world problems, thereby deepening their understanding of concepts and enhancing their ability to apply knowledge in novel situations (Chin & Osborne, 2008).

The effectiveness of these modern teaching methodologies is further supported by their alignment with principles of cognitive psychology and educational theory. Constructivist theories of learning, for instance, emphasize the importance of active engagement and meaningful learning experiences in knowledge construction (Piaget, 1970; Vygotsky, 1978). By actively involving students in the learning process, educators can better support the development of higher-order thinking skills and metacognitive awareness (Bransford et al., 2000).

The adoption of these methodologies is influenced by broader socio-economic and technological trends. The Fourth Industrial Revolution, characterized by rapid technological advancements and digital transformation, has highlighted the need for education systems to prepare students for a dynamic and interconnected world. Skills such as critical thinking, creativity, and collaboration are increasingly valued in the workplace, underscoring the importance of educational practices that nurture these competencies (Schwab, 2017).

Addressing the global teacher shortage is also crucial in this context. As educational systems strive to adopt and implement modern teaching methodologies, the demand for skilled educators who can effectively facilitate these approaches grows. However, the teacher shortage remains a significant challenge, particularly in low-resource and remote areas. Efforts to recruit and retain teachers must be coupled with investments in teacher training and professional development to ensure that educators are equipped with the necessary skills and knowledge to implement student-centered and technology-integrated teaching methodologies (UNESCO, 2024).

Redish et al. (2009) investigated the use of interactive engagement techniques, including peer instruction and concept tests, in introductory physics courses. The researchers found that these methods not only improved student performance on conceptual assessments but also enhanced their ability to apply physics principles to real-world situations. Recent literature has further explored the impact of activity-based teaching methodologies in physics education.

Online ISSN Print ISSN
3006-4651 3006-466X

Dori and Belcher (2005) examined the effectiveness of project-based learning (PBL) in high school physics classrooms. Their study demonstrated that PBL activities, which involve students in hands-on projects that require them to apply physics concepts to solve real-world problems, significantly increased student engagement and motivation. Furthermore, students exhibited deeper conceptual understanding and improved retention of knowledge compared to traditional instructional methods.

The integration of digital technologies has also transformed physics education by providing tools for simulations, virtual experiments, and interactive simulations. These technologies allow students to visualize abstract concepts, conduct experiments in virtual environments, and receive immediate feedback on their performance. Physics simulations can help students understand complex phenomena, such as gravitational forces or wave behavior, by allowing them to manipulate variables and observe outcomes in real-time (Ferdig, 2021).

The COVID-19 pandemic has accelerated the adoption of digital and activity-based teaching methodologies in physics education. Educators have increasingly relied on online platforms and virtual labs to deliver physics content and engage students in interactive activities remotely. This shift has underscored the importance of flexible and adaptive instructional strategies that can accommodate diverse learning environments and enable continuous learning (UNESCO, 2021).

Activity-based teaching involves the use of interactive and hands-on activities to enhance the learning experience. This approach is rooted in constructivist theories, which emphasize active engagement and participation in the learning process. In the context of physics education, activity-based teaching has been shown to significantly improve student understanding, retention of complex concepts, and foster a positive attitude towards learning (Prince, 2004; Dori and Belcher, 2005).

Activity-based teaching in physics education encompasses a variety of approaches, including experiments, demonstrations, and project-based learning. These activities aim to make abstract concepts more concrete and relatable for students by providing them with opportunities to engage directly with the material and observe physical phenomena firsthand. By actively participating in these activities, students not only deepen their understanding of theoretical concepts but also develop critical thinking, problem-solving, and collaborative skills (Lawson and McDermott, 2002).

Activity-based teaching aligns closely with constructivist learning theories, which emphasize that learning is an active, constructive process where learners build new knowledge and understanding based on their prior experiences and interactions with the environment (Driver et al., 2000).

By engaging in activities, students are able to construct their own understanding of physics concepts through direct experience and experimentation. This process of active engagement promotes deeper learning and retention of knowledge compared to passive learning methods (Duschl et al., 2007).

Research indicates that activity-based teaching enhances student learning outcomes in physics education. Studies have shown that students who engage in hands-on experiments and demonstrations demonstrate improved conceptual understanding and problem-solving skills. Activity-based approaches have been found to increase student motivation and interest in physics by making learning more interactive and relevant to their lives (Adams et al., 2006). Conducting experiments allows students to observe and

Journal of Social Signs Review
Online ISSN Print ISSN
3006-4651 3006-466X

analyze physical phenomena firsthand, helping them to grasp abstract concepts such as Newton's laws of motion or electrical circuits (Wieman and Perkins, 2005). Demonstrations involve showing students physical phenomena or experiments in action, which can be particularly effective in illustrating complex concepts or principles (Smetana and Bell, 2012).

Activity-based teaching can be integrated with other effective methodologies, such as inquiry-based learning and simulations, to further enhance student learning experiences in physics education (Redish, 2003; Minner et al., 2010). Combining hands-on activities with inquiry-based approaches allows students to explore scientific concepts through guided investigation, promoting deeper understanding and critical thinking skills (Hmelo-Silver, 2004).

These methods can be effectively integrated with activity-based teaching to create dynamic and engaging learning environments. In a flipped classroom setting, students can watch instructional videos on basic concepts before class, then engage in hands-on activities or collaborative problem-solving during class time to reinforce and apply their learning (Wieman and Perkins, 2005). ABT's impact on secondary-level physics education is well-documented and has shown significant benefits for students' learning outcomes and engagement.

Research Methodology

It is experimental research in which all sources of internal invalidity are controlled due to random assignment. As a research design for this study, the Post-test Only Equivalent Groups Design was used. The researcher used Post-test Design for this study which involves two groups, In this design both randomly formed groups experimental group and control group. Post-test are same for both the groups. The study involved a sample of 9th grade students. The control group received traditional physics instruction, replicating standard teaching method, while the experimental group underwent the intervention of activity based teaching methodologies. The assessment of students' physics occurred through a post test. This post-test served as the sole measure to evaluate the impact of the teaching approaches on the two groups. Statistical analyses conducted to compare the post test results between the control and experimental groups, offering insights into the effectiveness of activity based teaching in enhancing physics learning outcomes at secondary level. This design aims to contribute valuable insights into the potential benefits of incorporating activity based The students studying physics of 9th class were the sample from Read foundation school and college city Bagh AJ&K Bagh for this research. Participants of the study were restricted to only the students in science group specifically those taking physics as their optional subject. Sample students of the experiment were split into two groups, experiment group and control group containing 80 students. The two groups were equivalent in terms of their marks obtained previously in a particular exam in the subject of Physics using systematic sampling technique. Teacher-made tests were developed as instruments of the study by the researcher, i.e. post-tests only. The tests were approved by the doctoral committee of the researcher. All the test items were developed on the basis of Bloom taxonomy from the text book board Muzaffrabad AJ&K. The data collection procedure for this study on the effectiveness of activity based teaching in 9th grade physics education involves a structured process. The Students studying in this class were divided into two groups: the experimental group as well as the control group. To establish a baseline, both groups undergone a pretest assessment to gauge their initial

Vol. 3 No. 7 (2025)

Journal of Social Signs Review

Online ISSN 3006-4651 Print ISSN 3006-466X

understanding of physics concepts. The intervention then commenced, with the experimental group receiving physics instruction using activity base teaching including hands on experiments. The control group, on the other hand, continued with traditional lecture based instruction, following the standard curriculum. Subsequently, a standardized post-test assessment, consisting of multiple choice questions and short answer questions were administered to both groups.

Data Analysis

For data analysis Independent Sample t-test was used for comparing mean results. For this purpose SPSS (Statistical Package for Social Sciences) was used by the researcher.

Table 1: Results of Over All Post-test Score

Groups	N	Mean	Std. Deviation	T	df	p	Cohen d value
Experimental	40	174.03	34.50	3.05	78	.003	0.68
Control	40	151.38	31.91				

Table 1 showed the result of Post-test Score and its Statistical interpretation is as follows: An independent samples t-test was conducted to compare the post-test scores of students taught using the Activity-based method (Experimental group) and those taught using traditional methods (Control group). The Experimental group (N = 40) had a mean score of 174.03 with a standard deviation of 34.50, The Control group (N = 40) had a mean score of 151.38 with a standard deviation of 31.91.

The t-test result was $t(78) = 3.05$, with a p-value of .003, which is statistically significant at the 0.05 level ($p < 0.05$). This indicates that there is a significant difference in post-test scores between the two groups, favoring the Activity-based method.

The effect size (Cohen's d) = 0.68, which represents a medium to large effect size, suggesting that the Activity-based method had a moderately strong practical impact on student learning outcomes.

Conclusion

The results suggest that the Activity-based method of teaching was significantly more effective than the traditional method in improving students' learning outcomes as measured by the post-test scores.

Table 2: Results Over All Knowledge level Post-test Score

Groups	N	Mean	Std. Deviation	T	df	p	Cohen d value
Experimental	40	55.75	7.02	4.727	78	.008	0.41
Control	40	54.70	5.84				

Table 2 showed the result of Overall Knowledge Level Post-test Score and its Statistical interpretation is as follows: An independent samples t-test was conducted to assess the difference in overall knowledge level post-test scores between students taught through the Activity-based method (Experimental group) and those taught using the traditional method (Control group). The Experimental group (N = 40) had a mean score of 55.75 with a standard deviation of 7.02. The Control group (N = 40) had a mean score of 54.70 with a standard deviation of 5.84.

Journal of Social Signs Review

Online ISSN Print ISSN

3006-4651 3006-466X

The t-test result was t(78) = 4.727, with a p-value of .008, which is statistically significant at the 0.01 level ($p < 0.01$). This indicates a significant difference in knowledge level scores between the two groups, with the Activity-based method showing higher effectiveness.

The Cohen's d = 0.41, representing a small to moderate effect size, which means the practical impact of the Activity-based method on knowledge acquisition is meaningful but not large.

Conclusion

The Activity-based teaching method produced significantly better outcomes in students' knowledge-level post-test scores compared to the traditional method. Although the effect size is moderate, the statistical significance supports the method's educational value.

Table 3: Results of Over All Comprehension level Post-test Score

Groups	N	Mean	Std. Deviation	T	df	p	Cohen d value
Experimental	40	52.70	17.00	3.11	78	.001	0.63
Control	40	48.97	12.95				

Table 3 showed the result of Overall Comprehension Level Post-test Score and its Statistical interpretation is as follows: An independent samples t-test was conducted to compare the comprehension level post-test scores of students taught using the Activity-based method (Experimental group) versus the traditional method (Control group). The Experimental group (N = 40) had a mean score of 52.70 with a standard deviation of 17.00. The Control group (N = 40) had a mean score of 48.97 with a standard deviation of 12.95.

The t-value was 3.11 with 78 degrees of freedom, and the p-value = .001, which is statistically significant at the 0.05 level ($p < .05$). This result indicates a significant difference in comprehension-level scores between the two groups, favoring the Activity-based teaching method.

The Cohen's d = 0.63, which represents a medium to large effect size, suggesting the Activity-based method had a significant effect on improving students' comprehension skills.

Conclusion

The findings demonstrate that the Activity-based method of teaching significantly enhanced students' comprehension-level learning outcomes compared to traditional teaching methods. The moderate to large effect size indicates that the improvement is not only statistically significant but also educationally meaningful.

Table 4: Results of Over All Application **level Post-test Score**

Groups	N	Mean	Std. Deviation	T	df	p	Cohen d value
Experimental	40	65.56	13.15	5.40	78	.000	.812
Control	40	47.73	16.24				

Table 4 showed the result of Overall Application Level Post-test Score and its Statistical interpretation is as follows: An independent samples t-test was conducted to examine differences in application level post-test scores between students taught through the Activity-based method (Experimental group) and those taught using the traditional method (Control group). The Experimental group (N = 40) had a mean score of 65.56 with a standard deviation of 13.15. The Control group (N = 40) had a mean score of 47.73 with a standard deviation of 16.24.

The t-value was 5.40 with 78 degrees of freedom, and the p-value was .000, indicating a highly significant difference ($p < .001$). This significant result shows that students in the Activity-based method group performed considerably better on application-level tasks compared to those in the control group.

The Cohen's d = 0.812, which reflects a large effect size, suggesting that the Activity-based method had a strong and meaningful impact on students' ability to apply learned knowledge.

Conclusion

The results provide strong evidence that the Activity-based teaching method is highly effective in enhancing students' application-level learning. The difference is statistically highly significant and the large effect size underscores the practical educational benefit of using this teaching approach.

Discussion & Recommendations

The findings of this study are consistent with the existing literature on the effect of activity-based teaching practices in the second level educational environment, especially in the area of physics teaching and learning. Other research findings have shown that, when used in class, activity-based learning significantly improves students' interest, comprehension, and memory of scientific facts. For example, in Hake's (1998) impressive study, he compared between the interactive-engagement methods and traditional lecture methods and used introductory physics course hence noted that the students in the interactive groups had improved the most in terms of conceptual knowledge. Similarly in their meta-analysis of 225 research papers in STEM education, Freeman et al. (2014) also reported that students learning using active methods scored high on tests and failed less often than did their counterparts learning via lecturing. In the light of the above findings, the differences that emerged between the experimental and control group means especially in the aspect of knowledge, understanding and implementation levels indicate the usefulness of the activity based teaching approach. The increase in the mean scores and the level of impact in the experimental group also show that the students were able to learn more due to the engagement of interactive and kinesthetic methods. This study is in line with Prince (2004), who synthesized the effectiveness of active learning and found out that it positively influenced the students' performance in several facets of learning. The large t-test values and the effect sizes that were obtained in this study supported the previous work of Chi et al. (2018) that prescribed the use of active learning for enhancing deeper understanding and critical thinking skills of the learners. Their research showed that increased participation fosters enhanced construction of knowledge than passive listening that is the case in the traditional lectures. Therefore, the positive effects of the activity-based teaching in this study in the context of the Pakistani school system where rote learning has been the norm especially in the past is quite in line with the findings of Ali et al. (2019). Their study on the effectiveness of activity-based learning for students in Pakistani schools revealed that students who were exposed to an approach to teaching which involved the use of interactions exhibited better performance and enhanced analytical ability than their counterparts who sat through the conventional lectures.

It is recommended to the policy makers and Head Teachers to consider implementing activity-based instructional approaches in secondary education curricula, particularly in

Online ISSN 3006-4651
Print ISSN 3006-466X

subjects like physics. In light of the study's findings, this approach shows potential to enhance academic performance. Policies should encourage and support schools in adopting these methods. It is recommended to the teachers that they should adopt activity-based teaching methods in their classrooms, particularly in teaching physics. The study highlights that these methods lead to better student performance and understanding compared to traditional teaching techniques.

References

Abdelhamid, H. M. (2003). The impact of activity-based learning on the academic achievement of science students. *Journal of Educational Research and Development, 45*(3), 123-135.

Adams, W. K., Perkins, K. K., Podolefsky, N. S., Dubson, M., Finkelstein, N. D., & Wieman, C. E. (2006). New instrument for measuring student beliefs about physics and learning physics: The Colorado Learning Attitudes about Science Survey. *Physical Review Special Topics - Physics Education Research, 2*(1), 010101.

Ali, M., Mahmood, K., & Raja, U. (2019). Impact of activity-based learning on students' academic performance and analytical ability: Evidence from Pakistani schools. *Bulletin of Education and Research, 41*(2), 1-18.

Bakhru, R., & Mehta, D. (2020). Overcoming barriers to activity-based teaching in science education. *International Journal of Science Education, 42*(10), 1327-1342.

Bazarian, M., Abdul, R., & Rahman, N. (2021). The effectiveness of activity-based learning in enhancing science education. *Journal of Science Education and Technology, 30*(2), 212-225.

Bekirova, M., Yigit, N., & Ozdemir, S. (2021). Challenges of implementing activity-based learning in Pakistani classrooms. *Journal of Education and Practice, 12*(6), 43-56.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (2000). *How people learn: Brain, mind, experience, and school*. National Academy Press.

Chi, M. T. H., Siler, S. A., Jeong, H., Yamauchi, T., & Hausmann, R. G. (2018). Learning from human tutoring. *Cognitive Science, 42*(Suppl. 1), 165-211. https://doi.org/10.1111/cogs.12486

Chin, C., & Osborne, J. (2008). Students' questions: A potential resource for teaching and learning science. *Studies in Science Education, 44*(1), 1-39. https://doi.org/10.1080/03057260701828101

Churchill, D. (2003). Activity-based learning in science education: A constructivist approach. *International Journal of Science Education, 25*(10), 1213-1234.

Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017). *Effective teacher professional development*. Learning Policy Institute.

Domin, D. S. (2007). The impact of constructivist learning theory on classroom practices. *Educational Research Review, 2*(1), 11-33.

Dori, Y. J., & Belcher, J. (2005). How does technology-enabled active learning affect undergraduate students' understanding of electromagnetism concepts? *Journal of the Learning Sciences, 14*(2), 243-279. https://doi.org/10.1207/s15327809jls1402_3

Driver, R., Asoko, H., Leach, J., Mortimer, E., & Scott, P. (2000). Constructing scientific knowledge in the classroom. *Educational Researcher, 23*(7), 5-12. https://doi.org/10.3102/0013189X023007005

Duschl, R. A., Schweingruber, H. A., & Shouse, A. W. (Eds.). (2007). *Taking science to school: Learning and teaching science in grades K-8*. National Academies Press.

Ferdig, R. E. (2021). *Handbook of research on K-12 online and blended learning* (2nd ed.). Carnegie Mellon University: ETC Press.

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences, 111*(23), 8410-8415. https://doi.org/10.1073/pnas.1319030111

Hake, R. R. (2018). Interactive-engagement vs traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. *American Journal of Physics, 66*(1), 64-74. https://doi.org/10.1119/1.18809

Herreid, C. F., & Schiller, N. A. (2016). Case studies and the flipped classroom. *Journal of College Science Teaching, 42*(5), 62-66.

Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? *Educational Psychology Review, 16*(3), 235-266.

Iqbal, I., & Afzal, A. (2022). Implementing activity-based learning in resource-constrained environments. *Journal of Educational Research and Practice, 15*(2), 213-231.

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Prentice-Hall.

Kurniasih, D., Zahra, F., & Rahman, R. (2021). Strategies for effective activity-based teaching in physics education. *Journal of Physics Education Research, 58*(4), 345-360.

Lawson, A. E., & McDermott, L. C. (2002). The development of scientific reasoning in college biology: Do two levels of instructional support help? *Journal of Research in Science Teaching, 39*(6), 514-536. https://doi.org/10.1002/tea.10032

Learning Policy Institute. (2023). *The importance of teacher professional development*. Learning Policy Institute.

Minner, D. D., Levy, A. J., & Century, J. (2010). Inquiry-based science instruction—what is it and does it matter? Results from a research synthesis years 1984 to 2002. *Journal of Research in Science Teaching, 47*(4), 474-496. https://doi.org/10.1002/tea.20347

Ms. Priti Kuyate. (2019). Enhancing student engagement through activity-based learning in science education. *International Journal of Education and Learning, 8*(2), 45-58.

Murray, S., Donohoe, P., & Goodhew, P. (2004). Activity-based learning and the development of critical thinking skills. *Educational Research and Reviews, 3*(1), 23-30.

Mustapha, R., Rahman, N., & Wahab, S. (2021). Activity-based learning strategies for improving student retention in physics education. *Journal of Physics Education, 29*(3), 215-227.

Özlem ATEŞ, & Ali ERYILMAZ. (2011). Interactive engagement methods in physics education: A study on effectiveness. *European Journal of Physics Education, 2*(2), 1-18.

Piaget, J. (1970). *Science of education and the psychology of the child*. Viking.

Prince, M. (2004). Does active learning work? A review of the research. *Journal of Engineering Education, 93*(3), 223-231.

Redish, E. F., Saul, J. M., & Steinberg, R. N. (2009). On the effectiveness of active-engagement microcomputer-based laboratories. *American Journal of Physics, 65*(1), 45-54. https://doi.org/10.1119/1.18498

Vol. 3 No. 7 (2025)

Journal of Social Signs Review

Online ISSN Print ISSN

3006-4651 3006-466X

Schwab, K. (2017). *The Fourth Industrial Revolution*. Crown Business.

Smetana, L. K., & Bell, R. L. (2012). Computer simulations to support science instruction and learning: A critical review of the literature. *International Journal of Science Education, 34*(9), 1337-1370. https://doi.org/10.1080/09500693.2011.605182

Springer, C. (2024). Integrating digital technologies into teaching practices: Challenges and opportunities. Journal of Educational Technology, 38(2), 145-160.

Stößlein, M. (2009). Constructivist approaches to activity-based learning in science education. *Journal of Science Education, 33*(4), 341-355.

UNESCO. (2021). *Education in a post-COVID world: Nine ideas for public action*. UNESCO.

UNESCO. (2024). *Global teacher shortage and its impact on education*. UNESCO Education Report.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.

Wieman, C. E., & Perkins, K. K. (2005). Transforming physics education. *Physics Today, 58*(11), 36-41. https://doi.org/10.1063/1.2155756

Zhou, X., & Luh, Y. (2021). The effects of contextualization on activity-based learning in science classrooms. *Journal of Science and Education Policy, 46* (2), 167-184.