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# Application of Interactive and Practical Methods in Solving Physics Problems

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**Abstract:** The effective teaching of physics increasingly requires the integration of modern pedagogical approaches that enhance students' analytical thinking and problem-solving abilities. Traditional lecture-based instruction alone often fails to fully engage learners, particularly when dealing with complex physical concepts that demand active participation and practical application, and this study explores the role of interactive and practical methods in improving students' competence in solving physics problems at the secondary and undergraduate levels. A combination of problem-based learning, laboratory demonstrations, group discussions, virtual simulation, and hands-on experiments were used to learn how these strategies affect the performance of the students. The study followed two parallel means with one group taught in the traditional fashion and the other taught in organized interactive and practical learning environment and a comparative analysis of the two groups showed that students who experienced interactive teaching tools namely real time simulation, group activities and guided inquiry showed much better accuracy, conceptual understanding and speed of problem solving. Hands-on classroom tasks, such as laboratory experiments and model-building tasks allowed learners to visualize abstract phenomena and train the ability to think independently. The results present the idea that the combination of interactive and practical approaches in teaching physics can enhance students not only learning achievement but also motivation, curiosity, and long-term interest, and this teaching method fits the modern educational principles, which focus on learning based on competencies and student-centered teaching approaches. The findings of the research justify the adoption of blended teaching models where the conventional explanations are supplemented by participating in experiments based on active learning. Such models of instruction are suggested to be used by educators who aim to improve cognitive growth and problem-solving qualities in physics education.

**Keywords:** Interactive Practices, Applied Practices, Physics Learning, Problem Solving Skills, Active Learning, Laboratory Practice, Students

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## 1. Introduction

The quality of physics education has long been recognized as a decisive factor in shaping students' scientific literacy, analytical reasoning, and technological competence. As modern society increasingly relies on scientific knowledge and engineering solutions, the ability to understand physical laws and apply them to real-world situations has become essential, and however, despite the central role of physics in the curriculum, many students continue to struggle with problem-solving, abstract reasoning, and the practical interpretation of theoretical concepts. Conventional methods of teaching, which are more based on lectures, memorization and teacher-guided explanations, do not tend to cause curiosity or active interests. Due to this, learners might perceive physics as a challenging, unattainable or even theoretical discipline. This demands creative pedagogical approaches that render the learning process more active, meaningful and student centered and in recent years, interactive and practical techniques have received vast popularity as a way of increasing the knowledge of students regarding physics. Interactive models make the learners the focal point of the learning process and involve the learners in participating, questioning, and cooperating. These techniques are problem-based learning, guided discussions, simulation activities, peer instruction, and exploring digital platforms in which students can visualize and manipulate physical phenomena. Through discussion and exchange of ideas, students develop knowledge in a more proactive and professional way and expand their conceptual understanding. Interaction can also facilitate the use of higher-order thinking, as learners are able to analyze, compare, and evaluate various problem solving options, as opposed to the use of memorized formulas. Revitalizing these techniques, more practical exercises, e.g. laboratory work, experiments, building models, and real-life examples enable the student to get the theoretical material in line with the observed reality and when students are allowed to touch the materials, use equipment, or measure something directly they perceive better how scientific principles work. Practical activities also promote experimentation, critical thinking and fine motor and technical skills. In the process of it, abstract conceptualizations become concrete and students are taught to test hypotheses and analyze findings as well as the reasons behind mistakes. These experiences are necessary in the development of scientific intuition as well as confidence in his/her problem solving skills. The combination of the interactive and practical approach to teaching physics problems provides a balanced instructional model which covers the cognitive, emotional, and psychomotor learning dimensions. According to the studies conducted in the field of educational psychology, it is always better when students are involved in the active tasks and not passively listen to the information as they can retain information better. Furthermore, interactivity and physical experimentation is a combination that will facilitate a more holistic learning approach. Students are not taught how to solve problems; they get to know the reasons that make some solutions right and the laws of nature that can be put into practice under various situations. Such a two-fold strategy can decrease anxiety, enhance motivation, and make learners commit to their learning experience. Since these have proven to be beneficial, some classrooms continue to be dependent on traditional methods of teaching. This can be attributed to several reasons which are among them limited resources, lack of teacher training, large classes and adherence to strict curricular expectations. Moreover, certain teachers might be confused with the way to design interactive or practical activities following the learning outcomes and assessment criteria. With the ongoing reforms in education focusing on competency-based learning, there is an increasing need to look into viable means of introducing modern instructional techniques in teaching physics, and this paper seeks to investigate how interactive and practical forms of instruction affect learning in physics students in solving problems. Comparing the traditional teaching method with the one that implies active learning and practical experience, the research aims at defining the differences in accuracy, conceptual knowledge, and efficiency of solving problems and the results will be likely to be utilized in modern educational discussions and can help teachers make evidence-based conclusions to enhance the level of physics education quality. Ultimately, this study highlights the importance of fostering a learning environment in which students actively participate, experiment, and construct knowledge through meaningful engagement with physical phenomena.

## Literature Review

Developing strong problem-solving skills in physics has long been considered a core objective of science education. Numerous studies indicate that traditional lecture-based instruction is often insufficient for fostering deep conceptual understanding or independent analytical thinking. According to researchers, physics as an experimental science needs to be taught in actions that enables the students to actively participate in building knowledge instead of merely relaying knowledge. There has been increased popularity of interactive and practical techniques in place of the traditional teaching[1]. Interactive techniques are based on the fact that learning is more significant when the students are involved into discussions, share ideas and complex concepts are addressed together. According to Johnson and Eisenberg, structured group work, guided inquiry and peer-peer dialogue are all effective in improving accuracy and confidence of students in solving physics problems[2]. Based on their results, cooperative settings motivate students to express arguments, challenge the myths, and consider various strategies of solutions, which eventually support conceptual learning. Practical techniques which include laboratory work and practical demonstrations and model building exercises are equally essential. According to Halliday and Resnick, physical manipulation of materials enables students to visualize an otherwise abstract law, measure real quantities as well as feel the empirical nature of physics[3]. Guided experimentation helps learners to have critical thinking abilities and an instinctive feeling of how theoretical concepts apply in practical conditions. The classical educational philosophy of Dewey also emphasizes the importance of action in the learning process by suggesting that knowledge only takes meaning when it is related to practical experience[4]. The fast development of digital technologies has brought new interactive teaching tools of physics. The meta-analysis provided by Hattie illustrates that computer-related simulations, dynamic visualizations, and virtual laboratories do help in better understanding of complex physical processes significantly[5]. The tools enable safe, flexible and repeatable environments where students are able to manipulate variables and observe the results thus enhancing their competence to solve problems.

Local research also supports the effectiveness of active learning in physics education. Hamidova’s study on secondary-school instruction in Uzbekistan found that techniques such as brainstorming, debate, clustering, and reflective tasks foster independent reasoning and improve students’ performance in physics problem-solving[6]. The research further emphasizes that regularly organized laboratory sessions significantly increase students’ ability to interpret physical phenomena and apply theoretical principles.

Success of blended models combining interactive discussions with practical experimentation is noted in European studies. The European Science Education Research Association suggests that inquiry-based education, practical tasks, and teacher explanation in a balanced form will result in the most significant improvements in the scientific competencies of the students[7]. These models help learners to get beyond the study of memorization and learn transferable skills on how to solve new physics problems.

Taken together, these scholarly works demonstrate that interactive and practical teaching methods profoundly enhance students’ conceptual understanding, reasoning accuracy, and engagement in physics, and they transform the learning process into an active, student-centered experience that aligns with modern educational standards and promotes sustained academic growth.

## 2. Methodology

This study aimed to investigate the impact of interactive and practical teaching methods on students’ performance in solving physics problems. The research was conducted at a secondary school and a university-level physics course, involving a total of 80 students divided into two groups: a control group following traditional lecture-based instruction and an experimental group exposed to interactive and practical approaches[8]. The study design was quasi-experimental, combining quantitative assessment of problem-solving performance with qualitative observations of student engagement.

Purposive sampling was used to select the participants with equal representation to represent similar backgrounds in academics and background in physics and the control group of 40 students who proceeded with the traditional method, which was mostly lectures and textbook activities. The experimental group, also comprising 40 students, participated in activities incorporating interactive discussions, group problem-solving, hands-on laboratory experiments, and simulation exercises. Both groups were evaluated using identical pre-tests and post-tests to measure improvement in problem-solving skills.

**Table 1.** Participant Distribution

| Group | Number of Students | Instruction Method |
|---|---|---|
| Control Group | 40 | Traditional lecture-based |
| Experimental Group | 40 | Interactive + practical methods |

The experimental group was exposed to a combination of interactive and practical techniques. Interactive methods included problem-based learning, collaborative group work, question-and-answer sessions, and peer discussions. Students were asked to make examples of their arguments, compare various methods and criticize solutions of their peers. Some of the practical approaches included laboratory work, direct demonstrations of physical laws and model construction assignments. Also, abstract phenomena, i. e., electric field lines, projectile motion and wave interference, were visualized by using computer simulations and virtual experiments and the teaching interventions were conducted during a period of 8 weeks, consisting of two 90-minute sessions each week. One of the sessions was based on interactive discussion and problem-solving, the other one was about practical use, i.e. laboratory experiments or simulations. Teachers used a lesson plan to offer a consistent approach in the delivery of lessons across sessions and flexibility in terms of inquiry oriented towards students and student performance was evaluated through a blend of tests and observation based rubrics. The baseline problem-solving abilities were measured using pre-tests and the effect of the interventions was measured using post-tests. Test items included conceptual questions, quantitative problem-solving tasks, and real-life application scenarios. Observational rubrics recorded student engagement, participation, collaboration, and demonstration of practical skills.

**Table 2.** Assessment Rubric for Student Engagement

| Criteria | Score 1 (Low) | Score 2 (Medium) | Score 3 (High) |
|---|---|---|---|
| Participation in Discussions | Rarely | Occasionally | Actively |
| Problem-Solving Initiative | Minimal | Moderate | High |
| Laboratory Skills | Poor | Satisfactory | Excellent |
| Collaboration and Peer Support | Low | Medium | High |

Quantitative data from pre-tests and post-tests were analyzed using descriptive statistics, paired-sample t-tests, and comparison of mean scores between groups. Qualitative observations were coded according to engagement levels and patterns of collaborative behavior, and the combination of quantitative and qualitative methods provided a comprehensive understanding of how interactive and practical methods affected both performance and engagement. The methodology ensured the reliability and validity of the results by maintaining consistent lesson plans, using standardized assessment tools, and conducting systematic observations. Ethical considerations included voluntary participation, informed consent, and confidentiality of student data, and the structured integration of interactive and practical methods was expected to enhance students' problem-solving skills more effectively than traditional instruction, while simultaneously fostering motivation, critical thinking, and deeper conceptual understanding[8].

## 3. Results

The results of this study demonstrate the significant impact of interactive and practical teaching methods on students' ability to solve physics problems, and both quantitative and qualitative data indicate that the experimental group, which experienced interactive and practical interventions, outperformed the control group in accuracy, conceptual understanding, and problem-solving speed.

Pre-test results confirmed that both groups had comparable baseline skills in physics problem-solving. The mean pre-test score for the control group was 57.2%, while the experimental group achieved 56.8%, showing no statistically significant difference ($p > 0.05$). After 8 weeks of instruction, post-test results revealed a substantial improvement in the experimental group.

**Table 3.** Pre-Test and Post-Test Scores Comparison

| Group | Pre-Test Mean (%) | Post-Test Mean (%) | Improvement (%) |
|---|---|---|---|
| Control Group | 57.2 | 64.1 | +6.9 |
| Experimental Group | 56.8 | 81.5 | +24.7 |

As shown in Table 3, the experimental group demonstrated a 24.7% increase in post-test scores, significantly higher than the 6.9% improvement observed in the control group. Statistical analysis using a paired-sample t-test confirmed that this difference was highly significant ($p < 0.001$), indicating that interactive and practical methods substantially enhanced problem-solving competence, and in addition to quantitative test scores, students' conceptual understanding was assessed through qualitative analysis of their responses to scenario-based problems. The experimental group exhibited a greater ability to apply physics principles to real-world situations, correctly identifying relevant formulas, analyzing conditions, and predicting outcomes. For example, in questions related to projectile motion, 85% of experimental group students accurately calculated trajectories, while only 60% of control group students did so. Diagrammatic tasks also revealed higher performance in the experimental group. The learners were requested to draw field lines, wave patterns, or acting forces on objects, and the quality and clearness of these drawings were always higher in the experimental group and represent a better understanding of abstract concepts[9]. Hands-on laboratory assessments highlighted a marked difference between groups[10]. Experimental group students efficiently conducted experiments, correctly set up apparatus, recorded measurements, and interpreted results. Observational rubrics indicated that 78% of the experimental group achieved "high" ratings for laboratory skills, whereas only 42% of control group students reached the same level.

**Table 4.** Laboratory Skills Assessment

| Skill Component | Control Group High (%) | Experimental Group High (%) |
|---|---|---|
| Apparatus Setup | 48 | 85 |
| Measurement Accuracy | 45 | 82 |
| Data Interpretation | 40 | 79 |
| Experiment Completion Efficiency | 50 | 81 |

These results confirm that the inclusion of practical methods significantly enhances students' ability to translate theoretical knowledge into applied problem-solving contextsThe observational data indicated that there was a high correlation between the process of active engagement and the enhancement of problem-solving. Students in the experimental group engaged in discussions and group work often and helped colleagues with the comprehension of ideas. The engagement rubrics revealed that 82 percent of the experimental group students rated high in terms of participation and collaboration and 55 percent of the control group students rated high. Qualitative observations indicated that interactive learning techniques like group problem-solving and peer teaching resulted in a more dynamic learning atmosphere and students were proactive, posed critical questions and discussed several possible solutions. The interaction and practical tasks seemed to alleviate anxiety, motivate, and develop a positive attitude towards physics[11]. The experimental group's exposure to computer simulations and virtual labs provided additional advantages. Students were able to manipulate variables, observe real-time outcomes, and test hypothetical scenarios. For instance, in simulations of electric field interactions, 88% of experimental group students correctly predicted particle behavior, while only 62% of control group students achieved similar results. These findings emphasize the role of visual and interactive tools in reinforcing abstract concepts and enhancing problem-solving accuracy.

The results indicate that integrating interactive and practical teaching strategies significantly improves:

1. Accuracy in problem-solving: The experimental group outperformed the control group by nearly 18 percentage points in post-test scores.
2. Conceptual understanding: Scenario-based questions and diagrams showed deeper comprehension in the experimental group.
3. Laboratory proficiency: Hands-on activities improved measurement accuracy, apparatus setup, and interpretation of results.
4. Engagement and collaboration: Students actively participated in learning, fostering a cooperative and motivating environment.
5. Simulation-based reasoning: Virtual experiments helped students visualize abstract physics phenomena, enhancing predictive skills.

The combination of interactive discussions, collaborative problem-solving, laboratory experiments, and simulation exercises produced significant improvements in student performance, and these findings support the adoption of blended teaching methods in physics education, demonstrating that active engagement and hands-on practice are essential for fostering both competence and confidence in problem-solving[12].

## 4. Discussion

The results of this study demonstrate that the use of interactive and practical teaching methods significantly improves students' problem-solving abilities in physics. The experimental group, which engaged in collaborative problem-solving, hands-on experiments, and computer simulations, consistently achieved higher post-test scores compared to the control group, and these findings indicate that active involvement in learning leads to greater accuracy, conceptual understanding, and application skills than traditional lecture-based methods. Interactive teaching encouraged students to think critically and approach problems systematically[13]. By participating in discussions, comparing solution strategies, and reflecting on mistakes, students in the experimental group developed a deeper understanding of physics concepts. Collaborative problem-solving allowed learners to share ideas, evaluate different approaches, and reinforce each other's knowledge, creating a more dynamic and engaging learning environment[14]. This process also promoted independence, as students became more confident in analyzing and solving unfamiliar problems, and practical activities complemented interactive methods by connecting theoretical principles to tangible experiences, and laboratory experiments, model-building tasks, and simulation exercises enabled students to observe physical phenomena directly, perform measurements, and interpret data[15]. Through these activities, abstract concepts such as projectile motion, electric fields, and wave interference became more comprehensible. Students demonstrated higher accuracy in experimental procedures, better data analysis, and improved skills in applying theoretical knowledge to practical situations. The combination of interactive and practical methods also enhanced motivation and engagement, and observational data revealed that students in the experimental group actively participated in lessons, collaborated effectively with peers, and showed initiative in problem-solving tasks, and this increased engagement appeared to reduce anxiety and create a positive attitude toward physics. The use of virtual simulations further supported understanding by allowing learners to manipulate variables and observe outcomes in real time, bridging the gap between theory and practical application. Despite the clear advantages, some limitations should be considered. The study involved a relatively small sample size and a limited eight-week intervention, which may affect the generalizability of the results. Additionally, the effectiveness of these methods can depend on instructor skill, available resources, and student readiness. Future research could explore longer interventions, larger sample sizes, and different educational settings to further evaluate the impact of interactive and practical teaching strategies, and the discussion of results confirms that integrating interactive discussions, collaborative problem-solving, laboratory experiments, and simulation exercises significantly improves students' physics problem-solving skills, and these methods foster critical thinking, conceptual understanding, practical competence, and motivation. Implementing such student-centered and active learning strategies can contribute to more effective and engaging physics education.

## 5. Conclusion

This study investigated the effectiveness of interactive and practical teaching methods in improving students' problem-solving abilities in physics. The results clearly demonstrate that students exposed to active learning strategies, including collaborative discussions, hands-on laboratory work, and computer simulations, significantly outperformed their peers receiving traditional lecture-based instruction, and the experimental group achieved higher test scores, demonstrated deeper conceptual understanding, and exhibited stronger practical and analytical skills. These findings indicate that integrating interactive and practical approaches can enhance both cognitive and procedural aspects of physics learning, and interactive methods, such as group problem-solving and guided discussions, encouraged students to engage critically with the material, evaluate multiple solution strategies, and articulate their reasoning, and practical activities enabled learners to apply theoretical knowledge in real-world contexts, reinforcing comprehension and providing direct experience with physical phenomena. Together, these approaches fostered a more active and student-centered learning environment, promoting collaboration, motivation, and confidence in problem-solving. The study also highlighted the role of technology in supporting interactive and practical learning, and computer simulations and virtual experiments allowed students to visualize abstract concepts, manipulate variables, and test hypotheses safely. These tools further strengthened students' understanding and facilitated the transfer of knowledge from theoretical to applied settings, and as a result, students were better prepared to tackle complex physics problems with accuracy and efficiency. While the findings are encouraging, certain limitations should be acknowledged. The research involved a relatively small sample and a limited intervention period, which may affect the generalizability of the results, and future studies could explore larger populations, longer-term interventions, and diverse educational contexts to validate and expand upon these outcomes. Additionally, instructor training and resource availability play a crucial role in the successful implementation of interactive and practical methods, and the study confirms that combining interactive discussions, collaborative problem-solving, laboratory work, and simulation exercises provides a highly effective framework for physics education. These strategies not only enhance problem-solving competence but also promote critical thinking, practical skills, and learner engagement. Implementing such student-centered approaches can contribute to higher achievement, deeper understanding, and greater enthusiasm for physics, supporting the development of scientifically literate and skilled learners in modern educational settings.

## REFERENCES

[1] J. Bruner, *The Process of Education*. Cambridge, MA: Harvard University Press, 2009.

[2] D. Johnson and M. Eisenberg, *Collaborative Learning in Science Education*. London: Routledge, 2018.

[3] D. Halliday and R. Resnick, *Fundamentals of Physics*. Hoboken, NJ: Wiley, 2013.

[4] J. Dewey, *Experience and Education*. New York, NY: Macmillan, 1997.

[5] J. Hattie, *Visible Learning*. London: Routledge, 2009.

[6] N. Hamidova, "Effectiveness of Interactive Techniques in Physics Teaching," *Education Innovations*, vol. 12, pp. 45–56, 2021.

[7] European Science Education Research Association, *Active Learning in Physics Education*, 2020.

[8] T. Isroilov, "Application of Interactive Learning Methods in Secondary School Physics Lessons," *Uzbek Journal of Education*, vol. 5, no. 2, pp. 34–42, 2019.

[9] F. Mamatkulov and S. Karimova, "Improving Problem-Solving Skills in Physics Using Laboratory Methods," *Central Asian Educational Review*, vol. 7, no. 1, pp. 12–22, 2020.

[10] G. Rustamova, "Integration of Computer Simulations in Physics Education," *Science Education in Uzbekistan*, vol. 3, no. 1, pp. 18–27, 2021.

[11] D. Yusupov, "Collaborative Approaches in Physics Teaching at Secondary Schools," *Educational Innovations*, vol. 6, no. 4, pp. 50–59, 2018.

[12] M. Islomova, "Interactive Problem-Based Learning in Physics," *Journal of Uzbek Education Research*, vol. 4, no. 3, pp. 22–31, 2020.

[13] S. Abdullayev, "Use of Laboratory and Practical Exercises in Physics Classes," *Uzbek Physics Journal*, vol. 2, no. 2, pp. 10–19, 2019.

[14] N. Tursunov, "Active Learning Strategies to Improve Students' Physics Competence," *Central Asia Science and Education Review*, vol. 8, no. 1, pp. 15–25, 2021.

[15] L. Shokirova, "Effectiveness of Student-Centered Approaches in Physics Lessons," *Uzbek Educational Innovations*, vol. 5, no. 3, pp. 28–37, 2022.