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Research Article

METHODOLOGY FOR IDENTIFYING STUDENTS' RESEARCH SKILLS THROUGH THE ORGANIZATION AND CONDUCT OF CLUB ACTIVITIES RELATED TO THE "MECHANICS" SECTION OF PHYSICS

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ABSTRACT

This article explores the methodology for identifying and developing students' research skills through the organization and conduct of club activities focused on the "Mechanics" section of physics. The study emphasizes the importance of integrating theoretical knowledge with practical activities to foster students' investigative abilities. The principle of gradual progression from simple to complex tasks is applied to ensure consistent skill development. Additionally, the article highlights the role of hands-on problem-solving, laboratory experiments, and the use of physics equipment in enhancing the educational process. The research demonstrates that students' participation in structured extracurricular activities promotes not only academic growth but also contributes to their ability to apply scientific knowledge to real-world problems.

KEYWORDS

Research skills, methodology, club activities, mechanics, physics education, laboratory experiments, problem-solving, extracurricular learning, skill development, scientific inquiry.

INTRODUCTION

Extracurricular Activities as a Part of General Education

Extracurricular activities are an essential part of educational and developmental work in schools and a form of organizing students' leisure time meaningfully. These activities provide ample opportunities to develop well-rounded individuals and prepare students for life. Extracurricular clubs include a system of various activities aimed at educating and imparting

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knowledge to students. These activities are conducted outside school hours by teaching staff, class teachers, youth organizations, and student self-governance bodies. Such clubs offer the most opportunities for developing students' research skills.

Schools implement various types of extracurricular clubs. Special attention is given to organizing these activities and fostering students' research abilities.

1. Supporting Continuous Research Skills

Extracurricular clubs provide opportunities for continuously supporting students' research abilities. Interest in topics and the initiative to explore them further arise naturally from students' capabilities. Creating such opportunities during regular lessons would require additional time.

2. Time Beyond Regular Lessons

Activities such as preparing technical objects for laboratory work and assembling them require more time than is available during regular lessons, necessitating extracurricular sessions.

3. Access to Resources and Expertise

Conducting research activities also requires access to equipment, tools, and expert advice, which are best provided in these settings.

4. Creating a Productive Research Environment

A productive research environment that encourages teamwork and effective collaboration is essential. Such an environment can be optimally created within extracurricular clubs through carefully organized activities.

Challenges in Extracurricular Research Activities

Teachers must address several challenges during students' research activities, including the need to sustain students' interest in the club. Participation in these clubs is voluntary and continues throughout the year. Regularly analyzing the composition of the club and holding discussions with teachers confirms that students' interest in research increases over time and reaches its peak during the activities.

When a teacher selects or develops topics aligned with the school curriculum and criteria for developing research skills, the sessions become more effective. For example, during physics club sessions, the teacher guides students toward key concepts, omitting less significant details and providing brief information or solutions, directing students' attention to the essential aspects of the phenomenon or process under study.

The effectiveness of a methodology aimed at developing students' research skills depends on the students' engagement and the success of their research activities. The success of research cycles, in turn, depends on the degree to which students acquire the necessary knowledge to solve the given tasks. Additionally, success is determined by the conditions necessary for quickly implementing the project. Both factors depend on how well the club's program is designed to ensure successful future sessions.

Physics Club "Young Researcher Physicists"

The topics covered in the "Young Researcher Physicists" club must be related exclusively to physics. The closer the topics are to the curriculum and the fewer additional explanations required, the easier it is for the physics teacher to manage the activities.

Therefore, the club leader must choose engaging topics for students that present a series of challenges within the field of physics. These challenges, both theoretical and practical, form the foundation of students' research activities. Other tasks serve merely to complete the research cycle. The process should be as efficient as possible to ensure students quickly

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achieve practical results and feel satisfied with their success.

Planning the Activities of the "Young Researcher Physicists" Club

It is advisable to plan the activities of the "Young Researcher Physicists" club to ensure engaging sessions for students.

Below is a sample plan for organizing the activities of the club (Table 1).

Table 1

Activity Plan for the Club

T/p	Form and Location of Activities	Content of Activities	Duration of Activities	Participants and Facilitators
1				
2				

Effectiveness of Club Activities

The effectiveness of a club largely depends on how well the plan is structured. The club must have its own journal or logbook. Members should also maintain individual diaries. The teacher records students' interests, methods of conducting activities, students' independence, and challenging questions in the logbook. A list of relevant literature is also included.

The program of the "Young Researcher Physicists" club is designed for students in grades 7-10. The uniqueness of the club lies in preparing students to understand school subjects, apply their knowledge in practice, and connect it with science, technology, and engineering.

The "Young Researcher Physicists" club is one of the key elements in a general education school structure. It helps foster and support students' interest in specific activities, broadening and deepening the skills and competencies they acquire in class. The club creates conditions for personal development and serves as a source of motivation for students, providing emotional satisfaction and promoting interdisciplinary connections. It also develops qualities such as perseverance, aesthetic sense, and research abilities.

Developing students' research skills in physics is one of the primary tasks for physics teachers in modern schools. Experimental research and assignments are essential tools in developing these abilities. Students' ability to solve problems depends mainly on their preparation and understanding of the subject matter. Solving non-standard problems and conducting interesting experiments stimulate and strengthen students' interest in physics.

The club activities progress from simple to complex stages, allowing for the correct selection of teaching methods and allocation of time for theoretical and practical tasks.

The club leader, together with the members, develops the club's charter. The charter typically includes the following sections:

a) Objectives and tasks of the club,

b) Content and methods of the club activities,

c) Leadership and membership structure,

d) Rights, obligations, and duties of the members.

At the end of the academic year, a report on the club's activities is presented, which typically includes:

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a) A yearly report by the active members of the club,

b) Recognition of the best participants,

c) Selection of new active members for the next academic year.

Innovation in the Program

The uniqueness of this educational program lies in the development of learning and research skills through various activities, including didactic games based on interactive teaching technologies.

The program is designed for one academic year, with a total of 17 hours allocated for its implementation.

Program Objectives

- To form a holistic understanding of the world based on acquired knowledge, skills, and methods of practical activities.
- To gain experience in both individual and collaborative research activities.
- To prepare students for the conscious choice of future careers.

Program Tasks

1. Educational:

a) Encourage self-development among members when studying physics topics,

b) Develop and support students' interest in learning physics as a science,

c) Introduce students to the latest achievements in science, technology, and engineering,

d) Teach students to solve problems using non-standard methods,

e) Increase students' activity in conducting experiments and using information technologies for research.

2. Character-Building:

a) Cultivate confidence in students' abilities, knowledge of natural laws, and the rational use of scientific achievements,

b) Foster respect for people and the environment,

c) Develop an appreciation for physics as an element of human culture,

d) Improve students' communication and behavior skills.

3. Developmental:

a) Enhance students' knowledge, skills, and competencies and teach them to work independently with scientific literature,

b) Develop practical skills in applying physics knowledge in everyday life,

c) Foster students' research abilities.

Forms of Club Activities (Figure 1):

Different formats for conducting club activities include:

- Practical and experimental sessions
- Group discussions and problem-solving activities
- Project work and presentations
- Competitions and quizzes
- Guest lectures and field trips

These diverse forms ensure that students remain engaged while developing both their theoretical and practical skills in physics.

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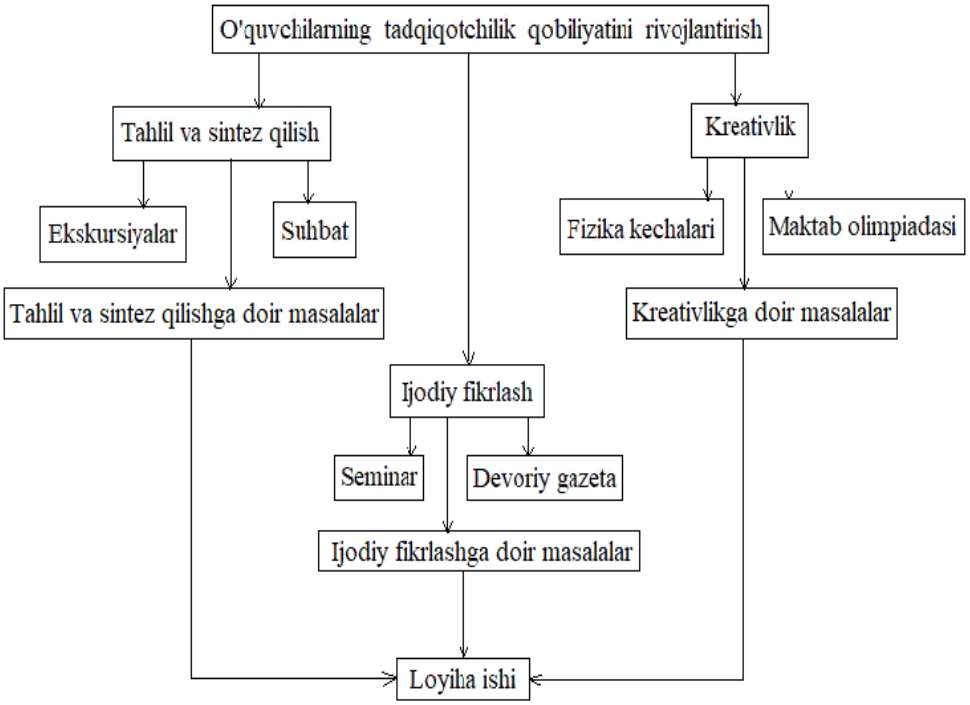

Figure 1. Components of Developing Students' Research Skills and Their Elements

It is not always possible to demonstrate every object, phenomenon, process, or event related to the studied topic during the lesson. Therefore, excursions are organized based on the subject being studied. In essence, excursions are considered an auxiliary form of education. An excursion plan includes the topic and purpose, the object of the excursion, the order of acquaintance with the object, the organization of students' perception activities, the tools and equipment required to complete tasks, and the conclusion process.

The method of conducting an excursion depends on the topic, didactic objectives, the students' age and level of development, and the nature of the excursion object. During the excursion, principles such as visualization and the connection between theory and practice are implemented. Students' cognitive and research activities, as well as their sense of community and patriotism, develop during the excursion. Additionally, excursions contribute to students' aesthetic education. The success of an excursion largely depends on the teacher's preparation.

The preparation phase includes:

a) Selecting the location and observing it in advance,

b) Assessing students' prior knowledge and concepts related to the topic,

c) Planning the excursion and defining its objectives.

To improve the learning process or verify the accuracy of scientific assumptions, the discussion method is used. This method fosters independent thinking in students. During discussions, students express their thoughts, debate their ideas, and prepare to articulate their views verbally. This process ensures that students develop a clear and focused thought process.

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During discussions, students may feel the need to express their opinions and justify their correctness. They learn to support their viewpoints with physical concepts, rules, laws, and formulas, developing the skill of providing examples and finding evidence.

The discussion method is usually employed both in individual and group formats with teachers and students. Before applying this method, a purposeful plan is created, implementation paths are determined, and the outcomes are analyzed to draw relevant conclusions.

Physics Nights

Physics nights are one of the most labor-intensive yet effective extracurricular events in schools. They aim to deepen and expand students' knowledge of various branches of physics. These events require the participation of many students, who prepare demonstration experiments, produce wall newspapers, decorate the event venue, and welcome guests. Preparing for the event helps foster teamwork among students.

Like all events, physics nights require careful planning and precise organization. The theme, stages, sequence, duration, venue decoration, demonstration experiments, selection of equipment and models, and wall newspaper production must all be well-planned and prepared.

Physics nights can be dedicated to various topics, such as:

- Specific sections or topics from the physics curriculum
- Achievements in science, technology, and engineering
- Significant dates (e.g., Radio Day, Cosmonautics Day)
- The lives and contributions of prominent local and international physicists
- Results of club activities
- Fun and interesting aspects of physics

Physics nights dedicated to specific topics in physics serve as a tool for deepening students' knowledge.

School Olympiads

School-level Olympiads play a crucial role in selecting talented students for regional stages and preparing them for both national and international competitions. The goal is to identify students' potential and prepare them for prestigious national and regional Olympiads.

It is recommended that school physics Olympiads be organized in three formats:

1. Written work – To assess students' theoretical knowledge.
2. Laboratory work – To evaluate practical and experimental skills.
3. Tests – To measure overall comprehension and problem-solving abilities.

This structure ensures a comprehensive evaluation of students' capabilities, providing a foundation for further participation in higher-level competitions.

Written Work

In written tasks, five problems are selected based on the students' grade level and the curriculum. The complexity of the problems varies.

Laboratory Wor

Laboratory work aims to determine the extent to which students can apply their theoretical knowledge about physical phenomena and processes in practice. It also fosters students' research abilities.

Test Questions

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Test questions cover the content of the curriculum, helping students develop skills to analyze the knowledge they have acquired in each topic.

Seminar

A seminar is one of the main forms of organizing the learning process, where students engage in group discussions on theoretical topics under the teacher's supervision.

During seminars, teachers conduct Q&A sessions with students. The teacher interacts with students individually, asking targeted questions rather than addressing the whole group. If a student gives an unclear or incomplete answer, the teacher helps clarify or supplement the response.

The purpose of the seminar is to deepen the theoretical concepts introduced during lessons, evaluate and reinforce students' knowledge, and develop their ability to work with literature. It also aims to enhance students' engagement, encourage independent thinking, and promote their research abilities.

Wall Newspaper Design

One of the educational activities in the club is designing wall newspapers. These newspapers can cover various topics, and teachers may assign them at any point during the club's sessions. Students create their own newspaper pages based on sample templates, contributing their ideas.

The wall newspaper allows students to express themselves creatively and report on events. It can be tailored to any subject. One advantage of the wall newspaper project is that it enables students to convey their ideas rather than just display artistic skills. Teachers can adapt the task to students' needs by allowing either manual or digital creation.

Since there are numerous wall newspaper templates available, students and teachers can easily find the resources they need to design the newspaper from scratch.

Project Work

When working on projects, students must prepare thoroughly, following a clear plan and purpose. Project work involves a systematic approach aimed at achieving specific goals. It requires more effort and independent work compared to routine assignments. Students gather information through literature, the internet, and empirical data, which they then analyze for their project.

The project culminates in a written report, which includes:

- The project topic
- The project's objectives
- Equipment and resources used
- Project development
- Analysis and findings
- Conclusions

Each group prepares a presentation based on their project work and delivers a report on their findings.

The content, objectives, and tasks of the research activities are geared towards achieving clear outcomes. The research activities (conducted in club sessions) must align with the theoretical knowledge, practical sessions, and laboratory work covered in the academic curriculum.

Research Method

The research method is one of the key approaches used to develop students' research skills. This method encourages inquiry by setting practical, knowledge-based problems that require independent and creative

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solutions. Through the use of the research method, students engage in creative activities, applying previously acquired knowledge and skills to new situations. They learn to identify relationships between phenomena and laws and develop the ability to find optimal solutions to problems.

Table 2

Work Plan for the "Young Researcher Physicists" Club for Grade 7 Students (2022-2023 Academic Year)

T/p	Йиллик иш режа мавзулари	hour	Form of Implementation	Date	Implementation
1.	**General Information about Mechanical Motion Linear Motion**	2	theoretical		
2.	• Solving Problems	2	theoretical		
3.	**Uniformly Accelerated Motion**	2	Practical		
4.	Speed, Acceleration, and Distance Covered	2	theoretical		
5.	Solving Problems	2	Practical		
6.	"Determining the Acceleration of an Object in Uniformly Accelerated Motion" (Laboratory Work-1)	2	Practical		
7.	**Uniform Circular Motion**	2	theoretical		
8.	Laws of Motion	2	theoretical		
9.	Solving Problems	2	Practical		
10.	**Motion of Objects under the Influence of External Forces**	2	theoretical		
11.	Solving Problems	2	Practical		
12.	**Laws of Conservation of Momentum**	2	theoretical		
13.	Solving Problems	2	Practical		

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14.	**Work and Energy**	2	theoretical		
15.	Laws of Conservation of Energy	2	theoretical		
16.	Solving Problems	2	Practical		
17.	"Determining the Energy Lost during the Impact of a Ball on the Floor" (Laboratory Work-2)	2	Practical		

In the learning process, students develop research skills through studying theoretical knowledge, practical exercises, and laboratory work. During a club activity designed for 7th-grade students, they carry out the recommended laboratory work based on the knowledge they have acquired, utilizing their own ideas, imagination, and thinking. The aim is to determine the level of development of their research abilities. In this process, the teacher introduces students to concepts related to energy, kinetic and potential energy, and elasticity.

Table 3

Work Plan of the "Young Researcher Physicists" Club

Designed for 10th-grade students for the 2022-2023 Academic Year

T/p	Annual Work Plan Topics	Hour	Date	Implementation
1.	Research Methods in Physics	2	Theoretical	
2.	Types of Mechanical Motion	2	Theoretical	
3.	Research Methods in Physics	2	Practical	
4.	Types of Mechanical Motion	2	Theoretical	
5.	Solving Problems	2	Practical	
6.	Non-uniform Circular Motion. Angular Acceleration. Tangential Acceleration	2	Theoretical	
7.	Solving Problems	2	Practical	
8.	Laws of Dynamics. Motion in a Gravitational Field	2	Theoretical	

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9.	Solving Problems	2	Practical	
10.	Energy and Work. Law of Conservation of Energy. Work Done by an Object Moving along an Inclined Plane	2	Practical	
11.	Solving Problems	2	Practical	
12.	"Determining the Efficiency (E.F.F.) of a Device for Lifting an Object along an Inclined Plane" (Laboratory Work-1)	2	Theoretical	
13.	Determining the Efficiency of a Pulley System (Laboratory Work-2)	2	Practical	
14.	Conditions for the Equilibrium of Objects. Mechanisms Based on the Law of Moments	2	Theoretical	
15.	Solving Problems	2	Practical	
16.	Dynamics of Rotational Motion. Harmonic Oscillations	2	Practical	
17.	Solving Problems	2	Practical	

In the learning process, students develop research skills by studying theoretical knowledge, participating in practical exercises, and conducting laboratory work. During the club activities provided for 10th-grade students, they apply their research abilities by implementing tasks based on their ideas, imagination, and reasoning.

The principle of progressing from simple to complex was followed to foster students' research abilities. Finding reliable solutions to tasks, verifying their correctness, constructing equipment, and using laboratory tools effectively are essential objectives for ensuring efficiency in physics education.

From the above, it can be concluded that the development of students' research skills through club activities, like activities in any other subject, yields concrete results. For instance, a student might successfully solve a problem related to a research project prepared in the club, improving a specific item or device used in household or laboratory activities. This undoubtedly leads to the application of the results of the research tasks performed during the club activities in real-world production processes.

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