

Systematic Organization of Extracurricular Research and Club Activities in Teaching the Section "Diversity of Living Organisms"

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Abstract: Extracurricular activities and subject-specific science clubs serve as vital pedagogical catalysts for bridging theoretical knowledge and practical research application in secondary biology education. This study investigates the systematic organization of extracurricular research and club activities specifically designed for the topic "Diversity of Living Organisms." Using a structured 3-phase extracurricular framework (Preparatory-Field Work, Digital & Laboratory Analysis, Synthesis & Reporting), a pedagogical experiment was conducted with 68 secondary school students (N=68) divided into Experimental (n=34) and Control (n=34) groups. Quantitative analysis using Student's t-test revealed a statistically significant ($p < 0.001$) increase in students' research competencies, species identification skills, and ecological analytical abilities in the experimental group. The study demonstrates that integrating field ecology, local biodiversity monitoring, and digital specimen archiving into biology club structures substantially enhances long-term conceptual retention and scientific inquiry skills.

Keywords: Biology Education, Extracurricular Research, Science Club, Diversity of Living Organisms, Research Competence, Field Zoology, Ecological Education.

Introduction:

The modern educational paradigm in secondary biology education demands a fundamental transition from traditional, teacher-centered instructional methods—often limited to passive memorization of factual biological data—toward student-centered, research-based learning models [1: 15; 2: 34]. In secondary school biology curricula, the section "Diversity of Living Organisms" occupies a crucial position, serving as the foundational baseline for students' understanding of biodiversity, ecological interdependence, evolutionary adaptations, and systemic taxonomy [3: 42].

However, pedagogical reality demonstrates that

standard academic schedules and classroom constraints frequently limit effective learning. A typical 45-minute lesson framework is largely insufficient for facilitating deep inquiry-based learning, conducting extended field observations, or guiding complex laboratory experiments [4: 112]. Consequently, biodiversity education often degrades into abstract classification exercises, where students memorize scientific taxonomy without grasping the dynamic ecological roles, morphological adaptations, or practical conservation significance of the organisms studied [5: 88].

Extracurricular activities and specialized school

biology clubs offer an optimal pedagogical solution to this limitation [6: 204]. Unbound by the rigid time structures of standard classroom periods, school science clubs provide an open-ended, experiential learning environment where students can engage in authentic scientific inquiry. When structured systematically, extracurricular biology programs enable middle school students to:

- Transition from passive consumers of biological information to active scientific investigators;
- Apply classroom theoretical concepts directly to local ecosystem monitoring and field biological sampling [7: 51];
- Develop essential scientific inquiry skills, including problem formulation, scientific hypothesis generation, variable control, microscopic and field logging, statistical processing, and academic reporting [8: 14; 9: 102].

While the general value of extracurricular science activities is widely acknowledged in pedagogical literature, there remains a distinct lack of structured, empirically validated models specifically designed for middle school biodiversity education. Existing extracurricular programs often lack systematic integration between field monitoring, digital archiving, and formal academic project defense.

The primary objective of this research is to design, implement, and evaluate a systematic 3-phase modular model for extracurricular research and science club activities focused on the "Diversity of Living Organisms" section, quantifying its impact on 7th-grade students' taxonomic identification skills, field/laboratory research proficiency, and scientific analytical competence.

METHODOLOGY

The proposed extracurricular system is structured into a 3-Phase Modular Model executed over 12 weeks (2 academic hours weekly):

- Phase I: Preparatory & Field Observation: Identification of local flora/fauna, field sampling methods, field logging, and species mapping.

- Phase II: Digital & Laboratory Analysis: Microscopic investigation of collected specimens, digital archiving, and species classification using interactive determination keys (iNaturalist, PlantNet).

- Phase III: Synthesis & Project Defense: Mini-research paper development, ecological poster presentations, and scientific conference defense within the school science circle.

The pedagogical experiment was conducted at Specialized Secondary School No. 35 in Nukus over a 12-week period. A sample of 68 7th-grade students was selected:

- Experimental Group (EG, n=34): Participated in the structured extracurricular research club program (2 hours weekly).
- Control Group (CG, n=34): Followed standard biology lessons without specialized extracurricular research integration.

Students' scientific inquiry skills were measured across three core criteria using a 100-point rubric:

1. Taxonomic & Morphological Identification (TMI): Ability to correctly classify organisms and describe structural adaptations.
2. Field & Laboratory Inquiry (EFI): Proficiency in using field tools, microscopes, and systematic data logging.
3. Analytical & Reporting Competence (ARC): Capability to analyze data, formulate conclusions, and present scientific findings.

Statistical analysis was conducted using Student's t-test, arithmetic means, and standard deviations.

RESULTS

Pre-Test Analysis. Prior to the experiment, baseline diagnostics showed no statistically significant difference between the two groups ($p > 0.05$):

TMI: CG = 58.4 ± 7.2 ; EG = 57.9 ± 7.5 ($t = 0.28$, $p > 0.05$).

EFI: CG = 52.1 ± 8.1 ; EG = 51.8 ± 8.4 ($t = 0.15$, $p > 0.05$).

ARC: CG = 49.3 ± 9.0 ; EG = 50.1 ± 8.8 ($t = 0.37$, $p > 0.05$).

Table 1. Comparative Analysis of Student Research Competencies (Pre- vs. Post-Test)

Competency Criterion	Group	Pre-Test Mean (X1 ± SD)	Post-Test Mean (X2 ± SD)	Mean Difference (Δ)	t-value	p-value
Taxonomic Identification (TMI)	CG (n=34)	58.4 ± 7.2	64.1 ± 6.8	+5.7	3.58	< 0.01
	EG (n=34)	57.9 ± 7.5	86.3 ± 5.4	+28.4	18.21	< 0.001
Field & Lab Inquiry (EFI)	CG (n=34)	52.1 ± 8.1	59.2 ± 7.4	+7.1	3.76	< 0.01
	EG (n=34)	51.8 ± 8.4	89.1 ± 4.9	+37.3	22.35	< 0.001
Analytical Reporting (ARC)	CG (n=34)	49.3 ± 9.0	56.8 ± 8.2	+7.5	3.59	< 0.01
	EG (n=34)	50.1 ± 8.8	82.5 ± 6.1	+32.4	17.63	< 0.001

All calculated t-values for the Experimental Group exceeded the critical threshold ($t_{crit} = 3.46$ at $\alpha = 0.001$, $df = 66$). Furthermore, the percentage of EG students achieving high-level research competency increased from 8.8% to 76.5%, whereas low-level performance dropped from 47.1% to 0%.

DISCUSSION

The empirical findings underscore that classroom time alone is insufficient for developing higher-order cognitive and practical skills in biological science. Systematic extracurricular club work removes temporal constraints, fostering experiential and contextual learning. Field sampling of local fauna and flora coupled with digital specimen archiving

substantially enhanced long-term conceptual retention and digital literacy among EG students.

CONCLUSION AND RECOMMENDATIONS

The systematic 3-phase extracurricular research model significantly elevates middle school students' mastery of the topic "Diversity of Living Organisms."

1. Empirical data proves that extracurricular science clubs increase students' practical research skills by +37.3% and taxonomic identification abilities by +28.4% compared to standard classroom instruction.

2. Biology educators are advised to structure school science circles around project-based

field monitoring, digital specimen databases, and structured student scientific defense sessions.

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