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STUDYING ANIMAL TAXONOMY THROUGH SYSTEM-ACTIVITY PROJECTS (7th GRADE)

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ABSTRACT

This article presents a feasible methodology for teaching animal taxonomy in grade 7 through a system-activity approach that integrates project-based inquiry, field observation, and representational work with dichotomous keys and simple phylogenetic trees. The design addresses common difficulties in classification—memorization without mechanism, confusion between morphological traits and ecological roles, and weak transfer to unfamiliar organisms—by organizing learning around purposeful activity with authentic specimens and datasets. Over three weeks, students conduct a local biodiversity mini-survey, construct and iteratively refine trait matrices, design and test identification keys, and justify taxonomic decisions with evidence and reasoning. A quasi-experimental evaluation with pre/post concept inventory, performance rubrics, and written explanations indicates substantial gains in identifying diagnostic characters, distinguishing convergent similarities from taxonomically informative homologies, and applying keys to novel cases. Classroom discourse shifts from naming to explaining, and learners demonstrate improved argumentation grounded in observable traits and simple evolutionary ideas. The study concludes that system-activity projects provide coherence, motivation, and durable understanding while remaining implementable in ordinary school conditions.

KEYWORDS: Animal taxonomy; system-activity approach; project-based learning; dichotomous keys; phylogenetic thinking; middle school biology; formative assessment.

INTRODUCTION

Animal taxonomy offers a powerful context for cultivating scientific practices, yet it is often taught as lists of phyla and classes detached from evidence. Learners routinely overgeneralize from familiar vertebrates, classify by habitat or diet rather than by diagnostic traits, and treat categories as fixed rather than as hypotheses supported by characters. A system-activity approach reframes taxonomy as coordinated activity within a system of tools, representations, and norms. Students engage in the authentic problems of observing, recording, comparing, and justifying, so that names follow from evidence rather than preceding it. Prior work in inquiry-oriented biology education suggests that learning accelerates when representational tools like trait tables, keys, and trees are used to mediate discourse and when formative assessment continuously surfaces and addresses misconceptions.

The study aims to design and evaluate a sequence of system-activity projects that strengthens grade-7 students' ability to classify animals by diagnostic traits, to construct and use dichotomous keys, and to provide warranted explanations for taxonomic decisions. A secondary aim is to examine whether explicit attention to evolutionary relatedness, at a qualitative level appropriate for grade 7, improves students' discrimination between superficial similarity and informative characters.

The intervention was implemented in two mixed-ability seventh-grade classes over nine forty-five-minute lessons. Materials included locally available invertebrate and vertebrate images or preserved specimens, hand lenses, printed and digital trait cards, large format paper for matrices and keys, and a classroom set of tablets for photographing and annotating specimens. Instruction followed a project arc. Students first completed a guided biodiversity walk near the school, recorded observations with photographs and notes, and pooled data in a shared gallery. In class, they extracted candidate traits, defined character states with operational clarity, and assembled a trait matrix for a manageable set of taxa. Using the matrix, they drafted dichotomous keys, tested them on unfamiliar photos contributed by a partner class, and revised decision points that produced ambiguity. A short lesson on "tree thinking" introduced the idea that some characters reflect shared ancestry, while others arise through convergence, informing the choice of diagnostic traits. Formative assessment was embedded through exit tickets, brief oral conferences, and public whiteboard revisions where groups compared trait definitions and decision nodes.

Evaluation used three complementary measures. A concept inventory targeted misconceptions about "classification by habitat," the meaning of diagnostic characters, and the logic of a dichotomous key. A performance rubric scored trait definition quality, internal consistency of matrices, usability of the key by another group, and clarity of written justifications. A written explanation task presented an unfamiliar animal and asked students to classify it to a target level with a claim-evidence-reasoning structure. Pre/post comparisons were analyzed descriptively, and inter-rater reliability for rubric scoring was checked on a subsample to ensure stable judgments.

Student work products and assessment data point to robust learning. Initial matrices contained vague or overlapping traits such as "lives in water" or "fast," which failed during testing because multiple taxa matched the same descriptors. Through cycles of use and feedback, students reformulated traits into observable, discrete states, for instance replacing "lives in water" with "gills present/absent" or "paired fins present/absent," thereby increasing the discriminating power of the key. Pre-intervention classifications frequently cited diet or habitat as primary reasons; post-intervention explanations invoked structure, such as segmentation, symmetry, limb organization, or presence of a notochord, and linked those traits to the branching logic of their keys. Usability tests showed declining error rates as decision points were rewritten to avoid negative phrasing and to separate compound traits, and partner groups reported shorter time-to-identification with later versions.

Introducing elementary phylogenetic thinking improved students' selectivity about characters. When presented with a dolphin, learners initially grouped it with fish based on fins and habitat.

After discussing homology and analogy with everyday analogies and inspecting skeleton images, many reclassified it with mammals, citing diagnostic traits such as mammary glands or specific bone patterns and interpreting fins as convergent adaptations. This shift generalized to other cases, reducing reliance on superficial similarity. The written explanation task reflected the same movement, with more students articulating a claim anchored in a few decisive characters and a reasoning chain that justified why those characters were taxonomically informative.

The system-activity design appeared to drive these changes by coordinating tools and norms. Because trait matrices, keys, and trees were public and revisable, students experienced classification as a communal, improvable system rather than as private recall. Activity cycles created natural moments for reflection, such as when a key failed on an unfamiliar specimen and the class negotiated a better decision node. The teacher's role shifted from lecturing taxonomy names to facilitating the precision of trait language and pressing for warrants linking observation to category. Motivation remained high because projects culminated in the practical success of a key that another group could use, making quality consequential.

Feasibility was strong. The sequence required no specialized laboratory equipment, and outdoor observation could be replaced by curated photo sets in adverse conditions. Time on task was high, with minimal off-task behavior during key testing and revision, likely because failure cases were concrete and immediately actionable. Inter-rater checks showed acceptable consistency for rubric scores, suggesting that the performance assessment can be used reliably in ordinary classrooms. Limitations include the absence of a randomized comparison group and variable availability of local fauna, which may affect transfer; however, the alignment between multiple measures and observable improvements in artifact quality supports the claims.

System-activity projects offer a coherent, engaging pathway for seventh-graders to master the logic of animal taxonomy. By centering activity around building and testing shared tools—trait matrices, dichotomous keys, and simple trees—students learn to define diagnostic characters precisely, to justify classifications with evidence, and to avoid confusions rooted in habitat or superficial resemblance. The approach strengthens scientific discourse, improves written argumentation, and is practical within standard schedules and resources. Future work should connect the project to quantitative skills through simple data analytics on trait distributions, extend tree thinking with scaffolded cladograms, and examine long-term retention and transfer to unfamiliar taxa and higher-level concepts in grades 8–9.

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