

Weak Conceptual Knowledge Base of Zoological Classification in Students Pursuing Higher Education

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ABSTRACT

Background: Zoology is one of the favorite subjects of the biology group students interested in knowing about themselves and the animals around them. However, zoology comprises a package of animal-related sub-fields; the subject's basics lie in the subdiscipline: Taxonomy, systematics, and Diversity studies. These studies are often called Zoological Classification studies in which the student is given detailed information about the systematic division of animals into different taxonomical ranks based on their morphological and anatomical characteristics. Thus, all the zoological studies courses begin with animal taxonomical studies, followed by more profound studies into sub-fields.

Method: The students who opt for Zoology in higher education generally have poor confidence in taxonomy and systematics. The present study was conducted on a group of graduate and post-graduate students to assess their knowledge based on various aspects of Taxonomy and Systematics by attempting a multiple-choice questionnaire.

Result: The results were computed to estimate the aspect-wise understanding of the students. It was found that an average of more than 50% of the questions were answered incorrectly or left unanswered.

Conclusion: This showed that systematics, a sub-discipline of zoology, is difficult to understand and even students do not enjoy learning it and often skip classification-related questions.

Key-words: Connecting link, Genus, Systematic, Taxonomy, Zoology classification

INTRODUCTION

Animals are an essential part of the world's biodiversity, which plays key role in maintaining the balance in ecosystem ^[1-4]. The systematic study of animals is called "Zoology" which encompasses various aspects such as their description, genetics, physiology, morphology, developmental biology, systematics, etc ^[5,6]. Additionally, Zoology explores the interactions between wildlife and human populations, recognizing the significance of animals in the world ^[7]. The classification and systematics of animals form the fundamental basis of Zoology ^[8,9].

Taxonomy or classification is the multidimensional and scientific sub-discipline within the field of zoology that aims to determine the systematic position of an animal and elucidate the interrelationships between different species ^[1,10]. Classification is a fundamental and comprehensive field that organizes animals based on their hierarchy, considering their morphological and anatomical characteristics, habitat, preferences, affinities, and phylogenetic relationships ^[11]. A study revealed that elementary, secondary, and college students struggled to complete a classification task ^[12]. Many students across all age groups struggled with invertebrate and vertebrate taxonomic studies. They face problems in learning scientific names and even fail to generalize and discriminate between representative and non-representative members of specific animal groups, such as vertebrates and invertebrates ^[13,14].

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As a result, this lack of understanding led to a wide range of conflicts and misconceptions. Many students give up learning classification in Zoology due to frequent confusion, which ultimately undermines their foundational understanding of the subject. The educationists^[15] drew the attention of educators to the fact that, based on their examination of students, 30% of the students classified sea turtles as reptiles, while 70% classified sea turtles as amphibians. As per the survey and in-depth interviews with students at the school level, revealing that students understand the purpose of animal classification^[16]. Still, the students were observed to struggle with its practical application. It has been observed that students tend to skip specific questions during examinations and do not attempt them.

In the Indian scenario of high competition, the teachers must strategize their teaching plans to impart in-depth knowledge to students pursuing higher education^[17]. The educationists need to carefully estimate the knowledge gap of the subject to develop strategies for improvement^[18]. These assessments shall form the basis of development means to resolve the knowledge gap by incorporating information communication tools, which can aid in improving the student's learning outcomes^[19,20]. Thus, the present study was planned to assess students' knowledge base by conducting a questionnaire quiz based on various criteria of learning animal classification, including their perspective.

MATERIALS AND METHODS

The study was conducted in the classroom teaching in the Department of Zoology, University Maharani's College and University of Rajasthan, Jaipur. Different days of July were selected as per the weekly schedule in the year 2019, where the student's problem was considered, analyzed, and evaluated. The test was conducted on the students of the graduation and post-graduation.

The current study utilized a multiple-choice questionnaire of 50 questions categorized into seven sections to facilitate analysis and draw conclusions. The questionnaire was designed to evaluate the student's knowledge base under our instruction and assess their inclination toward zoological classification.

The questionnaire quiz consisted of two sections (Fig. 1).

Section A consisted of student perception-based questions about animal classification-based studies. It was oriented solely toward students' perspectives so that students could give their personal views.

Section B consisted of questions based on various aspects of Zoological classification knowledge-based studies.

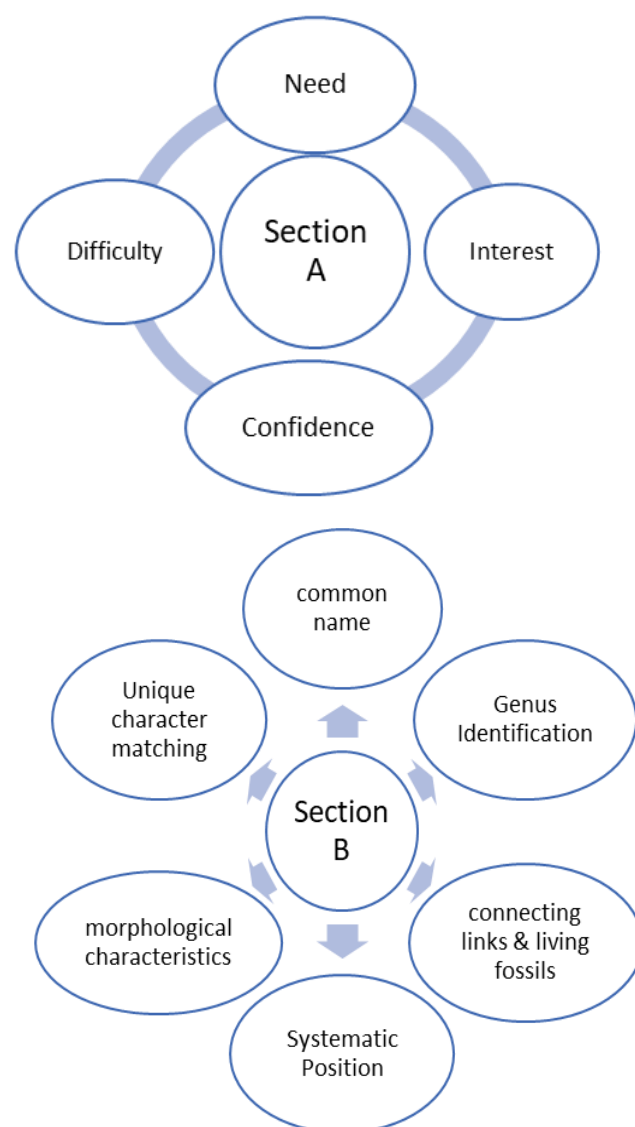


Fig. 1: Major criteria of student perspectives studied in sections A and B to study the student's conceptual knowledge of animal classification

Sampling- This research paper serves as a preliminary exercise or pilot experiment to determine whether the gaming application and one-page classification chart of vertebrates or invertebrates would be accepted by students if implemented. Consequently, the sample size was limited, comprising 40 students currently enrolled in undergraduate and postgraduate programs, with Zoology being one of their chosen subjects.

Statistical Analysis- For statistical analysis, an index of internal consistency and the Chi-square test were performed.

RESULTS

Section A- The questionnaire based on students' opinions about needs, difficulties, interests and understanding of animal classification provided us with an honest student's perspective. All the students realized the need and importance of zoology classification study, but low interest and understanding resulted in high difficulty levels in memorizing. Most students identified zoology classification as the most challenging sub-discipline to learn and memorize. They unanimously agreed that condensing vertebrate and invertebrate classification into a single page would facilitate students' memorization, comparison, and comprehension between diverse ranks and categories.

Section B- The students' criterion-wise correct and incorrect answers were computed into percentages and compared.

Criteria I- In this category, we assessed the knowledge of animal common names, which is the most superficial criterion and requires brief subject knowledge. The assessment results were surprising as only 38% of students could correctly identify the common name of the animals out of four options and the remaining 62% could not identify the correct option.

Criteria II was based on correctly identifying animal genera based on morphological attributes or images. The students who had an idea about the distinctive characteristics of the animals could quickly identify the genus. The knowledge of animal genus is one of the eight most essential taxa in animal classification. In our study, only 28% of students could answer correctly, indicating a poor state of knowledge in most students (72%).

Criteria III- The third essential criterion to assess the subject knowledge was based on questions on connecting links and living fossils. The importance of connecting links in animal classification lies in the overlapping characteristics of the animal, linking it to two different taxonomic groups. Similarly lies the significance of the living fossils, which have not undergone any change in the evolutionary time scale. The other members of the taxa have long been extinct,

and only fossils are available. The students were expected to find connecting taxonomic groups of the common examples. Similarly, students were expected to identify the most famous living fossils under these criteria. Students' responses to these questions were comparatively better, with 59% correct and 41% incorrect answers.

Criteria IV included questions on prominent taxonomic positions such as kingdom, phylum, class, order, and genera. Considering the wide variety of animals in each taxonomic group, the difficulty level of all the questions was limited to the representative animals or type study animals in the syllabus covered in previous classes. The students' responses were discouraging, with only 27% of students giving the correct answers. The results represent the weak knowledge of the systematic position of animals in the studied group.

Criteria V included the questions on identifying animals based on morphological characteristics. This criterion assesses the knowledge of each taxonomic group's most critical morphological characteristics. The students' responses to these criteria were also poor, with only 34% of the answers being correct and 66% were found to be incorrect.

Criteria VI- The last criterion was based on the unique characteristic matching with the particular specimen. The difficulty level was estimated with questions based on the common specimens seen in the laboratory. The statistical analysis indicated that the Index of internal consistency of reliability i.e. KR20 was found to be 0.70, which is slightly lower than the acceptable value of 0.80.

This indicates that the questions asked appeared hard to answer by the respondents in each category. Hence, it concludes that the classification part is difficult for students to accept. Secondly, the Chi-square test was applied to examine students' category-wise independence of correct and incorrect answers. The mode of correct and incorrect answers was calculated for each category, and the chi-square test was 7.12 with $p=0.30$. Thus, our hypothesis of interdependence of category and answer is accepted, meaning the trend of responses does not vary from category to category.

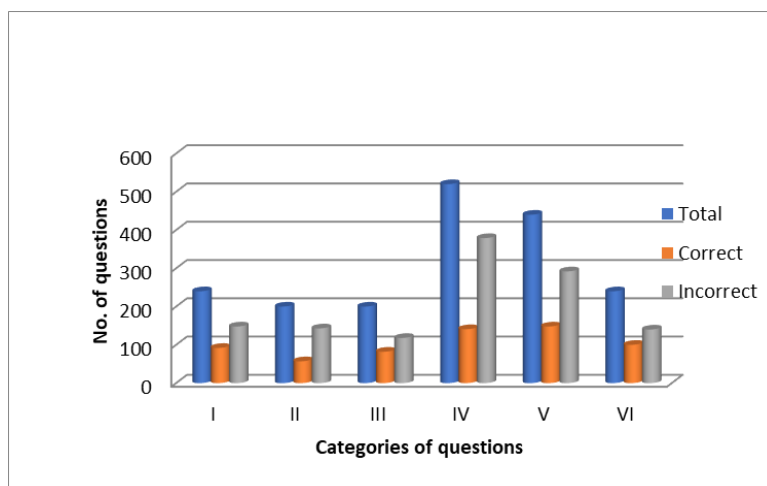


Fig. 2: The consolidated response of students on the animal classification knowledge base

DISCUSSION

The students' overall performance was weak, with the lowest score in group IV followed by groups II, V, III, I, and VI. This evaluation noted that 60.6% of the questions were either unanswered or answered incorrectly, while 39.4% were answered correctly by the students. The student's performance was unsatisfactory as overall results were below half of the correct answers (42%).

The teaching faculty must know the impact of this poor knowledge base on higher education students. The poor knowledge and performance of students generally hamper their confidence level. In Akbari and Sahibzada's study^[21] conducted to measure the learning outcomes with self-confidence in students of Kandahar University. The study's results indicated a positive relationship between learning outcomes in self-confident students.

The knowledge base of Zoology in young and adults has also been studied earlier^[22]. In this study, the performance of the questionnaire was assessed. The questions were based on human-insect relationships, insects' role in maintaining ecological balance, concepts, and characterization of animals. The statistical analysis of data indicated that most of the answers were based on common sense instead of scientific criteria. The study concluded with a change requirement in teaching pedagogy to improve performance.

In a systematic review^[23], the importance of new pedagogical strategies for delivering lectures about interest with inputs like video, audio, pictorial, game, etc., have been discussed. The positive impact of digital tools in improving mathematics and science subject knowledge has also been reported earlier^[24].

The improvement in learning of zoology with the use of three-dimensional animal models has been reported^[25]. They have proposed this technique as an innovative alternative to traditional teaching for undergraduate students. The assessment was based on interviews with workshop participants using 32 animal models of representative animals of various species. The results were encouraging as this approach triggered curiosity, making the animal studies less complicated. This method also helped disseminate knowledge about the vital role of animals in maintaining ecosystems and biodiversity conservation. In the modern learning environment, many sources of educational content are available, with differential impacts of each of them on learning. In a study conducted by^[26], blogs were shown to improve learning, as evident in students' pretest and post-test performance.

The improvement in the confidence level of students can also be obtained using an appropriate learning tool with an interactive interface for active learning, as in gaming applications. All the students were willing to learn zoology using innovative tools (section A). They believed incorporating this supplementary material into their studies could facilitate a unique and enjoyable approach to learning zoology classification.

Thus, the study provides insight into poor knowledge of Zoology classification students pursuing higher education. This issue needs to be addressed by deliberate efforts on the part of teachers by planning and executing newer pedagogical approaches for the improvement of subject knowledge and learning outcomes.

CONCLUSIONS

The demonstration of the student's knowledge about the classification of zoology reported a weak conception and learning about the subject. As concluded by the authors following the evaluation of the poor state of knowledge, an urgent need to incorporate newer pedagogical approaches is desired.

The educationist needs to address the issue of weak conceptual knowledge by putting directional efforts into developing subject interest and making it simpler and interactive. This can be achieved by incorporating real or virtual learning aids like videos, charts, and models. Games can be a useful alternative or supportive approach to improve learning outcomes.

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