

Integrating Quantitative Approach in Class Room Study to Develop Better Understanding about Biological Concepts, Processes and Phenomena

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Short Communication

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BACKGROUND

Development and integration of quantitative approaches and understanding of the various facets of dynamic biological phenomena is one of the most important perspectives required for intricate understanding of the various morphological, histological, physiological, molecular and biochemical cellular features and processes. Although, qualitative knowledge can help us understand multiple existing biological variations across the population and species, but it has intrinsic limitation in terms of comprehensive quantification and correlation thereof with specific features or phenomena, impeding the holistic and meaningful understanding and illustration. Overcoming such limitation and developing subtle understanding, one needs to quantify such processes and their occurrences through various ways using mathematical tools, such as biostatistics and biometrics. Integrating such statistical tools and logically basing our theoretical and practical concepts in the classroom teaching will certainly go a long way in inculcating better understanding and deepening of knowledge of students and other stakeholders so as to make them self-competent and self-evolving at not only understanding and interpretation, but also the translational applications of such concepts and interpretation.

Considering above facts, a proposal can be introduced at the very beginning of tertiary education, starting from undergraduate level of the higher education or even at secondary level. Such proposal involves practical application and understanding of variability and diversity of various processes like phenotypic variation, experimental variability, students' year-on-year basis performances, drawing conclusive cause-and-effect relationship and so on by employing various available tools such as measurement of central tendency, measurement of dispersion. The significance of such phenomena and conclusion regarding the random chance or external factor-induced variability and their level of significance can be understood employing test of significance such as z-test, t-test, F-test, Chi-square (test of goodness of fit and/or test of independence), testing hypothesis and errors, probability, ANOVA etc. These statistical tests can be used to develop holistic understanding of various concepts involved in zoology, botany, biochemistry, molecular biology, genetics, and microbiology among others. Statistical applications and interpretation help inculcate quantitative understanding, providing solid base for further research with better perspective. Precise quantitation with factored-in normal variation would help us decipher degree of deviation as of result pathophysiological abnormality and so does the severity of a disease etc.

OBJECTIVES AND METHODOLOGY

This proposal intends to put students on learning trajectory in a "Learn-by-doing fashion". Following objectives can be set with customized deviation in a very cost effective manner with high level of learning outcome.

Objective 1: Statistical Understanding the Various Morphological/Phenotypic Features (Height, Obesity/BMI/Heart Rate/Pulse Rate) of Students across the Various Departments of Biological Sciences

Such practice will help students appreciate and reconcile with the apparent phenotypic diversity prevalent among population

across the sex, age and region which can be further traced at the cellular and molecular levels via higher level study. For this, following steps will be followed:

Step 1-Collection and tabulation of biological data such as height, Body-Mass Index (BMI) or any other similar variations contingent upon feasibility.

Step 2- Presentation of aforementioned data through appropriate table, graphs and picture.

Step 3- Application of the Central tendency and measurement of dispersion of the data using standard deviation, variance etc.

Step 4- Interpretation of the statistical results and their implication and application in understanding concept.

Objective 2: Statistical Understanding of the Individual and Collective Performance of the Classes

Conducting the experimentation regarding the student performances based on their performances in internal and external examinations would continuously keep them on the right tract of academic life, improving overall learning outcome and developing healthy competition needed for survival during academic and post academic life.

Step 1-Collection and tabulation of data concerning the results of various classes across the departments.

Step 2- Presentation of aforementioned data through appropriate graphs and picture.

Step 3- Application of the appropriate statistical tests such as standard deviation, Variance, student's t-test, z test etc.

Step 4- Interpretation of the statistical results and their implication and application.

On the basis of results, students can be guided in time to stay on the right course of academic life. Similarly, Department performance and outcome can also be consistently measured, and if need be, evidence-based course correction can be made in larger benefit of institutions, colleges and academia.

Objective 3: Statistical Understanding of the Experimental Performances, Efficiency and Inclination of a Particular Class with Regard to Various Theoretical and Practical Concepts

Real time result analysis could help them understand underlying mistakes, if any, and their inclination and interest towards practical courses. It will also help teachers to find out and fill in the gap area.

Step 1-Collection and tabulation of data concerning the real time-experimental results of the students, keeping every other parameter same.

Step 2- Presentation of aforementioned data through appropriate graphs and picture such as bar chart, pie chart, histogram, line graph etc.

Step 3- Application of the Central tendency and measurement of deviation of the data and appropriate course correction thereof

Step 4- Interpretation of the statistical results, and their implication and application.

Objective 4: Statistical Understanding of the Various Biological Processes Contingent upon Theoretical and Experimental Data on Protein, DNA, RNA, etc.

Step 1-Collection and tabulation of data concerning the experimental results.

Step 2- Presentation of aforementioned data through appropriate graphs and picture.

Step 3- Application of the Central tendency and measurement of dispersion of the data along with the other tests.

Step 4- Interpretation of the statistical results, and their implication and application.

RESULTS AND INTERPRETATION

Integrating theory with quantitative practical understanding has been one of the several approaches of our educational system followed across the disciplines. However, our perspective has been appallingly tilted towards theoretical approach, which needs to be balanced with rational quantification and practical interpretation of the various results obtained during theory and practical classes. The obtained results can be discussed with all the students involved, factoring in their innovative suggestions so as to strengthen their cooperation, thereby improving upon the overall meaningful understanding of the concept and holistic development of students. This would also help improve our pedagogic system, producing world class students with rational and competitive bent of mind.

Precautions

Following precautions can be taken into account:

1. All the measurement have to be rational and accurate following well established protocols.

2. There has to be statistically significant amount of data and appropriate sample size for each experiments.
3. Statistical testing and interpretation should be scientific and unambiguous.

Significance

This study aims to inculcate an empirical perspective about the theoretical study, resulting into holistic understanding of any scientific concept. A theoretical study of any scientific concepts remains incomplete until it is underpinned with systematic quantitative analysis. Such analysis needs quantitation of variables and translation of the same to our own refinement and consolidation of understanding. Therefore, we would be bringing in various existing quantitative and statistical tools to aforementioned biological experiments so as to test our hypothesis and develop our own unique and pragmatic understanding. Such method would help students develop their own unique perspective and also broaden their analytical horizon.

Note: The aforementioned article presents broad framework which can be customized as per the need/purpose of class, course and institution. There are various online and offline standard books and material are available for references.