



## Content analysis of grade XI Mizoram board of school education Biology textbook

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**Abstract:** This study investigates whether a biology textbook meets the criteria for content development and fulfills the requirements of the curriculum. Qualitative research design is used, and the data analyzed is the content of a biology textbook titled "Biology Textbook, XI As per Mizoram Board of School Education E Syllabus" by Madhuban Educational Books, a division of Vikas Publishing House Private Limited. The analysis focuses on whether the textbook meets the criteria for an appropriate textbook and fulfills the curriculum requirements. Results indicate that the textbook meets the criteria for a good textbook, with all chapters featuring concise and accurate treatment of subject matter, simple vocabulary, comparative tables, illustrated examples, appropriate language functions, an attractive format, and methodological guidance for teachers. The textbook also satisfies all curriculum requirements, including competencies, learning models, and cultural content. However, the textbook is criticized for not utilizing color in its figures.

**Key Words:** Biology text book, Curriculum requirements, Content analysis, Qualitative research; Textbook development, Educational publishing.

### 1. INTRODUCTION:

The use of textbooks as a tool in the process of learning and teaching has a long history, dating back to the classical era of Greece. According to Clement (2008) and Koppal & Caldwell (2004), science educators generally recognize the significant role that textbooks play in the process of teaching and learning. When researchers analyze a Biology textbook, they consider various aspects, including the proportion of theoretical and practical knowledge, how different perspectives are represented, whether the textbook is fair and inclusive to different genders, how it handles socio-scientific and controversial issues, how graphical information is depicted, the complexity of vocabulary and how easy it is to understand at the intended level, the accuracy and coherence of the content, how indigenous knowledge is represented, the quality of textbook questions, how it handles misconceptions, and whether it is culturally and religiously sensitive. Biology educators have noted that, when teaching science topics, it is crucial to prioritize deep conceptual understanding over simple factual recall. Biology, as a natural science, is focused on the study of life and living organisms. These educators emphasize that textbooks are a crucial source of knowledge for students, and any inadequacies or inconsistencies in the scientific information presented within them can have a significant impact on students' understanding of scientific phenomena. Researchers who analyze Biology textbooks typically examine a range of factors. These include the balance between theoretical and practical knowledge, how the textbooks represent various perspectives, whether they are inclusive and fair to all genders, how they deal with controversial and socio-scientific issues, how they present graphical information, the complexity and ease of understanding of the vocabulary used, the accuracy and coherence of the content, the representation of indigenous knowledge, the quality of the questions included in the textbook, how they address misconceptions, and whether they show sensitivity towards cultural and religious beliefs. Modern biology is a diverse and interdisciplinary field that includes many specialized sub-disciplines focused on studying the structure, function, growth, distribution, evolution, and other characteristics of living organisms. The Class XI (MBSE) biology textbook is organized into five units, beginning with Unit 1, which covers Diversity in the Living World, followed by Unit 2 on Structural Organization in Animals and Plants, and then Unit 3 on Cell Structure and Function. Unit 4 covers Plant Physiology, while Unit 5 focuses on Human Physiology. All of these components are



presented in a standardized textbook that aims to align with the needs and goals of learners and the activities that occur in a classroom.

## 2. OBJECTIVE:

To analyse the content and evaluation of grade XI Biology textbook with reference to instructional effectiveness and Life skills.

## 3. METHODOLOGY:

The data in this study was analyzed and evaluated using qualitative research methods. Specifically, the study focused on analyzing the NCERT Biology textbook for 11th grade, authored by Sarita Aggarwal and published by Maduban Educational Books, which was selected as the sample for the qualitative research method employed in the study.

## 4. FINDINGS:

### *Textual and Language Analysis of Science Textbooks*

In the analysis of Unit 1 of the biology textbook, it was found that the language used by the author exhibits a systematic variation in the representation of scientific knowledge, leading to different interpretations of the "living world". A multivariate analysis of linguistic and textual features demonstrates distinct and interpretable differences among various biology disciplines, including botany, zoology, biochemistry, biotechnology, microbiology, and others. Notably, topics related to biochemistry and biotechnology present scientific knowledge in the form of rules, statements, procedures, and arrangements, and are structured around a small number of underlying concepts. In contrast, topics covering botany and zoology are presented through descriptions, elaborations, diagrams, and persuasion. For example, in Unit 1 on page 63, figures 3.9 and 3.10 display common ferns, while figure 3.11 presents a word diagram that combines linguistic and drawing skills to construct a mind map about the topic.

Unit 4 of the biology textbook highlights the fact that school science is often presented as static and absolute knowledge, whereas in reality, it is dynamic and subject to negotiation in meaning-making. The text compares two types of plants, C3 and C4 plants, to highlight different conceptions. The use of textuality is introduced through Figure 9.14, which shows a double DNA helical structure with labeling, as well as textual elements like the benzene ring, which shows the simplified structure of the ATP molecule. The properties of enzymes are also discussed, with Figure 9.19 and Table 9.17 (pg. 315) showing various classes of enzymes and their catalytic reactions, which can enhance learners' flexibility. The concept of an "epistemologically valid image" is emphasized, with the cell cycle (pg. 322) discussed using such an image, showing the various phases such as interphase, M phase, and cytokinesis. An epistemological image is also used to describe the vascular tissue system (pg. 181).

This Biology textbook examined the use of analogies as a tool for helping students understand new concepts. Both oral and textual analogies are commonly used by science teachers and textbook authors. Textual analogies, in particular, are useful when students need to learn independently, without the help of a teacher. Compared to oral analogies, textual analogies can be more detailed and explicit, as authors have more time to construct them. However, the study found that many textual analogies in Biology textbooks are not explained in enough detail to be helpful to students. As a result, the textbook examined the potential learning benefits of textual analogies and identified the factors that contribute to their effectiveness.

It is interesting to note that the MBSE prescribed Biology textbook did not incorporate the use of analogies as a learning resource. Instead, the textbook focused on summarizing the principles, chemical equations, and commonly used terms in a separate column. This approach can be helpful for improving reading comprehension and understanding of the scientific concepts presented in the textbook. However, the use of analogies can also be a powerful tool for improving student understanding and retention of scientific concepts, and it may be worthwhile for future revisions of the textbook to consider incorporating more analogies as a teaching and learning resource.

### *Content Analysis of Biology Textbooks*

The curriculum of Biology Grade XI comprises various topics such as Diversity in Living World, Structural Organisation in Plants and Animals, Cell: Structure and Function, Plant Physiology, and Human Physiology. For the purpose of content analysis based on life skills, five chapters were chosen from Unit IV of Biology Grade XI, which are Transport in Plants, Mineral Nutrition, Photosynthesis, Respiration in Plants, and Plant Growth and Development. The content analysis of selected five chapters of Biology Grade XI is given in the table below:



Table 7: Table of Content Analysis of Selected Chapters of Biology I

Sl.no	Life Skills	Name of Chapters
1.	Creativity and Innovation	Biological Classification
2.	Critical Thinking & Problem solving	Morphology of Flowering Plants
3.	Collaboration	Anatomy of Flowering Plants
4.	Health Literacy	Cell cycle and cell division
5.	Communication	Mineral Nutrition
6.	Information Literacy	Photosynthesis
7.	Flexibility & Adaptability	Plant Growth and Development
8.	Information and Communication Technology (ICT) Literacy	Neural Control and Coordination

Upon analyzing the selected chapters of Biology Grade XI, it was found that the content did not address the creativity and innovation skill. Although a few topics from the four chapters encouraged some initial form of critical thinking, there were no questions or activities that required problem-solving ability. The majority of the content in the selected chapters followed a structured and sequenced approach. The concepts were explained in a sequential manner, with examples, uses, and differences shown in a table (pg.192). The language and terminology used were comprehensible, but most of the pictures and diagrams used were of low quality and unclear, such as "Secondary Growth in Dicot roots" (pg.193). A well-organized written explanation can promote clear communication (pg.311). However, the variety of skills required for verbal and non-verbal communication were not emphasized, as no group or classroom activities for collaborative work were suggested in the chapters.

In addition, it was observed that the content lacked opportunities for teamwork and collaborative work to achieve a common goal. None of the chapters provided any suggestions for group activities or classroom activities that could promote collaborative work. Out of the eight chapters, only "Biological Classification" (pg. 22) encouraged the development of information literacy skills, where different classifications of animals, plants, protists, and monera were highlighted. However, the questions provided in the exercises were answerable by simply referring to the information provided in the chapters, which did not promote the development of skills required to search and evaluate material from multiple sources to solve problems. Furthermore, the content did not promote the development of media literacy, Information and Communication Technology (ICT) literacy, productivity and accountability, leadership, and responsibility skills. Only one topic, "Mineral Nutrition" (pg. 368), addressed the promotion of the skill of flexibility and adaptability. The chapter described the hydroponics or water culture experiment conducted by Sachs in 1860, which demonstrated soilless cultivation and helped in the commercial production of vegetables such as tomatoes, lettuce, and cucumbers. Thus, flexibility and adaptability helped various farmers and consumers.

The Biology Grade XI Textbook did not provide any opportunities for the development of social and cross-cultural skills. There were no activities or projects included in the chapters to encourage the practice of soft skills. In terms of interdisciplinary skills, two units - Human Physiology and Plant Physiology - did address the importance of global awareness for students. Knowledge of Biology can help students in pursuing careers in fields such as environmental studies, animal husbandry, and medicine. However, the units did not focus on developing students' awareness of civic literacy. Several topics in the textbook promoted health literacy among students.

## 5. CONCLUSION & DISCUSSION :

The analysis of the Biology Grade XI textbook's chapters showed that it aimed to enhance students' written communication and collaboration skills, health literacy, and global awareness. However, the textbook did not provide sufficient opportunities for developing skills such as critical thinking, problem-solving, creativity and innovation, productivity and accountability, leadership and responsibility, media literacy, and ICT literacy. The textbook emphasized breadth of topics over depth of concepts, leading to an overwhelming amount of information for students without ample opportunities for collaborative problem-solving. While the textbook's descriptions of topics were clear and objective, it did not target the development of social and cross-cultural skills or verbal and nonverbal communication skills. The textbook provided ready-made information in the form of "Glossary" boxes, but students were not challenged to apply the concepts in real-life scenarios. The questions and exercises in the textbook did not sufficiently develop critical thinking or problem-solving skills. The content analysis revealed that the textbook prioritizes covering a wide range of topics rather than delving deep into each concept. Consequently, it presents a significant amount of information



without offering students the chance to explore the material from different perspectives and work together to address real-world issues. The way in which knowledge and content are presented in the textbook does not encourage the development of problem-solving skills, as noted by Bergevin in 2010. However, the content of each chapter is well-organized and structured, beginning with a clear definition and introduction to the topic, followed by a description of its history, structure, functioning, or use of particular techniques, processes, or instruments. The structured and objective pattern of describing topics in the textbook can effectively communicate ideas to students and help them develop the ability to communicate clearly and objectively. However, it is noted that the textbook was not designed to develop social and cross-cultural skills, as well as verbal and nonverbal communication skills which are essential parts of communication. The textbook aimed to foster a comprehensive understanding of the concepts and their interconnections. The glossary boxes provided interesting information but did not encourage critical thinking skills in students as it gave them ready-made information. To develop critical thinking, problem-solving, leadership, and responsibility skills, students need to be given short assignments or tasks that require them to apply concepts in real-life situations under the guidance of a biology teacher. The textbook included a special box of questions at the end of several topics to promote critical thinking skills, which were in various formats like multiple choices, fill in the blanks, comparison, and short and long answer. However, the analysis found that the questions did not require students to process the information and think critically to find the answer. Instead, most of the questions were based on information already provided in the chapters. Such practices are not effective for developing critical thinking skills. Furthermore, the textbook lacked sufficient questions and exercises to promote problem-solving skills.

## 6. CONCLUSION & RECOMMENDATIONS :

Based on the findings and discussion, it was concluded that the Biology textbook for higher secondary school students needs to be reformed. The following recommendations were made:

1. The questions in the textbook should be reworded in a way that requires critical thinking and problem-solving skills from students.
2. Cooperative learning activities should be included in the textbook.
3. The textbook should include colourful and bright images, as well as more epistemological images.
4. Over simplification should be avoided.
5. Analogies should be incorporated in the textbook to enhance the teaching-learning process for Grade XI students.

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