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Abstract

This study explores the development of higher-order thinking skills (HOTs) in secondary school students through a qualitative content analysis of a Biology textbook grade X (2020). The analysis was done using software called NVivo 12, and the book was chosen through purposeful sampling. The results showed that the textbook uses various strategies to develop critical thinking, such as practical activities, experiments, analytical questions, real-world applications, and open-ended problem-solving questions. Practical activities and experiments help students apply their theoretical understanding to actual problems. Analytical questions make students think critically by making them analyze data and explain complicated relationships between biological concepts. Real-world applications show students how scientific knowledge is used every day so they can evaluate scientific advancement more critically. Open-ended questions challenge students to use what they have learned to solve new problems and come up with unique answers.

Key Words: Critical Thinking, Biology Textbook, Document Analysis, Science Education, Secondary Level

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Title

Biology Textbook Grade X (2020): Analysis for the Development of Higher Order Thinking Skills among Secondary School Science Students

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Contents

Abstract

This study explores the development of higher-order thinking skills (HOTs) in secondary school students through a qualitative content analysis of a Biology textbook grade X (2020). The analysis was done using software called NVivo 12, and the book was chosen through purposeful sampling. The results showed that the textbook uses various strategies to develop critical thinking, such as practical activities, experiments, analytical questions, real-world applications, and open-ended problem-solving questions. Practical activities and experiments help students apply their theoretical understanding to actual problems. Analytical questions make students think critically by making them analyze data and explain complicated relationships between biological concepts. Real-world applications show students how scientific knowledge is used every day so they can evaluate scientific advancement more critically. Open-ended questions challenge students to use what they have learned to solve new problems and come up with unique answers.

Keywords: Critical Thinking, Biology Textbook, Document Analysis, Science Education, Secondary Level

Introduction

Critical thinking is an extremely important skill that helps people analyze information effectively (Dwyer et al., 2014). When it comes to science education specifically, critical thinking plays an important role in giving students scientific literacy that will help them make informed decisions later on in life (Vieira et al., 2011). It is no wonder why researchers have been looking into how well secondary school science programs are helping kids develop their critical thinking skills.

Out of all the sciences taught during high school though, biology provides the best opportunity for nurturing these skills. The subject already makes kids inquire about things scientifically and solves complex problems (Gresch et al., 2013). With biotechnology advancing faster than ever nowadays too; there's never been a better time for kids to learn

how to critically think while they're still young enough to change their mindsets (Eastwood et al., 2012).

Textbooks are what students rely on the most during their educational careers. They are typically the main sources students use to learn about concepts and practices (Chiappetta & Fillman, 2007). So, it should go without saying that the quality of these books and the information they provide play a huge role in how well kids develop their critical thinking skills (Stern & Roseman, 2004).

Previous studies have examined how textbooks can promote critical thinking. Bailin (2002) is of the view that there should be more open-ended questions with real-world problems in textbooks for the students to think critically and analytically. Ennis (2018) also provided a list of important characteristics, such as the ability to evaluate sources of information, analyze arguments, and draw reasonable conclusions based on evidence.

This study aims at filling part of this gap by conducting qualitative content analysis on the Grade X Biology textbook which was taught at secondary schools in Pakistan. The country faces many issues when it comes to giving a science education that is worth learning, and the development of critical thinking skills has been identified as a key priority in the country's educational reforms (Ministry of Education, 2009). By examining the Grade X Biology textbook through the lens of critical thinking, this study seeks to provide insights into the strengths and limitations of the textbook in fostering these essential skills and offer recommendations for improving the design and content of biology textbooks to better support the development of critical thinking among secondary school students.

By undertaking this research, we aim to contribute to the growing body of knowledge on critical thinking in science education and provide practical insights for educators, curriculum developers, and policymakers working to enhance the quality of biology education in Pakistan and other developing countries. The findings of this study can inform the design of biology textbooks for secondary school students to support the development of their critical thinking skills – ultimately contributing to the preparation of a scientifically literate citizenry equipped to face the challenges of the 21st century for humans to survive beyond this planet.

To fully engage with scientific inquiry and problem-solving in Biology, Eastwood et al. (2012) argue that students need excellent critical thinking skills especially because Biology continues to rapidly evolve as we learn more about it every day.

The researchers have been interested in the development of critical thinking skills in students globally. In science teaching especially biology, many studies have focused on the role of textbooks in promoting these vital abilities. There are recent investigations conducted within and outside Pakistan that concentrate on analyzing Biology textbooks as well as their ability to enhance critical thinking among secondary school learners.

In a study, Liu (2023) explored the perspective of Chinese mathematical teachers about defining critical thinking and other their teaching experiences during their teaching. Another study done by Liang & Cobern (2013) analyzed Chinese high school biology textbooks using the specific standards of the American Association for the Advancement of Science (AAAS). The analysis of three chapters showed relevance to the standards of AAAS. Moreover, the Chinese textbook was found satisfactory. Further suggestions were provided for the textbook improvement. Chiappetta & Fillman (2007) conducted a study to analyze the five high school biology textbooks in the context of the United States. It was found that there was a balance of presentation with four themes related to science literacy. Another study conducted by Zorluoglu et al. (2020) analyzed the chemistry textbook for grade IX in the Turkish curriculum context keeping in view the revised Bloom's taxonomy. It was found that the focus was on conceptual and factual knowledge in specific units. Sabri (2019) conducted a study in the UAE context to explore the effectiveness of inquiry-based learning on the CT skills development of Biology students. It was found that there was less effective implementation of inquiry-based learning regarding instruction as well as assessment methods and practices. Another study was conducted by Ibitoye (2021), regarding the effectiveness of project-based learning with self-regulation strategies to enhance students' attitudes, achievement, and practical skills in Biology subject in the Nigerian context. Similarly, a study conducted by Quitadamo et al. (2008) found community-based inquiry for the improvement of

CT in biology general education. In the same way, problem-solving techniques used by undergraduate Biology students were explored in a study (Hsu et al., 2024). Knowledge and strategy aspects were aligned with previous research for biological knowledge.

Several studies have investigated whether biology textbooks effectively develop critical thought processes among Pakistani students. In a study conducted by Bhatti et al. (2015) regarding alignment of curriculum with the textbook of Biology. The findings of the study revealed lower-order thinking skills related to context having knowledge and comprehension. Recommendations were made to incorporate the content based on higher-order thinking aspects. Another study conducted by Tufail et al. (2016), analyzed the biology textbook for higher secondary schools with alignment to 21st-century skills like creativity, critical thinking, collaboration, flexibility, responsibility, etc. It was found that textbooks did not meet the requirements of twenty-first-century learners. In another study conducted by Ali et al. (2017), it was found that general science textbooks for grades 6-8 lacked higher-order thinking questioning with activities. In the same way, different studies have been conducted in this perspective as an analysis of education policy and science teachers' practices for CT skills development (Jamil, 2021); an analysis of the physics, chemistry, biology, and mathematics curriculum (Jamil et al., 2024; 2024a; 2024b; 2024c). Similarly, textbooks have been analyzed keeping in view the incorporation of critical thinking among students as addressed focused on Physics textbooks for grade IX, Chemistry textbooks for grade IX, X (Jamil et al., 2024; 2024a; 2024b); single national curriculum social studies for critical thinking skills development (Jamil et al., 2024); qualitative content analysis of policy and curriculum documents for this phenomenon (Jamil et al., 2020), and critical thinking skills development of Pakistan studies, analysis of the document (Naseer et al., 2022).

Objectives of the Study

Objectives of the study were to:

1. Analyze the Biology textbook grade X regarding the incorporation of elements that promote critical thinking skills.
2. Identify the techniques and strategies used in the textbook to foster critical thinking skills.

Research Methodology

The current research employed a qualitative content analysis approach to review the biology textbook aimed at developing CT skills among secondary school science students. The present method is the best because it systematically examines large text data to establish key themes, patterns, and underlying meanings (Kyngäs, 2020). In analyzing a textbook, this method is extremely relevant in educational material such as textbooks where one can gather knowledge from its content and assess learning outcomes (Mayring, 2014). A purposive sampling technique was used to select the Biology textbook for grade X downloaded from https://pctb.punjab.gov.pk/E-Books. This technique was implemented based on specific criteria as well as features (Etkina et al., 2006). Qualitative content analysis was facilitated by NVivo software (Jackson et al., 2019) besides helping to organize all data and performing an analysis concerning textual information effectively (Silver & Woolf, 2015).

Findings of the Study

The biology textbook chapters cover a wide range of topics. The aim of CT skills development is presented in the following aspects:

Practical activities and experiments:

Practical activities and experiments are crucial components of science education as they provide students with opportunities to engage in the process of scientific inquiry. By conducting experiments, students learn to formulate hypotheses, design experiments, collect and analyze data, and draw conclusions based on evidence. The chapters include many practical activities and experiments that encourage students to apply concepts, make observations, analyze results, and draw conclusions. For example:

- *"Investigate the effect of light on the net gaseous exchange from leaf, by using bicarbonate as the indicator."* (Page 22).
- *"Identify and draw labelled diagrams of different bones of the human skeleton*

from real specimens, models or charts." (Page 7)

- *"Investigate the role of yeast in the fermentation of flour."* (Page 9)

These hands-on approaches help students develop critical thinking skills by challenging them to apply theoretical concepts to real-world situations. Moreover, practical activities often involve problem-solving and decision-making, which are essential skills for critical thinking. These also encourage students to think critically about the relationship between light and gaseous exchange in plants and to use their understanding of photosynthesis to explain their observations.

Analytical and interpretive questions:

An analytical question aims to make students think. They are made to go beyond the simple recall of information. These questions typically involve interpreting graphs, analyzing data, or explaining complex relationships. After a few topics, you'll notice that there are these types of questions that ask them to do a deep dive into the concept.

- *"Identify the producers and consumers in a pond ecosystem and describe the interactions among the biotic and abiotic factors involved here."* (Page 4)
- *"Interpret the data about local environmental problems (through survey search)."* (Page 28)
- *"Analyze how artificial selection can lead to the development of crop plants with higher yields."* (Page 23)

Asking this kind of question forces students to think about the countless ways genetic principles are applied in medicine and agriculture for example. By doing so, this helps students see just how important Scientific knowledge is in daily life.

Emphasis on real-world applications:

Students learn to think critically about scientific advancements, as well as understand their practical benefits, limitations, and environmental consequences. The textbook often connects biological concepts with their technological applications and societal implications. For example, each chapter contains a section called "Science, Technology, and Society." This area focuses on opening student's eyes to the real-life impact of what they're learning. To put it into perspective, here's one question:

- *"Explain how genetics can predict the progeny of two individuals which are crossed."* (Page 25)

It makes students critically think about genetics in real-life situations like agriculture and medicine. When they think about it this way and realize how scientific knowledge can drastically change something, they will have learned the significance behind it all.

Open-ended and problem-solving questions:

These questions ask students to apply their knowledge and start thinking outside the box. They require multiple steps to solve and might not always have one correct answer. This pushes students to be more creative in their solutions and consider different perspectives. Some end-of-chapter questions will ask them to design an experiment or propose hypotheses like:

- *"Predict from pedigree charts the passage of traits from one generation to the other."* (Page 14)
- *"Solve basic genetic problems involving monohybrid crosses, incomplete dominance and codominance, using the Punnet square."* (Page 14)

Challenging students with these kinds of open-ended questions encourages them to push themselves further mentally by using what they've learned in new situations. For them to come up with solutions for our sample question above, they'll have no choice but to critically analyze pedigree charts and apply the principles of Mendelian genetics amongst other things.

Discussion and Conclusion

The current study aimed to examine the development of critical thinking skills among high school science students. The study involved a qualitative content analysis of the Grade X Biology textbook used in Pakistani schools, with findings analyzed using NVivo 12 software. Several strategies were identified by the researchers to foster critical thinking, which included practical activities and experiments, analytical and interpretive questions, real-world applications, and open-ended problem-solving questions. This

outcome is consistent with previous research that calls for specific elements in textbooks to promote critical thinking skills (Bailin, 2002). Moreover, Hofstein and Lunetta (2004) focused on the importance of the application of laboratory work for the development of CT skills in students. Moreover, these findings are also supported by Ennis (2018), Eastwood et al. (2012), and Eastwood et al. (2012). It is also clear that there is a connection between biological concepts with real-world problems for the effective application of critical thinking. The current study analyzed the Biology textbook grade X through thematic analysis facilitated by NVivo 12 software. It might provide facilitation regarding critical thinking skills development among the students of science at the secondary level. Different techniques have been identified through the analysis of the textbook for the promotion of critical thinking like practical activities, real-life examples, analytical questioning, open-ended questioning, and problem-solving skills. These results support previous studies that underlined the importance of integrating specific components into textbooks to foster critical thinking skills. Though the textbook exhibits strengths in promoting critical thinking it also uncovers areas that need improvement like the inclusion of explicit guidance on critical thinking strategies and the adoption of diverse assessment techniques. The outcomes obtained from this research can be very useful for teachers, curriculum developers, and policymakers not only within Pakistan but in other countries as well because they can be used to design textbooks that better support the development of these skills in science students. This study contributes to ongoing discourse about effective strategies for fostering essential skills in science education, but future research is necessary to build on these findings.

Recommendations

- Developers should include more explicit instructions on how to use problem-solving frameworks and reflective prompts to aid students develop essential skills.
- Teachers should receive professional training on the efficient utilization of textbooks to develop critical thinking among their students; emphasis should be put on inquiry-based learning and engagement with real-world applications.
- Curriculum designers should collaborate with experts within different fields alongside educational researchers so that they can keep up with current best practices in developing materials that promote critical thinking; examples include socioscientific issues and open-ended problem-solving tasks.
- The current evaluation methods deployed by biology education need diversification to evaluate a wider range of skills present among students apart from traditional tests & quizzes eg portfolios; performance-based tasks etc.
- Policymakers should allocate resources to foster the development of critical thinking skills in their students through creating and disseminating high-quality textbooks.

References

Ali, I., Akhter, N., & Nawaz, M. (2017). Critical analysis of general science textbooks for inclusion of the nature of science used at the elementary level in Khyber Pakhtunkhwa. *Journal of Educational Research*, *20*(1), 113-131.

Google scholar Worldcat Fulltext

Bailin, S. (2002). Critical thinking and science education. *Science & Education*, *11*, 361-375.

Google scholar Worldcat Fulltext

Bhatti, A. J., Jumani, N. B., & Bilal, M. (2015). Analysis of alignment between curriculum and biology textbook at secondary level in Punjab. *Pakistan Journal of Social Sciences*, *35*(1), 261-272. https://link.springer.com/article/10.1023/A:1016042608621

Google scholar Worldcat Fulltext

Chiappetta, E. L., & Fillman, D. A. (2007). Analysis of five high school biology textbooks used in the United States for inclusion of the nature of science. *International Journal of Science Education*, *29*(15), 1847-1868. http://dx.doi.org/10.1080/09500690601159407

Google scholar Worldcat Fulltext

Dwyer, C. P., Hogan, M. J., & Stewart, I. (2014). An integrated critical thinking framework for the 21st century. *Thinking Skills and Creativity, 12,* 43–52. https://doi.org/10.1016/j.tsc.2013.12.004

Google scholar Worldcat Fulltext

Eastwood, J. L., Sadler, T. D., Zeidler, D. L., Lewis, A., Amiri, L., & Applebaum, S. (2012). Contextualizing Nature of Science Instruction in Socioscientific Issues. *International Journal of Science Education*, *34*(15), 2289–2315. https://doi.org/10.1080/09500693.2012.667582

Google scholar Worldcat Fulltext

Ennis, R. H. (2018). Critical thinking across the curriculum: A vision. *Topoi*, *37*, 165-184. https://link.springer.com/article/10.1007/s11245-016-9401-4

Google scholar Worldcat Fulltext

Etkina, E., Murthy, S., & Zou, X. (2006). Using introductory labs to engage students in experimental design. *American Journal of Physics*, *74*(11), 979-986. https://doi.org/10.1119/1.2238885

Google scholar Worldcat Fulltext

Gresch, H., Hasselhorn, M. and Bögeholz, S. (2013) 'Training in Decision-making Strategies: An approach to enhance students' competence to deal with socio-scientific issues', *International Journal of Science Education*, 35(15), pp. 2587–2607. https://doi.org/10.1080/09500693.2011.617789

Google scholar Worldcat Fulltext

Hofstein, A., & Lunetta, V. N. (2004). The Laboratory in Science Education: Foundations for the Twenty-First Century. *Science Education,* *88*(1), 28–54. https://doi.org/10.1002/sce.10106

Google scholar Worldcat Fulltext

Hsu, J. L., Sung, R. J., Swarat, S. L., Gore, A. J., Kim, S., & Lo, S. M. (2024). Variations in Student Approaches to Problem Solving in Undergraduate Biology Education. *CBE life sciences education*, *23*(2), ar12. https://doi.org/10.1187/cbe.23-02-0033

Google scholar Worldcat Fulltext

Ibitoye, T. M. (2021). *Project-based learning and self-regulatory strategies as determinants of secondary school student achievement, attitude and practical skills in Biology concepts in Ibadan, Nigeria*

Google scholar Worldcat Fulltext

Jackson, K., Bazeley, P., & Bazeley, P. (2019). *Qualitative data analysis with NVivo*. Sage.

Google scholar Worldcat Fulltext

Kyngäs, H. (2020). Qualitative research and content analysis. In *The application of content analysis in nursing science research* (pp. 3-11).

Google scholar Worldcat Fulltext

Liang, Y., & Cobern, W. W. (2013). Analysis of a typical Chinese high school biology textbook using the AAAS textbook standards. *Eurasia*

Journal of Mathematics, Science and Technology Education, *9*(4), 329-336.

Google scholar Worldcat Fulltext

Liu, W. (2023). Critical Thinking Skills for Chinese Teachers: A Study of Mathematics Teachers' Perceptions. *PUPIL: International Journal of Teaching, Education and Learning*, *7*(2), 01-16. https://doi.org/10.20319/pijtel.2023.72.0116

Google scholar Worldcat Fulltext

Mayring, P. (2014). Qualitative content analysis: Theoretical foundation, basic procedures and software solution. In *Approaches to qualitative research in mathematics education* (pp. 365–380). Springer. http://nbn-resolving.de/urn:nbn:de:0168-ssoar-395173

Google scholar Worldcat Fulltext

Naseer, H., Muhammad, Y., & Jamil, M. (2022). Critical thinking skills in Pakistan studies textbook: Qualitative content analysis. *Pakistan Journal of Social Research*, *4*(3), 744-755. http://dx.doi.org/10.52567/pjsr.v4i03.764

Google scholar Worldcat Fulltext

Quitadamo, I. J., Faiola, C. L., Johnson, J. E., & Kurtz, M. J. (2008). Community-based inquiry improves critical thinking in general education biology. *CBE—Life Sciences Education*, *7*(3), 327-337. https://doi.org/10.1187%2Fcbe.07-11-0097

Google scholar Worldcat Fulltext

Sabri, S. (2019). *The Effects of Inquiry-based Learning on the Development of High School Biology Students' Critical Thinking Skills in the UAE* The British University in Dubai (BUiD).

Google scholar Worldcat Fulltext

Silver, C., & Woolf, N. H. (2015). From guided instruction to facilitation of learning: the development of *Five-level QDA* as a CAQDAS pedagogy that explicates the practices of expert users. *International Journal of Social Research Methodology*, *18*(5), 527–543. https://doi.org/10.1080/13645579.2015.1062626

Google scholar Worldcat Fulltext

Stern, L., & Roseman, J. E. (2004). Can middle-school science textbooks help students learn important ideas? Findings from Project 2061's curriculum evaluation study: Life science. *Journal of Research in Science Teaching*, *41*(6), 538-568. https://doi.org/10.1002/tea.20019

Google scholar Worldcat Fulltext

Tufail, M., Ali, R., & Malik, S. (2016). Analysis of textbook of biology for higher secondary students with reference to 21st century life skills. *Journal of Research in Social Sciences*, *4*(2), 197-213.

Google scholar Worldcat Fulltext

Vieira, R.M., Tenreiro-Vieira, C., & Martins, I. (2011). Critical thinking: Conceptual clarification and its importance in science education. *Science Education International, 22*, 43-54.

Google scholar Worldcat Fulltext

Zorluoglu, S. L., Kizilaslan, A., & Yapucuoglu, M. D. (2020). The Analysis of 9th Grade Chemistry Curriculum and Textbook According to Revised Bloom's Taxonomy. *Cypriot Journal of Educational Sciences*, *15*(1), 9-20. http://dx.doi.org/10.18844/cjes.v15i1.3516

Google scholar Worldcat Fulltext