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Investigating the Extent of Integration of the History of Science into Grade 12 Life Sciences Textbook in the FET Phase

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Abstract. This study investigates the representation of the History of Science (HoS) in a Grade 12 Life Sciences textbook used in the Further Education and Training (FET) phase in South Africa. The purpose of the study was to evaluate the extent and quality of HoS integration, particularly in alignment with Curriculum and Assessment Policy Statement (CAPS) objectives. A qualitative content analysis was conducted using a conceptual framework developed by the researcher, focusing on seven HoS tenets: curriculum alignment, historical accuracy, pedagogical approach, learner engagement, critical thinking, assessment practices, and supporting materials. Findings revealed that the textbook provided substantial historical context in topics such as evolution, DNA, and genetics, including visual depictions of key scientists. However, other tenets were only partially addressed or inconsistently represented. The study concludes that HoS is minimally yet meaningfully integrated in certain sections of the textbook, supporting CAPS Specific Aim 3, which emphasizes understanding scientific developments and applying knowledge to real-world contexts. Practically, the research recommends enhanced integration of HoS by textbook authors, curriculum developers, and Life Sciences educators, and encourages professional development for teachers to effectively embed HoS in classroom instruction for deeper learner engagement.

1. INTRODUCTION

Integrating the History of Science (HoS) into science education has a significant role in improving the understanding of science regarding the evolution and the environment within which they develop. Through identification of the prior events of a concept as narratives, learners develop sound understanding of Life sciences and its applicability in solving present day issues. Consequently, when applying the rationale to Life Sciences education, HoS presents a chance to expose students to sharp critical thinking skills as well as problem-solving skills, while embracing scientific discoveries as the basis of acquired knowledge. Since Grade 12 Life Sciences textbooks occupy a central position in learners' knowledge construction, it is crucial to determine how they address historical dimensions. This systematic review explores how and where HoS is incorporated into the Grade 12 Understanding Life Sciences textbook. This includes the alignment between the HoS and the curriculum, the teaching and learning strategies used, the engagement of learners, and the availability of more historical types of learning and teaching support material (LTSM). They will also try to establish what elements in present textbook resource material are strong and weak as far as the incorporation of HoS in learning are concerned. This study contributes to the broader debate on the use of history in science education, and how history may be used to enrich the learning experience of learners while preparing them for future innovation, by helping them understand the history of the subject area in question more fully.

1.1. The Aim of the Study

The study aims to investigate the quantity of learner activities and assessmentsl to which the HoS is integrated into the Understanding Life Sciences textbook in the FET phase.

1.2. Objective of the Study

To determine the extent to which the HoS is integrated into the selected grade 12 Life Sciences textbooks' content in the FET phase.

1.3. Research Question

This study sought to answer the following research question:
To what extent is the HoS integrated in a selected Grade 12 Life Sciences textbook in the FET phase?

1.4. Conceptual Framework

When developing a framework for the analysis of a Grade 12 Life Sciences textbooks, it becomes necessary to identify areas of focus within the conceptual framework that will help in the evaluation of an individual Life sciences textbook to determine if it will support learners' learning. Here is the specific framework which the researcher considered that it falls in Ithaca. The Ithaca framework is one of the tools that is applied in higher learning institutions to facilitate the evaluation of students' learning outcomes. It offers a framework for assessing the educational programs to the institutions, employing the both the traditional and modern research techniques Haneveld, (2024). This ensures goals are set and achievements are monitored, and decisions made based on the data to improve learners' performance. Teaching and learning can for instance concentrate on how the curriculum, assessment and instructional practices can be made to correspond to the intended learning outcomes.

The researcher designed a conceptual framework for HoS based on the Ithaca guidelines believed to be well captured in any Life sciences textbooks Haneveld, (2024). The HoS tenets developed by a researcher are as follows: Curriculum with reference to the concept of history of science, these key areas include *curriculum alignment to general history, content accuracy and historical relevance, history of pedagogy, learners' engagement and access to the history content, critical thinking and skills implementation activities, assessment questions drawn from history, culture sensitivity and inclusive history and finally supplementary support materials.* These will be discussed in detail by proceeding with the reviewed literature.

2. LITERATURE REVIEW

The focus of this section is to provide the conceptual framework that underpin this study and will be used for selected Textbook One analysis. A conceptual framework is a collection of concepts, theories, and ideas that serve as a framework and point of reference for research, analysis, and interpretation in a particular field of study (Karunarathna, Gunasena, Alvis & Jayawardana, 2024). According to the citation in Yao, (2024) study, a conceptual framework is a written or visual presentation that explains the main elements to be studied, such as the important components, concepts, or variables, and the assumed relationships among them, either graphically or in narrative form. The literature on the incorporation of HoS in Life sciences textbooks will be reviewed using the established framework. The Life science curriculum for grades 10 -12 consists of four knowledge strands. The Life science curriculum for grades 10 -12 consists of four knowledge strands. These knowledge strands include Life at the molecular, cellular and tissue level, Life processes in plants and animals; Environmental studies including diversity, change and continuity (DBE, 2011).

These knowledge strands must be compatible with the analysed textbooks. It is not recommended to study these Knowledge Strands, or the topics contained within each Knowledge Strand separately or independently (DBE, 2011). The HoS integration must be taught through the content subtopics within these provided strands.

2.1. Life Sciences Curriculum Alignment to the History of Science

This tenet aimed to satisfy the researcher with the selected Textbook Ones the source to supplement what should be taught in curriculum standards and learning objectives of Grade 11 Life Sciences. The researcher started by reviewing each textbook historical content to ensure the content matches the recommended curriculum standards set down by the education department. I then looked at the evidence that determine whether the content of the textbook defines and tackles the details of the historically based objectives for Grade 11 Life Sciences. This was followed by the content flow and determined if the textbook presented easy historic ideas before presenting complex ideas as lessons to be learned (DBE, 2011).

2.2. Historical Content Accuracy and Relevance

The purpose of this tenet was to check the accuracy and relevance of the Life Sciences content in textbooks. The content according to CAPS must be factually correct, current and leads a learner to the topic under consideration. Assuring scientific accuracy meant the check of current scientific data and other findings, ensuring relevancy that the history of science content reflects. This includes the up-to-date advancements in sciences and pay attention to the practical usage. Under this objective I further looked at the depth of HoS coverage. This implied the review if the textbook develops the HoS in the required depth, which can offer the learners enough information without overloading them.

2.3. Historical Pedagogical Approaches

This tenet aimed to assess the teaching approaches and techniques applied in the textbook in the process of enhancing learners' performance. This include examining the design of lesson plans. In this tenet, I examined which historical concepts are introduced, explained, and taught again, throughout the textbook. I also looked at the variety of teaching strategies and methods. With this, I evaluated the applicability of historically based teaching strategies, including teacher differentiation activities, explanation and directions, 'guided discovery' approach and solving problems at hand like monohybrid and dihybrid crosses. My other concern was with scaffolded learning especially to slow learners. This means that I also needed to consider whether the analysed textbook uses a gradual approach in presenting knowledge and skills so that the information is broken down to allow the learner to build on what he or she already knows to be able to handle more challenging content concepts.

2.4. Learners Engagement and Accessibility to Historical Content

The researcher further made sure that the textbook is interesting and comprehensible for each of the learners. This included language usage and content readability. As such, I assessed whether the language used to present historic material was appropriate for learners in Grade 12 and whether any complicated terms have been used. But if the author used such terms, were they simplified or explained adequately. The use of visual aids when engaging learners was also evaluated. I looked at how helpful and easy to understand the various forms of past science images including diagrams, charts, illustrations, posters and photographs in enhancing learner understanding. Diverse Learning styles cannot be over emphasized in this tenet. I further determined whether the textbook was sensitive to learners' different learning styles as well as kind of learning that suits them, visual learning, auditory learning, and physical learning.

2.5. Historical Content that Promotes Critical Thinking and Application

This aspect scrutinised the role of the textbooks and checked whether it helped to develop the learners' capacity to think critically and be able to apply the knowledge in real life situations. As a result, I checked for questions that promotes and fosters higher order thinking. The aim was to evaluate the textbook to see whether it had questions and activities that encouraged the ancient scientific discoveries activities with features above simply recalling the content. So, I searched for questions that probe analysis, synthesis and evaluation. Real-world connection evidence was also a priority. I therefore determined whether these textbooks presented historical discoveries that are linked to real life scenarios and life challenges. Inquiry based activities were worth to look at as listening for any call for students to participate in history of science related investigations, experiments, inquiries, etc. like past scientists was crucial.

2.6. Historically based Assessment Questions

The purpose of this next aspect advocates the need to make sure that the Textbook One analysed is useful in giving proper means for evaluating the knowledge of the learners. The following forms of assessments were at the forefront of this analysis. Formative assessment called for the consideration of historically based activities and questions that facilitate, checks and balances of the learning process that is ongoing. The summative assessment activities were checked on the frequency and quality of at the end of each chapter. And this included tests, quizzes, and summaries that checked learners' general understanding of the content. The feedback mechanism checks were also a necessity. In this instance the textbook should therefore indicate whether it provides content information on the kind of feedback that is required by CAPS curriculum, or where learners should seek clarification about how well they grasped a certain topic.

2.7. Inclusivity and Cultural Sensitivity

This tenet aimed at confirming from the textbook that it is culturally sensitive to all the learners that may be there in a Life sciences class. AS such, cultural relevance to determine whether the content is culturally sensitive and whether it portrays different scientific cultures, background, and the attitudes properly. As such, I therefore analysed each textbook for biases and stereotype which might be viewed by learners to ensure that they in turn do not develop any bias when learning. The accessibility features couldn't be emphasis further. I therefore determined whether the textbook offered accommodations for learners with different learning abilities to learn, including study guides that provides a summary of the chapters.

2.8. Historically based Supplementary Materials to Learning

The last tenet that the researcher looked at was to evaluate the possibility of getting historically based supplementary materials to learning. As a result, supplementary materials also known as LTSM were checked and examined for the appropriateness of the addition of historical teachers' manuals and guides, learners' notebooks and workbooks, and web sites and related resources more from the internet. I further checked on the references and further reading. This was to find out whether the author of the textbook presented a bibliographic source for additional examination of history of science concepts and issues.

3. METHODOLOGY

This study employs a systematic literature review Subran & Mahmud, (2024), which includes a review of the HoS integration associated with literature, an evaluation of curricular materials, and an investigation of two Life sciences textbooks used in grade 12. This study adopts a systematic literature review which included the following inclusion criteria: examining related literature, CAPS curriculum document analysis and examination of two selected grade 12 Life Sciences textbooks. Choosing a selection of popular Life Sciences texts for the FET Phase of secondary schooling was imperative for the current study. As such, a thorough examination of the chosen texts to find any historically based content conducted. Lastly, the documentation of instances and sections in the Life sciences textbooks where HoS was discussed was done except the examination question papers.

This paper analysed and discussed results for the collected data. It investigated the extent of integrating the history of science into Life Sciences selected textbooks in the Further Education and Training Phase, specifical in grade 12. The targeted sample consisted of two (2) textbooks that were authorised by the Curriculum and Assessment Policy Statement (CAPS). Data was collected through the qualitative content analysis as pointed by authors Szabó, Soós & Schiller, (2025), under the conceptual framework of the HoS designed by the researcher. The results were recorded using Textbook analysis tool created by the researcher. This self-constructed tool allowed for an in depth historically based content analysis.

The table developed allowed the ticking if there is evidence and the crossing, an indication that there is no content in the textbook. All pages in each textbook were analysed according to the criteria provided in the framework.

3.1. Research Design

This study is qualitative in nature, focusing on process, meaning, and understanding with words or pictures rather than numbers Bentalha & Alla, (2024). According to Davids, van Houte & Jill (2025), qualitative research is an inquiry process of understanding, where the research develops a cogent argument. This is a suitable design for this study because the study intends to make historical content analysis of the Life sciences textbooks, how they represent the concept of HoS. Instead of attempting to predict results, as in the positivist paradigm, qualitative research focuses on interpretivist and constructivist paradigms (Tariq, 2025).

The interpretive paradigm is used in this study. According to Acharya, (2024), interpretivism aims at developing knowledge by appreciating individuals' distinctive points of view and the significance associated with them. According to Feinstein & Baram-Tsabari, (2024), the growth of understanding of how people interpret their environment, the context in which they live and work, and how they interpret the meaning of their specific acts. As individuals attempt to make sense of their experiences, constructivism sees knowledge as being built (Wibowo, Wangid, & Firdaus, 2025). Again, this paradigm believes that there is no single reality or truth, and therefore reality needs to be interpreted (Wibowo et.al., 2025), and therefore in this case the textbooks that are used by teachers in Further and Training Phase for integrating the indigenous knowledge systems will be analysed and the results will be interpreted.

In this study, the representation of HoS in grade 12 Life sciences textbooks was analysed. The textbooks analysed were published in South Africa and supported by the CAPS curriculum in the Department of Basic Education. To fulfil the aim of this study, qualitative content analysis was carried out and the study addressed the research question: *To what extent is the HoS integrated into selected Grade 12 Life Sciences textbooks in the FET phase?*

3.2. Sample and Sampling Techniques

Purposive sampling was used in selecting a grade 12 Life Sciences textbook to analyse how it represented the historically based content. Purposive sampling is a non-probability sampling strategy in which the researcher only chose the textbook that met the current study's objectives (Nyimbili & Nyimbili, 2024).The panel, which was assembled by the South African Departments of Basic Education (DBE), made recommendations on the grade 12 Life Sciences prescribed textbooks for school orders, which

are the basis for the textbook selection .The textbook chosen for this study is deemed by the panel to be complaint with National Curriculum and Assessment Policy Statement (CAPS).The most available and commonly used Life Sciences textbook in the FET phase was selected for this study.

Understanding Life Sciences textbook was therefore sampled for this study. The textbook sampled is used by teachers in the form of teacher's guide and learners' book to integrate HoS in grade 12. The conceptual framework which entailed the list of the content(topics) or concepts for Life sciences Textbook One analysis was compiled by the researcher. The purposive sampling technique mentioned above was employed for the selection of the textbooks. A textbook content analysis instrument was created and developed by a researcher. The tool aimed at analyzing the selected textbook to generate the data that assisted in answering the question on the concept of HoS representation in Life Sciences textbooks.

3.3. Data Collection Procedure

This section presented how data was collected and analyzed in this study. The Textbook One analysis focuses on content topics indicated by each strand in Life Sciences. This will be done under the developed conceptual framework.

3.3.1. Tool for Data Collection

The Textbook One analysis tool was organized in a three-column table format, where a first column represented a criterion used and the other two columns represented each textbook. The textbook content analysis looks at the Curriculum Alignment to the History of Science, Historical Content Accuracy and Relevance, Historical Pedagogical Approaches, Learners Engagement and Accessibility to historical content, Critical Thinking and Application activities, historically based Assessment Questions, Inclusivity and cultural Sensitivity and Historically based supplementary materials to learning. These will be discussed in detail by providing the reviewed literature. To ensure the accuracy of data collection through Textbook One analysis, each textbook is analyzed twice. The following indications were used to mark the tool viz. √ and x

The tables below indicate the tool created by the researcher and data collected from the selected textbooks.

3.4. Data Analysis

3.4.1. CAPS Curriculum Documents Analysis

This section discusses the official subject matter documentation, more especially CAPS regulations promulgated by the South African Department of Basic Education for Life Sciences in the FET Phase. It also re-evaluates recommendations concerning historical views as applied to Life Sciences classrooms. The technique used in this study aims at collecting, understanding, and disseminating data with the use of perspective from History of Science. Knowledge of the paradigm for this study made it possible to apply better techniques in data collection and analysis to address research questions (Karunarathna, Gunasena, Hapuarachchi & Gunathilake, 2024). In this study, Life Sciences textbooks were used, and qualitative analysis of content analysis will be completed in terms of how history is taught in the curriculum. In so doing, the study seeks to establish the way such aspects as scientific thought developments in history can be depicted and how best they can be brought in to accomplish the intended curriculum goals.

3.4.2. Understanding Life Sciences Textbook Content Analysis

This study adopted a qualitative content analysis to analyse the grade 12 Life sciences textbooks within the best fit HoS conceived framework. According to Nicmanis, (2024) content analysis is described as" research method used for making communication replicable and valid inferences from text or other forms of meaning content for the context in which it was used". Once again, this research technique comprises structured methods which should be adhered to in data analysis, and it is considered as a scientific tool used to help researchers have a better understanding of texts and problems aired in relation to them.

According to Nicmanis, (2024), there are three specific features of content analysis. Firstly, content analysis is "fundamentally empirical in orientation" Nicmanis, (2024). Secondly, "a content analysis transcends conventional notions of content" and, thirdly, "content analysis is developing a methodology of its own" Nicmanis, (2024). Relating to the case of interpretation of text and images, one can decipher phenomena and meanings through qualitative content analysis. Besides, it is a way to address the research questions (Lim, 2025).

The existence of a topic in the textbook is assessed by using simple qualitative content analysis. The easiest way to decide whether the topics outlined in the syllabus have been included in the textbook is to flip through the pages of the book and view the table of contents (Pedrera, Barrutia & Díez, 2024). It would also be possible to conclude the analysis based on the results in the form of a table where the row headings would include content that defines whether the content is covered in a specific textbook, and the columns would correspond to the list of textbooks. Therefore, this research aims at investigating how HoS is presented in chapter topics that are taught in each of Life science strands. In this study, all the content pages of the Life Sciences textbooks were examined within the context of the HoS.

4. STUDY FINDINGS

4.1. Presentation of Results

The data presented in Table 1 sheds light on the content identified in the two textbooks.

Table 1: Presentation of research results from a review of Understanding Life sciences textbook.

Content analysed	Availability
Curriculum alignment to the history of science	✓ Textbook has an ability to align with the curriculum requirements of the HoS
Historical content accuracy and relevance	✓ Historical content accuracy is highlighted (accurate). ✓ Relevance of items of historical content in some topics is noted as indicated in CAPS
Historical pedagogical approaches	✗There is no identification of teaching strategies and methods targeting specifically HoS in teachers' guides. ✗ No pre-planned Historical Pedagogical Approaches of lesson plans included in teachers' guides
Learners engagement and accessibility to historical content	✓ There is learning engagement through historically based activities, and the activity is also easily located in selected content.
Critical thinking and application activities	✓ Daily effective, authentic, and curriculum relevant learner engagement activities to promote higher levels of HoS learners' reasoning and decision-making in solving genetics problems.
Historically based assessment questions	✓ **T**here are HoS-aligned assessment questions available in selected content.
Historically based support materials to learning	✗ Partial adoption of HoS-oriented LTSM ✗ LTSM historiographic coverage in the textbook in general is not comprehensive. ✗ Thus, the factor of material accessibility which is historically oriented is partially disclosed.

4.2. Analysis of Findings

The data collected by the researcher from a selected textbook was analysed using Saldana coding system "A coding in a qualitative study is frequently an expression that signifies summarizing, significant and captivating visible information," writes Saldana (2021:3). Observations, note-taking from these books served as instruments to collect qualitative data. This is how the coding system was utilized in this study: CODES were clustered into similar codes in CATEGORIES first, and from CATEGORIES, the EMERGING THEMES & SUBTHEMES were distilled.

Using a qualitative approach to evaluate the History of Sciences content and richness while taking instructional efficiency into account.

The conceptual framework from the above table was used to analyse the textbooks results on the availability of HoS content. Firstly, the Codes were identified. This was followed by CATEGORIES, then EMERGING THEMES and SUBTHEMES regarding the integration of HoS in Life Sciences education. Saldana (2021:3).

This was achieved in this subsequent manner:

From the following CODES I needed to find what were common patterns that will form CATEGORIES then these categories distilled or shortened to THEMES then to SUB-THEMES.

Table 2: Curriculum alignment to the history of science.

Data collected from the textbook pointed that its curriculum content on certain topics clearly Aligns to the integration of the History of Science
Allocating codes: a. Curriculum Alignment to the History of Science These two were coded as view of a content Group similar codes into categories: Category 1: History of science Distilling themes & subthemes: *From these categories, the following themes and sub-themes can be distilled.* Theme 1: Alignment to curriculum Sub-Theme 1: Curriculum alignment to the History of Science is evident

Table 3: Historical content accuracy and relevancy.

Data collected from the textbook revealed that its curriculum content on certain topics clearly Aligns to the integration of the History of Science
Allocating codes: The findings on the following aspects were codified as follows: a. Historical Content Accuracy and Relevance, This was Coded as Historical Content Accuracy and Relevance, Group similar codes into categories: Category: History of science Distilling themes & subthemes: *From these categories, the following themes and sub-themes can be distilled.* Theme 2: historical content accuracy Theme 3: historical content relevancy Sub-theme 2: historical content is accurate Sub-theme 3: Historical perspectives of a content is relevant.

Table 4: Historical pedagogical approaches.

Data collected indicated that the textbook insufficiently provides the historical pedagogical approaches.
Allocating codes: The findings on the following aspects were codified as follows: a. Historically based pedagogies This was coded as historically based pedagogy Group similar codes into categories: Category 4: Pedagogy Distilling themes & subthemes: *From this category, the following themes and sub-themes can be distilled.* THEME 4: Strategies and methods THEME 5: Assessment questions THEME 6: Inclusivity THEME 7: LTSM *These themes were distilled to the following sub-themes:* SUB-THEME 4: HoS Strategies and methods are not evident in teachers' guide. SUB-THEME 5: HoS aligned assessment questions available SUB-THEME 6: Indicates inclusivity SUB-THEME 7: Indicates the partial use of HoS oriented LTSM

Table 5: Learner engagement and accessibility to historical content.

Data collected from textbooks pointed that the textbook depicts learner Engagement and Accessibility to historical content in evolution, DNA and evolution.
Allocating codes: The findings on this aspect were codified as follows: a. Learners Engagement and Accessibility to historical content This was CODED as Learners Engagement and Accessibility to historical content Group similar codes into categories: Category 1: Learners Distilling themes & subthemes: *From these categories, the following themes and sub-themes can be distilled.* THEME: 1 Engagement The theme was distilled to the following sub-themes SUB-THEME 1: HoS based activities that promotes engagement, critical thinking and problem-solving skills are available in genetics

Table 6: Critical thinking and application activities.

Data collected from textbooks pointed that textbooks A and B depicts westernized ways to explore sustainability of resources like water and wood. However, a little to none is mentioned of indigenous ways to preserve such resources.
Allocating codes: The findings were codified as follows: a. Critical Thinking skills and Application activities This was coded as critical thinking skills and application activities group similar codes into categories Category 1: LEARNERS Distilling themes & subthemes: *From these categories, the following themes and sub-themes can be distilled.* THEME 3: Skills THEME 4: Application activities These themes were distilled to the following sub-themes SUB-THEME 1: HoS based activities that promotes engagement, critical thinking and problem-solving skills are available in genetics SUB-THEME 2: Application activities available

Table 7: Historically based assessment questions.

Data collected from textbooks pointed the availability of historically based assessment questions.
Allocating Codes: The findings were codified as follows: a. historically based Assessment Questions This finding was CODED As LEARNERS Group Similar Codes into Categories: Category 1: historically based Assessment Questions Distilling Themes & Subthemes: *From this category, the following theme and sub-themes can be distilled.* THEME 5: Assessment This theme was distilled to the following sub-theme SUB-THEME 4: Historically based assessment questions available

Table 8: Historically based support materials to learning.

Data collected from textbooks indicated the partial availability of historically based support materials to learning
ALLOCATING CODES: The findings on the following aspects were codified as follows: a. Historically based support materials to learning This was Coded as Learner Engagement Group Similar Codes into Categories: Category 1: Historically based support materials to learning Distilling Themes & Subthemes: *From these categories, the following themes and sub-themes can be distilled.* THEME: 1 Challenges with depiction of sustainable resources using indigenous ways. SUB-THEME: Lack Indigenous knowledge wisdom in textbooks

Table 9: Summary of the analysis.

Codes	**Categories**	**Themes**	**Sub-Themes**
Curriculum Alignment to the History of Science Historical Content Accuracy and Relevance,	HoS	Alignment to curriculum Historical content accuracy Historical content relevancy	Curriculum Alignment to the History of Science is evident Historical content is accurate/not Historical content is relevant/not
Historical Pedagogical Approaches,	Pedagogy	Strategies and methods Assessment questions Inclusivity LTSM	HoS Strategies and methods are not evident HoS aligned assessment questions available Indicates inclusivity Indicates the partial use of HoS oriented LTSM
Learners Engagement and Accessibility to historical content, Critical Thinking skills and Application activities, historically based Assessment Questions,	Learners	Skills Accessibility Application activities Assessment questions	HoS based activities that promote critical thinking and problem-solving skills available in genetics HoS material accessibility is partially evident Application activities available Historically based Assessment questions available
Historically based support materials for learning.	LTSM included in textbooks	Historically oriented LTSM	Availability of Historically Oriented LTSM

5. DISCUSSION OF FINDINGS

The analysis of the data reveals interesting insights into the content of selected textbooks. In terms of the historical content of the CAPS curriculum, the subject area is compliant with the History of Science (HoS). There exists a set of assessment questions and content that is aligned with the history of science; nonetheless, there are calls for unique teaching methods and approaches for HoS (Buthelezi, 2024), and limited use of LTSM based on HoS. On one hand, critical thinking and problem solving are fostered by activities in which learners engage according to (Buthelezi, 2024), on the other hand, access to HoS materials is restrained and historically oriented resources in textbooks are hardly incorporated.

5.1. Curriculum Alignment to the History of Science

Implementation of specific aim three of Life Sciences CAPS document to support Curriculum in the History of Science was acknowledged. According to the results obtained, curriculum alignment with the History of Science seems to be confirmed. This is evidenced by the acknowledgement of Historical content accuracy and relevance. It is clear from the analysis of the subject matter that there is inadequate documentation of historical content.

High historical relevance according to (Buthelezi, 2024) means that learners ought to be able to relate present day concepts to previous scientific advancements. However, any area that is weak in content in terms of accuracy and appropriateness defeats the purpose of using history as an educational model. The factual account assists in establishing the believability of HoS integration, and the contextual content that contributes to the applicability of the HoS material to current knowledge frameworks.

5.2. Historical Pedagogical Approaches

In practice, there are many learning theories including historical pedagogical approaches. History of Science as a pedagogical strategy seems to have been used sparingly (Buthelezi, 2024). The current study indicates that practices and approaches unique to HoS in textbooks appear scarce. This presumably reveals a problem within the teacher education and science education curriculum development process, whereby the historical context is given a scant consideration. Embedding the history of science into Life Sciences classroom teaching practices, according to the authors Buthelezi & Mpuangnan, (2024) holds immense significance in enhancing learners' understanding of scientific concepts.

5.3. Assessment Questions

There is a noticeable lack of assessment questions aligned with History of Science (HoS) content across scientific topics. This points to the minimal efforts to integrate HoS into summative and formative evaluation practices. CAPS curriculum alignment exists at the administrative level. However, inconsistencies in implementation at the classroom level suggest limited incorporation of HoS in content teaching and assessment methods.

5.4. Inclusivity and LTSM

Less degree of HoS inclusion was detectable in Life Sciences textbooks. There is weak evidence for HoS- oriented learning resources depicted. Diversity in HoS inclusion is important according to the authors Percílio, Oliveira & García, (2024) because it guarantees that learners in large can easily relate themselves to some of the examples shown by history. LTSM underpins the ability to arrange structured support for historical analysis.

5.5. Learners' Engagement and Accessibility to Historical Content

The findings suggest a mixed level of engagement and accessibility.

5.6. Skills Development

Activities encouraging the use of genetics in critical thinking and problem-solving activities (a HoS- aligned topic) are evident. These skills according to Panakaje et.al., (2024), are critical in the cultivation of learners' analytical skills and 'ways of thinking', promoting scientific literacy using historical perspective.

5.7. Accessibility of Historical Content

Accessibility of HoS-based materials and activities is revealed only in part. Limited issues of accessibility could arise from lack of resources, poor distribution or lack of proper communication anomalies to the practices of the classroom.

5.8. Application Activities and Assessment

Samples of application activities aligned with the historical learning objectives as well as Historical assessment questions are available to promote active engagement. However, there might be limited access to all the materials that are essential in the learning process, in that case limit their usefulness when employed in practice.

5.9. Historically Oriented Support Materials (LTSM)

Findings suggest the limited availability of historically oriented LTSM in textbooks content.

5.10. Availability and Use

The findings indicate that LTSM is only partially implemented with reception of HoS elements. Such kinds of materials have major importance for connecting theoretical and practical knowledge since they offer structured and organized material for teachers and learners.

5.11. Challenges

Less coverage of LTSM could be caused by restrictions in the possibility of developing the Life Sciences content of textbooks or the absence of the historical aspect to science as reflected in the pattern of the standard curriculum.

5.12. Synthesis of Themes

The findings reflect both progress and as pointed out by Buthelezi & Mpuangnan (2024), gaps in integrating the History of Science into Life sciences educational practices. It is apparent that Life Sciences CAPS curriculum facilitates and demonstrates the alignment to HoS. HoS-aligned assessment questions and the use of application activities that encourage critical thinking is evident. A few changes are needed towards inclusive content. However, this may seem impossible due to lack of effective use of historical oriented pedagogies. Also, the limited availability and access to HoS materials might contribute to this. The associated risk is that the historical content may not always be both accurate and current.

6. RECOMMENDATIONS

It is suggested that teachers' trainings institutes should adjust the content of Life sciences training modules to accommodate the integration of the HoS strategy. The study findings suggest that educators should be equipped with practical ways through which HoS can be incorporated in teaching approaches leading to improvement in the degree of learner engagement. Training on historically focused materials becomes a necessity to empower every Life sciences teacher on how to integrate HoS in their teaching practices. The study also brings out the possibility of enhancing a Life Sciences CAPS curriculum design. Sources of past material should be factual in that history presented should be as precise as possible. Historical material provided should be factual and ensure that history is accurate and probably relevant to what is required from the learners. The study suggests the introduction of historical reference materials to support the provision of access to such materials. The use of materials to promote participation in historically embedded lessons is recommended.

Teachers should be well envisaged with explaining to the students some general aspects of the lives of the scientist who embarked on adventurous expeditions into the newly discovered territories such as discovering penicillin and how it works. Additionally, teachers should be able to explain counterparts to students about wonderful and exciting lives of scientists who entered unknown territories of the Life sciences contents. They may go to an extent of utilizing movies, documentaries, and daily

/ weekly / monthly calendars to record not only what happened, but how people felt during that era, and what they struggled with. Let the students witness the thrill or agony of scientific history better, enjoying as if they were part of historical discoveries. Ask the students questions on ethical issues that the scientist must consider when studying the biological processes to encourage editing and rectifying the flaws of the past. The study also suggests extending access to history oriented LTSM by presenting historiographic resources to promote learner engagement, so that no learner is locked out from the HoS integration.

7. CONCLUSION

According to this study, the Life Sciences CAPS curriculum aligns with the History of Science (HoS), yet Grade 12 textbooks portray it in an unequal manner. In certain subjects, like evolution and genetics, which promote critical thinking and application, there is unmistakable proof of curriculum conformance and HoS integration. However, there is little or uneven use of historically oriented learning and teaching support materials (LTSM), inclusive content, and historical pedagogical practices. The entire pedagogical potential of HoS integration is limited by the lack of access to varied, accurate, and captivating historical information. As a result, despite the existence of fundamental frameworks, there are still large gaps in instructional assistance, textbook design, and teacher readiness.

HoS-based teaching techniques must be included into teacher preparation programs for meaningful adoption, and curriculum designers and researchers ought to make certain that pertinent, accurate, and interesting historical resources are available. It is possible to humanize science and make historical material more approachable by promoting student participation through narrative, media, and morally challenging exercises. Ultimately, to improve scientific literacy, contextual understanding, and learner involvement, a more thorough and useful integration of HoS in Life Sciences education is required.

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