International Journal of Current Research in Multidisciplinary (IJCRM) *ISSN: 2456-0979*
Vol. 9, No. 10, (November'24), pp. 06-17

CONTENT ANALYSIS OF CELL DIVISION CONCEPTS IN SENIOR HIGH SCHOOL BIOLOGY TEXTBOOKS

Nabonagea Emmanuel[1], Thomas Nipielim Tindan[2]
[1]*Tazika\Bagtua Junior High School, Post Office Box 46 Paga Upper East Ghana*
[2]*Department of Science Education, C.K. Tedam University of Technology and Applied Sciences. Ghana*

ABSTRACT: *Content and accuracy evaluation of textbooks is important as it provides quality assurance to both teachers and learners, especially in the new normal where modular instruction is used. This research aimed at evaluating the biology textbooks used by Senior High School STEM Science teachers in content, presentation, and learning strategies. Content analysis and Collaizzi's descriptive phenomenology approach were employed in this study. The results showed that all evaluated textbooks have unique, distinct content, presentation, and learning strategies. Most topics were also aligned with the minimum curriculum requirement for SHS STEM, but topics such as cyclin-dependent kinases (CDKs) and control checkpoints were not discussed in some books. Learning outcomes were not indicated in some books, and few textbooks did not reach synthesis and evaluation level. However, a comparative approach of cell division across the 5- kingdom system is observed but not explained well, and some misleading statements in the cell division mechanism were present. Considering that cell division precedes the discussion of cancer cell division and metastasis, content enrichment through learner-friendly visuals and diagrams is recommended to facilitate learning, improve retention, and avoid misconceptions.*

INTRODUCTION

Cell division is one of the most challenging concepts or topics to teach and understand in Biology as subject in the Senior High Schools. Students' understanding of concepts like cell division is greatly influenced by the content and precision of the textbooks used in for studies. Cell division is one of the fundamental to many biological processes and is crucial to understanding more general biological phenomena. In the Senior High Schools, when basic knowledge is developed and refined, the accuracy and lucidity of information pertaining to cell division are critical. This study aims to analyze the content of cell division as taught in biology textbooks for senior high school students. The material's pedagogical efficacy will be assessed, accuracy, and depth by closely examining its content in various textbooks. In particular, this study aims to pinpoint common topics, misconceptions, wrongly used terms and areas of strength and weakness in the discussion of cell division as a topic. The language used will be methodically examined and the illustrations utilized, and the explanations given in a few textbooks through the lens of content analysis. By combining this data, light will be thrown on how well Senior High School students are being taught on concepts related to cell division through current pedagogical approaches. This investigation will also add to the current conversation about instructional design and curriculum development in scientific education. The goal of this empirical research is to provide educators, and curriculum designers with information regarding possible areas where cell division content in biology textbooks should be improved at the Senior High School level. By enhancing the clarity, accuracy, and accessibility of educational materials, educators and students will be empowered in their pursuit of biological knowledge and scientific literacy.

LITERATURE REVIEW

Students mostly rely on memorization of stages and their respective distinguishing attributes but failed to provide a comprehensive synthesis of the process when asked to differentiate how cell division occurs between prokaryote and eukaryote, and how fungi and protozoans divide compared to animal and plant cells. Moreover, published literature also noted confusion on the following topics: tracing chromosome and chromatid number, the difference between dividing versus non-dividing chromosomes, what governs anaphase in the absence of centrioles in plant cells, an independent assortment of genes, how to count the centromere, and how gametes are

formed, to name a few (Chattopadhyay, 2012). Mitosis, meiosis, and mutations have the highest misconception and alternative conception among the students in Genetics (Kumandas et al., 2018). This problem is evidence in the Philippines, as noted by the study of Rogayan and Albino (2019), which stated that Filipino students' misconception level in Biology subject especially in genetics which includes cell division is high. Functional Literacy, Education and Mass Media Survey (FLEMMS, 2019) noted that the functional literacy rate for 10 to 64 years old in the Philippines is increasing with 91.6%, 85.8% in MIMAROPA Region (Philippine Statistics Authority, 2019), and 95.7% in Palawan (Philippine Statistics Authority, 2016). The Filipinos age group population of 15 to 19 years old had the highest basic literacy rate at 98.6%, while the 5 to 9 age group had the lowest at 73.2% in the country (FLEMMS, 2020). On the contrary, the Philippine's quality of Math and Science education ranked 76th out of 137 countries (World Economic Forum, 2018). Meanwhile, the OECD (2018) showed that the Philippines ranked second to the last among all other participating countries, with 357 scores (below average) in science. Teachers and curriculum experts believe that the poor quality of science textbooks contributes to this problem (Irez, 2009). Textbooks are essential for the educational enterprise (Okabe, 2013) because of the following reasons: (a) it is the most available teaching tool that provides essential information to students (Kashi et al., 2015); (b) convey knowledge to the learners (Tok, 2012); and (c) plays a crucial role in the teaching and learning process in many classrooms (Gok, 2012). Good quality textbooks also help to facilitate science teachers' development (Swanepoel, 2010). Although current online-based education technology has massively modified the learning platform of our students, textbooks are still widely favored because of their availability and ease of use. They are the most common instructional materials for students and teachers at all grade levels (Gok, 2012). In the Philippines, Rogayan and Albino (2019) revealed that some science reference learning materials contain misconceptions and errors that indirectly threaten science education quality. Many teachers have also reported that the books' content is obsolete and flooded with errors (Ambag, 2018). Considering that books' content quality and accuracy are crucial for educational effectiveness (Gok, 2012; Khine, 2013), evaluating science textbooks in terms of alignment of the book content with the curriculum, accuracy, and authenticity of the content is of paramount importance to ensure quality of science education. Similarly, attributes such as organization of instructional materials, readability, motivational strategies, explicit instruction, target assessment, and instructional strategies are also deemed essential (Gok, 2012), especially in the *new normal* where modular instruction is employed. However, the researches which are focused on content analysis still very limited. Hence, the current research conducted a content analysis of SHS Biology textbooks particularly in cell material. This research provided the need for studies on science education literacy using reference materials in teaching cell division by employing content analysis of textbooks in terms of content, presentations, and learning strategies. It also explored teachers' experiences and insights using the textbooks used by SHS teachers in the province of Palawan. This study primarily intends to help improve the content understanding of science teachers and serve as a guide in crafting learning modules that can be used in different learning modalities, such as modular instruction.

METHODOLOGY

The study employed a mixed-method research design utilizing content analysis and Collaizzi's descriptive phenomenology approach. This is composed of two parts: the content analysis of the identified Biology textbooks using the criteria recommended by the Florida University Department of Education (2008) [see Table 1] and the teachers' insights using the identified textbooks to triangulate the study results (Swanepoel, 2010). Teachers in SHS who teach Biology 1 in Science, Technology, Engineering, and Mathematics (STEM) strand in Paga were the informants of this study, and a purposive sampling procedure using a semi structured survey instrument was used. During the interview process, a Google form questionnaire was sent thru the e-mail of the informants, and a follow-up interview via cellular phone calls was employed to clarify and explain further the answers given in the survey. The study used descriptive statistics (i.e., mean and simple percentage) to analyze the quantitative data from the content analysis and employed thematic analysis to interpret the qualitative data based on the teacher participants' responses.

Table 1. Textbook evaluation criteria used in the study

Criteria	**Subcategories**	**Units of Measure**
Content	Alignment with the curriculum requirements Level of treatment of content Accuracy of the content Authenticity of the content	The competencies found in the identified books are aligned with the required competencies set by the Department of Education (DepEd). The method used is the inductive or deductive method. The terms used are appropriate for the learners, and the time allocation is adequate. The book is objective and factual, free of misleading statements and mistakes, biases of interpretation, and inconsistencies. The use of real-life connections and diversity of interdisciplinary connections.
Presentation	Number of pages for each topic Organization of the textbooks Comparison of typography Numbers and types of visuals used	Comparison of the number pages for each topic. The topics are organized according to: a) introduction for each topic; b) labelled reviews or summaries; c) index; d) glossary; and e) bibliography. Comparison of the typographical presentation and visual features of the books. Comparison of the number and types of visuals used.
Learning strategies	Motivational strategy Explicit instruction Guidance and support Targeted instructional and assessment strategies	The book contains thought-provoking problems, various hands-on activities in a concrete context relevant to learners' lives, and various assessment forms. The introduction of the topics is presented well. Textbooks' activities and experiments have clear instructions on how to perform the activities and experiments. Comparison of the analogies found in the textbooks, status of the terms used, the number of activities and experiments found in the textbooks. Comparison of the number of questions, the types of question used, and the cognitive levels of questions used in the textbooks.

RESULTS AND DISCUSSION

A textbook is a major source of information in teaching and translates the curriculum's intent into classroom practice by reflecting the science learning goals (Altbach & Kelly, 1998). The content's quality and accuracy are crucial for their educational effectiveness (Khine, 2013). Quality textbooks significantly impact the quality of instruction (Lemmer et al., 2008), and the availability of high-quality textbooks is one of the critical factors in the successful implementation of curricular reform (Khine, 2015; Liang & Cobern, 2013; Swanpoel, 2010). The following findings were presented in three (3) major clusters [content, presentation, and learning strategies] and their corresponding subcategories.

CONTENT

Table 2 shows the alignment of the content of the textbooks in the curriculum requirements. All books contain facts and data based on the curriculum requirements. Based on the analysis conducted, all books have learning outcomes at the beginning of each chapter. Learners' learning outcomes must contain cognitive, affective, and psychomotor characteristics expected to be mastered at the successful culmination of an entire educational program (ISCED, 2012). Learning outcomes aligned in the national curriculum indicate that the textbook is good in quality (Education Bureau the Government of the Hong Kong Administrative Region, 2016), and it also gives background information to the learners on the goals in every chapter

Table 2. Alignment with curriculum requirements

Learning Competency	**B1**	**B2**	**B3**	**B4**
Characterize the phases of the cell cycle and their control points (STEM_BIO11/12-Id-f-6)	√	√	√	√
Describe the stages of mitosis/meiosis given 2n=6 (STEM_BIO11/12 Id-f-7)	√	√	√	√
Discuss crossing over and recombination in meiosis (STEM_BIO 11/12 Id-f-8)	√	√	√	√
Explain the significance or applications of mitosis/meiosis (STEM_BIO 11/12 Id-f-9)	√	√	√	√
Identify disorders and diseases that result from the malfunction of the cell during the cell cycle (STEM_BIO 11/12 Id-f-10)	√	√	√	√

LEARNING COMPETENCY

Table 3 shows the content of the textbooks in line with learning competencies. Cell cycle phases were discussed in all books. Also, the control checkpoints were mentioned in B1 and B3 but not explained well. In B2, control checkpoints were not mentioned and explained, while B4 control checkpoints were mentioned and explained

well. In addition, B1, B2, and B3 mentioned the signaling system and actions of Cycling-dependent kinase (CDKs) but were not explained well. Lastly, in B4, signaling systems and CDKs were discussed and explained. This implies that B4 met the intended learning competency based on the curriculum guide, and all topics in the books presented have corresponding examples and illustrations.

Table 3. Content of the textbooks in line with learning competencies

Learning competency	**B1**	**B2**	**B3**	**B4**
Characterize the phases of the cell cycle and their control checkpoints (STEM_BIO11/12-ld-f-6)	Phases of the cell cycle were discussed, while control checkpoints and CDKs were mentioned but not explained well.	Phases of the cell cycle were discussed, control checkpoints were not mentioned and explained, while CDKs were mentioned but not explained.	Phases of the cell cycle were discussed, while control checkpoints and CDKs were mentioned but not explained well.	Phases of the cell cycle were discussed. Control checkpoints were mentioned and explained well. CDKs were mentioned and discussed.
Describe the stages of mitosis/meiosis given 2n=6 (STEM_BIO11/12 Id-f-7)	Stages of mitosis and meiosis were explained with corresponding illustrations. Plants also undergo cell division.	Stages of mitosis and meiosis were mentioned but not explained well.	Stages of mitosis and meiosis were explained with corresponding illustrations. Plants also undergo cell division.	Stages of mitosis and meiosis were explained with corresponding illustrations. Plants also undergo cell division.
Discuss crossing-over and recombination in meiosis (STEM_BIO 11/12 Id-f-8)	Mentioned and discussed with corresponding examples and diagrams.	Mentioned but not explained.	Mentioned but not explained.	Mentioned and discussed with corresponding examples and diagrams.
Explain the significance or applications of mitosis/meiosis (STEM_BIO 11/12 Id-f-9)	Significance and applications of mitosis/meiosis were discussed	Significance and applications of mitosis/meiosis were discussed	Significance and applications of mitosis/meiosis were discussed	Significance and applications of mitosis/meiosis were discussed
Identify diseases and disorders that result from the malfunction of the cell cycle (STEM_BIO 11/12 Id-f-10)	Discussed and explained with corresponding illustrations. Mentioned cancer but not explained.	Discussed and explained with corresponding illustrations.	Discussed and explained with corresponding illustrations.	Discussed and explained with corresponding illustrations. Cancer was introduced.

Stages of mitosis and meiosis were discussed and explained in three books (B1, B3, and B4), such as mitosis in body cells and meiosis in sex cells with corresponding illustrations. It was indicated that mitosis produces two daughter cells, and meiosis produces four daughter cells. Only B4 mentioned that mitosis produces two diploid daughter cells, and meiosis produces four haploid daughter cells. B1, B3, and B4 also discussed mitosis and meiosis in plants but not in other kingdoms that undergo the same process. All books mentioned that crossing-

over and recombination, but B1 and B4 discussed the process with corresponding diagrams. This means that B1 and B4 satisfied the learning competency for this topic. Thus, all books met the learning competency assigned in terms of the significance and applications of mitosis and meiosis.

Accuracy of the content

The accuracy of content was analyzed based on the following criteria: factual and objective in text and visuals, inconsistencies and biases of opinion, and misleading statements. Table 5 shows the accuracy of the content in the textbooks. All books discussed the topics in cell division, which are aligned with the learning competencies based on the taught curriculum. The books analyzed are based on facts and show objectivity in text and visuals, following the guidelines on textbooks publishing set by the DepEd. The content is consistent with important terms and reflects the learning competencies of the K to 12 Program stated in the curriculum guide. No bias and inconsistencies have been observed in the four books analyzed since textbooks are one of
the primary sources of lessons in the classroom, accuracy of the content adhere to curriculum standards as stated in the curriculum guide (Macasawang et al., 2019). The National Book Development Board (NBDB, 1994) is mandated to scrutinize the content of the textbooks published in the Philippines goes through a textbook review service to ensure the accuracy of the textbooks' content (Office of the President of the Philippines, 1999). Based on the analysis of the four books, three out of four books were found to be accurate in terms of content.

Table 5. Accuracy of the content

Accuracy of Content	**B1**	**B2**	**B3**	**B4**
Factual and objective in text and visuals	√	√	√	√
Consistent and no bias	√	√	√	√
Misleading statements	X	√	√	√

However, there were misleading statements found in B1 (Table 6). Campbell Biology (twelve edition) serves as reference material to correct the inaccurate terms and statements found in B1.

Table 6. Misleading statements from B1

Misleading Statements	**The Authors should use the correct terms and statements**
Page 39, lines 4-5: ***"Meiosis** is what produces the gametes, sperm, and eggs that fuse after two organisms have sex."*	Meiosis reduces the number of chromosomes sets from diploid to haploid.
Page 40, line 25: *"The normal 46 chromosomes will result in the **fetus**."*	The normal 46 chromosomes will result in a human organism.

Misleading Statements

***"Meiosis** is what produces the gametes, sperm, and eggs that fuse after two organisms have sex."* Meiosis reduces the number of chromosomes sets from diploid to haploid. Page 40, line 25:
*"The normal 46 chromosomes will result in the **fetus**."* The normal 46 chromosomes will result in a human organism. Misleading and inadequate descriptions of science may lead to serious implications for promoting science literacy and negatively affect students' ideas (Irez, 2016). Oakes and Saunders (2002) agreed that poor quality textbooks constitute a significant factor in students' low achievement in external examinations. Some reviewed textbooks in Biology have insufficient content (Nomoto et al., 2011), while other books have some

information that is not always accurate and out-of-date health information (Clifford, 2002; Nomoto et al., 2011). Furthermore, the misleading statements found in the book could lead to misconceptions of the content to the readers (Novitasari et al., 2019). With this, the books should be reviewed and evaluated carefully to check for misleading statements to avoid students' misconceptions.

Authenticity of the content

Table 7 shows the authenticity of the textbook content. The authenticity of the textbook content was presented in all books and evaluated based on two criteria: real-life connections and diversity of interdisciplinary connections.

Authenticity of the Content	**B1**	**B2**	**B3**	**B4**
Real-life connections	√	√	√	√
Interdisciplinary Connections	√	√	√	√

Real-life connections

All books have their respective real-life connections (Table 8). Real-life connections communicate theoretical concepts into students' everyday lives (Gamble & Gamble, 2013).

Table 8. Real-life connection statements

Books	**Page**	**Real-life connection statements**
B1	page 34; lines 16-18	Why and how your hair and nails are growing? What makes your wound heal? How does it happen? How do the cells in your body multiply?
B2	page 49; lines13-17	You are applying for admission and a scholarship for a doctoral degree in Health sciences. As part of the application process, you have to submit a project proposal on a specific type of cancer and risk factors associated with it, focusing on your future project proposal to your prospective supervisors and the scholarship review panel.
B3	page 128; lines 15-17	Important applications of mitosis and meiosis may be found in plant research. Bigger and better varieties of plants are produced modifying chromosomes like growing bamboo using tissue culture.
B4	page 76; lines 1-9	Cell division is associated with growth and development; even humans are products of numerous cellular divisions, as life begins only with one single cell from the

		fusion of the parents' sex cells. In about nine months, that cell becomes trillions of cells due to the numerous cell divisions during embryonic development. The image in figure 3-2 shows a picture of an onion root tip. It shows an area in the onion plant that rapidly produces new cells, making the onion elongate and grow in size.

Studies of Atilla (2012) and Bernardo (2013) found that students' understanding of essential learning concepts could be improved, making the learning experience meaningful by providing real-life situations in their daily lives. Another feature of real-life connections is by featuring well-known scientists with works related to genetics. B2 and B4 have separate sections to showcase real-life examples by featuring science experts. In addition, B4 featured both foreign and Filipino scientists. This will expose and motivate the students to pursue science-related courses someday as they aspire to become experts mentioned in the book. In textbook development, it must be carefully planned and reviewed by experts to avoid textbook fatigue.
This could be avoided if examples or situations are related to students' everyday lives (Lent, 2012). Lubis and Sahyar (2021) stated that the development of textbooks must be contextualized, integrating culture and students' daily experiences to be meaningful using appropriate examples based on their cognitive level.

ORGANIZATION OF THE TEXTBOOKS

Cell division topics were organized in all books according to a) introduction for each topic; b) labelled reviews or summaries; c) index; d) glossary; and e) bibliography (Table 10). Cell division topics were introduced in all books. However, only B3 and B4 have labelled reviews or summaries after each topic. Based on the data, parts of a book like an index, glossary, and bibliography were not found in the cell division chapter in all the books studied. These four books put the index, glossary, and bibliography at the last part of the book. Publishers of these books usually do this to economize the space. Barrus (2018) noted that index, glossary, and bibliography after each topic are important since it helps students recall information from the lessons discussed in a chapter or unit through the chapter summary. Yager (1983) believed that the glossary part in a science textbook where scientific terms or words are defined or described enriches students' learning. Hence, the inclusion of these parts is suggested to support students' learning and understanding of science topics.JPBI (Jurnal Pendidikan Biologi Indonesia)

Table 9. Organization of the textbooks

Parts of the Book	**B1**	**B2**	**B3**	**B4**
Introduction for each topic	√	√	√	√
Labeled reviews or summaries	X	X	√	√
Index	X	X	X	X
Glossary	X	X	X	X
Bibliography	X	X	X	X

Status of terms used in the textbooks

Table 10 presents the status of the terms used in the textbooks. All textbooks presented the new biological terms to support and aid students in learning and understanding the concepts and emphasizing immediately defined terms that boost easier reading, understanding, and comprehension. In contrast, terms that are laterdefined or

undefined hinder students' learning (Gok, 2012). With this, terms should be immediately or earlier defined to help students understand the concepts.

Categories	**B1**	**B2**	**B3**	**B4**
Terms immediately-defined	14	9	5	39
Terms earlier-defined	3	6	15	19
Terms later-defined	1	1	0	2
Terms undefined	1	0	0	0

Activities found in the textbooks

Activities found in the four (4) textbooks are shown in Table 11. B1, B2, and B4 have activities in the cell cycle and cell division. However, B3 does not have any activities regarding the topics. This may affect how students learn and understand the cell cycle and its subtopics since activities can help students develop and advance their learning and stimulate higher-order thinking skills. Mathai (2014) highlighted those activities must be incorporated in the textbooks to let students cope with complex concepts. Textbooks activities aids students grapple with complicated lessons. More activities are encouraged to be incorporated in the textbooks to better support students learning and understanding of the science concepts.

Table 11. Activities found in the four textbooks

B1	**B2**	**B3**	**B4**
1. Learning cell songs from websites (p.56)	1. Reflect on something that has changed… (p. 34)	-	1. Watch video tutorials on Mitosis and Cytokinesis, and Cell Cycle and Mitosis (p. 97)
-	2. Cell cycle (p.46)	-	2. Visit the following learning sites about Meiosis, Cells Alive, and Virtual Cell (p.123)

Experiments found in the textbooks for mitosis and meiosis

Table shows the experiments found in the textbooks. B3 and B4 have suggested activities/experiments in mitosis, while only B4 has suggested activities/experiments in meiosis. B4 is better and more helpful in increasing students' engagement and involvement in learning science concepts than other books. Books that incorporate experiments in the lesson helps to motivate and increase students' understanding (Townsend, 2012).

Table 12. Experiments found in the four textbooks for Mitosis and Meiosis

Experiment for Mitosis	**B1**	**B2**	**B3**	**B4**
-	-	1. Observing Mitosis (p.126)	1. Locating the Stages of Mitosis (p.96A)	
-	-	2. How long is each stage of the cell cycle? (p. 96E)		
Experiment for Meiosis	**B1**	**B2**	**B3**	**B4**
-	-	-	1. Modelling	

			Meiosis (p.122a)	
-	-	-	2. Stop Motion Meiosis (p.122g)	

Targeted instructional and assessment strategies

Types of questions, tests, and learning activities for identifying the targeted instructional assessment strategies were assessed and evaluated based on the context of Bloom's taxonomy of learning objectives. The learning objectives are categorized into three (3) known as affective, cognitive, and psychomotor. The cognitive aspect involves knowing, comprehending, applying, analyzing, synthesizing, and evaluating (Gok, 2012). Figure 1 presents the cognitive level of learning objectives in the textbooks. B4 has knowledge, comprehension, application, and analysis, which shows the various levels of complexity. Moreover, it was found that B3 has no learning objectives, which implies that it fails to guide students on what main ideas to be understood (knowledge), what skills to be master, and what attitude to learning. Furthermore, no learning objective reaches the synthesis and evaluation level in all textbooks, which requires higher-order thinking skills. Therefore, the cognitive level of learning objectives should not only stop on lower order thinking skills, but it should also reach a higher level of thinking skills since learning goals and objectives address the students' core and fundamental learning skills, content mastery, and critical and analytical thinking skills (Mahajan & Singh, 2017). With this, science textbooks should ensure that objectives are incorporated to organize, clarify, and prioritize learning.

Insights of senior high school biology teachers

Fifteen SHS teachers were the informants of this study, five SHS from Southern Palawan, six from Northern Palawan, and four from Puerto Princesa City. Results of insights serve as the validation to confirm the results of the researchers' content analysis. Insights of the teachers are vital because they are the ones who teach the students using the curriculum with the guide of the reference materials. Textbooks are essential to teachers and students who need to be prepared academically in all necessary competencies.

Content presented

Respondents stated that all books were aligned in the K to 12 Basic Education Curriculum Learning Guide (BEC-LG) in the content of cell division. In B1, crossing over and recombination on cell division were not further presented and emphasized contrary to the indicated BEC-LG. The content is accurately presented but not in detailed discussions, information is insufficient, and needs additional supplementary materials to teach the topic effectively. Activities such as minilab, reading check-in between discussions, and concepts in motion were included that are beneficial for in-depth learning. After each lesson, there are no other citations except the video links and optional video documentaries for further learning.

Respondents observed that some typographical errors and subject-verb agreement were presented in B2. In addition, the discussion is incomplete that needs other resources to expound on the concepts and give more examples. In B3, teachers mentioned that there is lacking descriptions and explanations. Some teachers believed that using this book was enough. The discussion and illustrations are well-presented and well-explained. Every stage in the cell cycle is well-described, including the control points, errors, significance, mitosis, and meiosis application. However, some teachers use other references on illustrations and more in-depth discussions to discuss the topic. Respondents evaluated B4 as a well-contextualized book. The objectives and activities match the competencies indicated in CG. The content was accurate, had no misconceptions, and was sufficient to discuss the SHS level topic. Key concepts in teaching cell division were also evident. Additional information was also provided related to the topic to motivate and make the readers aware of cell division. The order of main topics and subtopics was organized from simple to complex. The teachers rated and recommended using B4 as the most helpful book in terms of content, next with B1, B2, and lastly, B3. A single manner of organizing the content of the books was used. The textbooks must be free from errors, inaccuracies, and misleading statements to convey the correct information as they learn cell

division. The textbook is essential to improve quality education (Juwita et al., 2017) and can be used as teaching material for delivering curriculum content (Candra, 2020). The basic teaching contents in the textbook must be

arranged and ordered used in delivering the curriculum (Ruhiat et al., 2016). Unfortunately, many inappropriate textbooks were used in teaching and schools, such as sync content (Behnke, 2018; Mariani & Usmeldi, 2019).

CONCLUSIONS

Cell division topic in SHS identifies as least learned concept in science. Teachers commonly use textbooks as instructional material that can transfer the essential knowledge and information to the students. Accurate content and no misleading information, quality presentations, and aligned learning strategies in the curriculum and teaching-learning process are important features in the textbook to help the teachers and learners gain efficient and effective education. Using quality textbooks can positively affect students' learning and help the teachers in the science teaching and learning process. JPBI (Jurnal Pendidikan Biologi Indonesia) Vol. 8, No. 2, July 2022, pp. 159-177

Therefore, the role of an educational institution in choosing the best textbook is very vital. They should purchase, provide, and recommend updated books aligned in the curriculum guide with skeptical and keen scrutiny from the experts to avoid any misconceptions in the different topics. Moreover, the book publisher must have credible experts to review the books to avoid misleading statements and use technical and scientific terms to explain the science concepts accurately. Additional relevant activities and experiments with clear instructions are highly encouraged to explore and experience real-life applications of the concepts learned. Using higher order questions and objectives is also recommended to encourage learners to think critically and expound on the concepts learned.

REFERENCES

[1] *Atilla, C. I. (2012). What makes biology learning difficult and effective: Students views. Educational research and reviews, 7(3), 61-71. https://doi.org/10.5897/ERR11.205*

[2] *Behnke, Y. (2018). Textbook effects and efficacy. In the Palgrave handbook of textbook studies, 383–398. https://doi.org/10.1057/978-1-137-53142-1*

[3] *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 (PJSS), 35(1). http://pjss.bzu. edu.pk/index.php/pjss/article/view/306/276*

[4] *Bouma, H. (1980). Visual reading processes and the quality of text displays. In Grandjean, E., & Vigliani, E. (Eds.), Ergonomic aspects of visual display terminals: international workshop, 1980, Milan: proceedings, 101-114. Taylor and Francis Ltd. https://www.semanticscholar.org/paper/Visual-reading processes-and-the-quality-of-text-Bouma/47b4c640791b44c33b67baeeb7dacb305f97ead7*

[5] *Candra, P., Mercuriani, I. S., Nugroho, E. D., & Vlorensius, V. (2020). The biological content accuracy of natural Science textbooks for VIII Grade. JPBI (Jurnal Pendidikan Biologi Indonesia), 6(1), 135-146. https://doi.org/10.22219/jpbi.v6i1.10837*

[6] *Chattopadhyay, A. (2012). Understanding of mitosis and meiosis in higher secondary students of Northeast India and the implications for genetics education. Scientific & Academic Publishing. https://doi.org/ 10.5923/j.edu.20120203.04*

[7] *Clifford, P. (2002). The pressure-flow hypothesis of phloem transport: misconceptions in the A-level textbooks. Journal of Biological Education, 36 (3), 110–112. https://doi.org/10.1080/00219266.2002.9655814*

[8] *Dikenli, M. (2009). Conceptual problems in Biology-related topics in primary science and technology books in Turkey. International Journal of Environmental Science and Education, 4(4), 429-440. https://files. eric.ed.gov/fulltext/EJ884407.pdf*

[9] *Driscoll, M. P., Moallem, M., Dick, W., & Kirby, E. (1994). How does the textbook contribute to learning in a middle school science class? Contemporary educational psychology, 19(1), 79-100. https://doi.org/10.1006/ ceps.1994.1008*

[10] *Gök, T. I. (2012). Comparative analysis of Biology textbooks with regard to cellular respiration and photosynthesis. Doctoral dissertation, Bilkent University. http://www.thesis.bilkent.edu.tr/0006040.pdf*

[11] *Gu, X., Wu, B., & Xu, X. (2015). Design, development, and learning in e-textbooks: What we learned and where we are going. Journal of Computers in Education, 2(1), 25–41. https://doi.org/10.1007/s40692- 014-0023-9*

[12] *Hibbing, A. N., & Rankin-Erickson, J. L. (2003). A picture is worth a thousand words: using visual images to improve comprehension for middle school struggling readers. The Reading Teacher*

[13] *Irez, S. (2016). Representations of the nature of scientific knowledge in Turkish Biology textbooks. Journal of Education and Training Studies, 4(7), 196-210. https://doi.org/10.11114/jets.v4i7.1507*

[14] *Kashi, F., Andreeva, N., & Naeimi, A. (2015). The role of content analysis of Biology textbooks in process of their teaching and designing in Iran. Proceedings of International Academic Conferences 1003626,*

[15] *Khine, M. S. (2013b). Analysis of Science textbooks for instructional effectiveness. In critical analysis of science textbooks, 303-310. Springer, Dordrecht. https://link.springer.com/chapter/10.1007/978-94- 007-4168-3_15*

[16] *Kim, J. Y., Choi, D. S., Sung, C. S., & Park, J. Y. (2018). The role of problem-solving ability on innovative behavior and opportunity recognition in university students. Journal of Open Innovation: Technology, Market, and Complexity. 4, 4 (2018).*

https://doi.org/10.1186/s40852-018-0085-4 Kline, M., & Demuth, K. (2010). Factors facilitating implicit learning: the case of the Sesotho passive. Language Acquisition, 17(4), 220-234. https://doi.org/10.1080/10489223.2010.509268

[17] Kumandaş, B., Ateskan, A., & Lane, J. (2018). Misconceptions in Biology: a meta-synthesis study of research. Journal of Biological Education, 2000–2014, 1-15, https://doi.org/10.1080/00219266.2018.1490798

[18] Leivas Pozzer, L., & Roth, W. M. (2003). Prevalence, function, and structure of photographs in High School Biology textbooks. Journal of Research in Science Teaching, 40(10), 1089-1114. https://doi.org/ 10.1002/tea.10122

[19] Lemmer, M., Edwars, J. A., & Rapule, S. (2008). Educators' selection and evaluation of natural Sciences textbooks. South African Journal of Education, 28(2), 175-188. https://doi.org/10.15700/saje.v28n2 a169 hysics: Conference Series, 1811(1), 012081. IOP Publishing. https://doi.org/10.1088/ 1742-6596/1811/1/012081

[20] Lu, Q., & Liu, E. S. (2012). Research on the consistency of Biology textbooks for Senior High Schools with the curriculum standards—Taking the textbooks of People's Education Press and Zhejiang Science and Technology Press as an Example. Curriculum, Teaching Material and Method, 32(5), 75-82. https://caod.oriprobe.com/articles/29970209/Research_on_the_Consistence_of_Biology_Textbooks_f.htm

[21] Mathai, S. (2014). The role of science textbooks in influencing pedagogical practices: implications for teacher education. In Focus 2.0.

[22] Novitasari, C., Ramli, M., & Karyanto, P. (2019). Content analysis of misconceptions on bacteria in the biology textbook of high school. In Journal of Physics: Conference Series, 1157(2), 022076. IOP Publishing, https://doi.org/10.1088/1742-6596/1157/2/022076

[23] Oakes, J., & Saunders, M. (2002). Access to textbooks, instructional materials, equipment, and technology: Inadequacy and inequality in California's public schools. Los Angeles; University of California. Williams Watch Series: Investigating the, Claims of Williams v. State of California.

[24] Öztap, H., Özay, E., & Öztap, F. (2003). Teaching cell division to Secondary school students: an investigation of difficulties experienced by Turkish teachers. Journal of Biological Education, 38(1), 13-15. https:// doi.org/10.1080/00219266.2003.9655890

[25] Rakes, G. C., Rakes, T. A., & Smith, L. J. (1995). Using visuals to enhance secondary students' reading comprehension of expository texts. Journal of Adolescent & Adult Literacy, 39(1), 46-54. https://www. jstor.org/stable/40016720

[26] Rogayan, Jr. D., & Albino, M. (2019). Filipino students' common misconceptions in Biology: Input for Remedial Teaching. 4, 90-103. https://www.researchgate.net/publication/337683279_Filipino_Students'_ _Misconceptions_in_Biology_Input_for_Remedial_Teaching

[27] Swanepoel, S. (2010). The assessment of the quality of science education textbooks: conceptual framework and instruments for analysis. Thesis. Institutional Repository, University of South Africa. http://hdl. handle.net/10500/4041