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Content Digital Literation of Biology Textbooks SMA/MA Class XII in Genetic Materials Concept

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ABSTRAK

Buku teks dapat menjadi pertimbangan dalam menentukan tingkat kesempatan belajar peserta didik. Proses pembelajaran untuk mendukung kecakapan abad 21 diperlukan adanya kemampuan literasi, salah satunya literasi digital. Tujuan dari penelitian ini adalah untuk mengetahui perbandingan muatan literasi digital pada aspek elemen *(elements),* keterampilan *(skills),* tingkat *(levels),* dan model *(models)* buku teks Biologi SMA/MA kelas XII pada konsep materi genetik. Metode penelitian yang digunakan dalam penelitian ini analisis isi kualitatif. Secara keseluruhan, buku teks yang dianalisis sampai saat ini belum disusun secara digital karena masih sangat rendah. Literasi digital harus optimum dengan cara difasilitasi oleh buku yang juga sesuai. Penting untuk memodifikasi bentuk buku dengan akomodasi literasi digital yang lebih tinggi walaupun buku cetak, agar dapat dikolaborasikan dengan media digital. Oleh karena itu, guru sebaiknya menganalisis terlebih dahulu kualitas isi buku teks Biologi dengan muatan literasi digital yang lebih kompleks dari berbagai penerbit, untuk melihat perbandingan kualitas masing-masing buku yang digunakan dalam pembelajaran.

Keywords:
Textbooks
Digital literacy
Genetic materials

ABSTRACT

Content Digital Literation of Biology Textbooks SMA/MA Class XII in Genetic Materials Concept. Textbooks can be considered in determining the level of learning opportunities for students. The learning process to support 21st-century skills requires literacy skills, one of which is digital literacy. The purpose of this study was to determine the comparison of digital literacy content in the aspects of elements, skills, levels, and models in Biology textbooks for class XII SMA/MA on the concept of genetic material. The research method used in this research is qualitative content analysis. Overall, the textbooks analyzed so far have not been compiled digitally because they are still very low. Digital literacy must be optimum by being facilitated by appropriate books. Modifying the form of a book with accommodation for higher digital literacy is important, even though it is a printed book so that it can collaborate with digital media. Therefore,

teachers should first analyze the quality of the contents of Biology textbooks with more complex digital literacy content from various publishers, to see a comparison of the quality of each book used in learning.

INTRODUCTION

Learning in The Revised 2013 Curriculum for students is directed at 21st century skills, especially 4C skills, including: (1) communicating (communication); (2) cooperation (collaboration); (3) critical thinking and problem solving (critical thinking and problem solving); (4) creativity and innovation (creativity and innovation). The 21st century or what is known as the era of globalization began in 2001 showing changes and developments in various disciplines. Likewise, the teaching and learning system in the 21st century is very different from the previous century. Humans in the 21st century must be able to think critically and work hard. They are required to be able to define the problem by using the expertise and tools available both manually and electronically to find information in solving the problem.

Competition in the 21st century requires the ability to communicate effectively in various media. In addition, everyone must be able to master computer basics to a higher level for digital fluency and be able to use various computer-based software to complete tasks. The use of technology in education is not something new and it is not only able to help with assignments but has the potential as a tool to enrich knowledge in learning as well as being able to evaluate the information and content obtained. Therefore, the education system must be responsible for preparing students to face the global challenges of the 21st century. One of the things that need to be prepared is digital literacy skills in students.

The term digital literacy was first put forward by Gilster in his book entitled Digital Literacy (1997), digital literacy is defined as the ability to understand and use information in various forms from a very wide variety of sources that are accessed through computer devices. Bawden (2001), offers a new understanding of digital literacy that is rooted in computer literacy and information literacy. Computer literacy developed in the 1980s, when microcomputers were increasingly being used, not only in the business environment but also in society. Information literacy only spread widely in the 1990s when information became easier to compile, access, and disseminate through networked information technology. Digital literacy in Bawden's opinion is more associated with technical skills in accessing, assembling, understanding, and disseminating information.

Several important attributes of digital literacy cannot be separated from 21st century skills. Utilization of digital technology can be used as a communication medium for students with classroom learning. One of them is by utilizing the e-mail facility. The learning process by utilizing existing technological facilities can be used as a means of collaboration in classroom learning. One application that can be utilized in learning activities, especially student collaboration, is social network web applications such as WhatsApp, Facebook, Twitter, and so on. Digital technology in the implementation of the learning process can be used as a means to improve students' critical thinking and problem-solving, such as the use of internet technology as a learning resource. Developing students' creativity and innovation in learning can be done by utilizing applications such as Microsoft Word, Microsoft Power Point, and Macromedia Flash.

It is suspected that activities in schools have not optimally developed students' literacy skills. This condition is caused, among other things, by students' lack of understanding of the importance of literacy skills in their lives, as well as the minimal use of books in schools other than textbooks. Reading activities in schools are still limited to reading textbooks and do not yet involve other types of reading that are integrated with digital media (Kemendikbud, 2018). Budiana, et al. (2015) stated that the importance of digital literacy for students resulted in digital literacy being taught and trained in every lesson at school, including in biology learning. The learning process in schools requires teaching materials. Textbooks are one of the teaching

materials that are important to pay attention to both when preparing and implementing learning. Textbooks in Indonesia, especially Biology textbooks, have not yet analyzed their digital literacy content.

Biology is one of the subjects that is difficult to understand, especially the subject of the concept of genetic material because it is abstract. Murni, et al. (2013) stated that Genetic Substance or Genetic Material is a concept with a topic whose scope of genetic material is difficult to observe, especially without the aid of special tools. This concept is one of the concepts that is considered difficult in Biology. Valverde, et al. (2002) stated that textbooks are an important component of the learning process. Textbooks describe the minimum effort that must be made by teachers and students in the learning process and are not the only source that can be used for learning. Teachers and students can use other trusted sources besides textbooks in the learning process. Textbooks used in schools reflect what students learn. Textbooks represent real action processes of teaching and learning. There are still many types of learning textbooks circulating in the current environment, especially for Senior High School students.

Regulations of the minister of education and culture No. 8 of 2016 concerning, books used by education units, both in the form of textbooks and non-textbooks, are a means of the learning process for teachers and students. Schmidt in Wijaya, et al. (2015) also stated that textbooks can be considered in determining the level of learning opportunities for students. Thus, it can be said that the more digital literacy content in a textbook, the greater the opportunity for digital literacy to be trained and taught to students. Based on the explanation above, the authors are interested in researching the content of digital literacy textbooks for Grade XII Senior High School on the concept of genetic material.

METHOD

The research subjects used 3 books Grade XII on Biology in Senior High School which consisted of three books on the Revised 2013 Curriculum with different publishers. The books include a book published by "A", "B", and "C". The method used is qualitative content analysis with a qualitative descriptive research type. The data collection technique used a documentation technique with descriptive qualitative data analysis techniques. The researcher conducted data analysis to obtain the results as descriptive material in the final research report.

RESULTS AND DISCUSSION

Content of Digital Literacy Aspects of Elements Biology Textbooks for Grade XII Senior High School on the concept of Genetic Material

The elements aspect has six sub-aspects including: (a) ICT proficiency/functional skills; (b) information, data, and media literacies/critical use; (c) digital creation, problem solving, and innovation/creative production; (d) digital communication, collaboration, and participation/participation; (e) digital learning and development/ development; (f) digital identity and wellbeing/self-actualizing (JISC, 2018). Digital literacy content based on the elements of the three books is presented in Table 1.

Table 1. Content of Digital Literacy Aspects of Elements in Grade XII Biology Textbooks for Senior High School on the Concept of Genetic Material

No.	Biology Textbook for Grade XII	Results Findings	Aspect Elements					
			a	b	c	d	E	f
1.	Book A	Finding 1	-	22	-	-	-	-
		Finding 2	-	-	1	-	-	-
		Finding 3	1	-	-	-	1	-
2.	Book B	Finding 1	-	15	-	-	-	-
		Finding 2	2	-	-	-	2	-
		Finding 3	1	1	-	-	1	-

No.	Biology Textbook for Grade XII	Results Findings	Aspect Elements					
			a	b	c	d	E	f
		Finding 4	1	-	-	-	-	-
3.	Book C	Finding 1	-	11	-	-	-	-
		Finding 2	1	-	-	-	1	-
		Finding 3	-	1	1	-	-	-
		Finding 4	1	1	-	-	1	-
		Finding 5	1	-	1	-	-	-
	∑ Sub-aspect findings		8	51	3	0	6	0

Information:
a. ICT proficiency (functional skills)
b. Information literacy, data literacy, and media literacy (critical use)
c. Digital creation, problem solving, and innovation (creative use)
d. Digital communication, collaboration, and participation (participation)
e. Digital learning and development (development)
f. Digital identity and digital well-being (self-actualization)

Table 1 showed the content of digital literacy aspects of the elements contained in the class XII Biology textbooks for Senior High School, the concept of genetic material has a diversity of different findings. Book published "A" has the least amount of diversity, but has the most number of findings with 24 findings. The book published "C" has five diverse findings and can be said to be a book with more complex digital literacy content than the other two published books. One of the most complex findings has a slice that contains sub-aspects (a), (b), and (e). Table 1 showed that the findings of the most dominant digital literacy content are found from the three books on sub-aspect (b) information literacy, data, and media/critical use with 51 findings. The sub-aspects that were not found in the three books included: (d) digital communication, collaboration, and participation/participation; and (f) digital identity and digital well-being/self-actualization.

The findings of the digital literacy content of the most complex aspects of the three books that have been analyzed are found in books published "B" and books published "C". An example of the findings in the Exploration feature published book "C" is the use of video learning resources related to DNA, genes, and chromosomes that can be accessed online. JISC (2018) states that ICT proficiency/functional skills have two parts including ICT proficiency and ICT Productivity. Information, data, and media literacy/critical use has three parts including information literacy, data literacy, and media literacy. Digital learning and development/development has two parts including digital learning and digital teaching.

Information that can be accessed through a website link in the findings of the book complex published "C" is in the form of an animated video related to the content of DNA genetic material, genes and chromosomes. Genetic material is material that is abstract in nature, therefore learning resources are needed that are able to facilitate students to be able to understand information related to material and its relation to everyday life. In line with research by Fauzi & Mitalistiani (2018) that the concept of genetic material is difficult to understand because it is abstract and has a broad scope. Genetic material contains many foreign terms that are difficult to understand. Several terms such as DNA with a double helix structure have been studied, but concepts about DNA such as structure, location and mechanism of inheritance are still difficult to understand. One of the learning resources that can facilitate students is through animated video shows.

Digital research and problem-solving is closely related to the content of genetic material. The findings in the book published "C" present articles on cases of swapped babies identified through DNA, then solve the problem through studies of swapped babies in hospitals, identifying fingerprints, and determining the child's status using digital methods. DNA analysis techniques can be a procedure for scientific proof whose results can be accounted for. This technique is used in modern genetics by using genetic markers as a means of identifying an individual's genotype. In line with Sandwinata's research (2018) regarding DNA analysis in forensic cases, it is stated that DNA analysis in forensics is a relatively new technique and the quantity of crime is also used in determining family relationships. DNA analysis is a very potential method that is

currently widely accepted as an identification in the field of forensics, because it only requires a small sample that can be taken from all nucleated cells throughout the body.

Several sub-aspects of the elements that were not found in the three books include the following: (d) digital communication, collaboration, and participation/participation; and (f) digital identity and welfare/self-actualizing. Communication, collaboration, and digital participation must be owned by students as life skills to increase digital literacy and develop the importance of students' social and personal dimensions. In line with research conducted by Law, et al (2017) collaborative learning helps students learn socially and ultimately students also get an increase in their social skills. Meanwhile, Amalia (2015) stated that using the internet is also required to be able to build social relations and participate in society through the internet because of the wide network that can be reached by the internet. To build social relations, a person needs to have the ability to communicate well via the internet. Therefore, communicating via the internet requires netiquette so that the relationship can run well. Netiquette is an abbreviation of "network etiquette" or "internet etiquette".

Digital Literacy Content Aspects of Skills Biology Textbooks for Senior High School Grade XII on the Concept of Genetic Material

The skills aspect has five sub-aspects including the following: (a) using devices and handling information; (b) creating and editing; (c) communicating; (d) transacting; (e) being safe and responsible online (The Department for Education, 2019). Digital literacy content based on the skills aspects of the three books is presented in Table 2.

Table 2. Content of Digital Literacy Aspects of Skills in Grade XII Biology Textbooks for Senior High School on the Concept of Genetic Material

No.	Biology Textbook for Grade XII	Results Findings	Aspect Skills				
			a	b	c	d	e
1.	Book A	Finding 1	1	-	-	-	-
2.	Book B	Finding 1	7	-	-	-	-
		Finding 2	-	1	-	-	-
3.	Book C	Finding 1	8	-	-	-	-
		Finding 2	-	1	-	-	-
∑ Sub-aspect findings			16	2	0	0	0

Information:
a. Using devices and handling information
b. Create and edit
c. Communicate
d. Transact
e. Safe and responsible online

Table 2 showed the content of digital literacy aspects of skills contained in the Grade XII Biology textbooks for Senior High School, the concept of genetic material has a variety of different findings. Book "A" has only one finding. Books published "B" and "C" have two varieties of findings. However, the book published "C" has the most number of findings compared to the other two published books. The content of digital literacy based on the most dominant aspect of skills is found from the three books on sub-aspect (a) using devices and handling information. The sub-aspects that were not found in the three books included (c) communicating, (d) transacting, and (e) being safe and responsible online.

The Department for Education (2019) states that using devices and handling information has five parts including: using devices; finding and evaluating information; managing and storing information; identifying and solving technical problems; and developing digital skills. The search for information accessed via the internet on the most dominant finding examples of books published "C" contains genetic material content related to protein synthesis. Pujiyanto (2017) states that protein synthesis occurs through two main stages, namely transcription and translation. Transcription is the copying of the genetic codes from DNA by RNA, while translation is the translation of the genetic codes in mRNA by tRNA into the amino acids that make up proteins.

The findings of the skills aspect sub aspect (b) creating and editing are found in the book published "B" and the book published "C". An example of the findings of a book published "B" features scientific activities regarding: observation of the salivary glands of *Drosophila melanogaster*. This activity contains an instruction for making the task of documenting the observed images and compiling a report on the results of the observations using the mastered word processing media. The Department for Education (2019) states that creating and editing has three parts including: creating and editing documents; creating and editing digital media; and processing numerical data.

Several sub-aspects of skills that were not found in the three books include (c) communicating, (d) transacting, (e) being safe and responsible online. The Department for Education (2019) states that the communicating sub-aspect has two parts including communicating and sharing and managing traceable online activities. The transaction sub-aspect has two parts including: using online services and buying securely online. While the sub-aspect of being safe and responsible online has four parts including: protecting privacy; protecting data; being responsible online; and digital wellbeing.

Digital Literacy Content Aspects of Levels Biology Textbooks for Senior high School Grade XII on the concept of Genetic Material

The level aspect has three sub-aspects including: (a) level I, digital competence includes digital competence which includes skills, concepts, approaches, and behaviors; (b) level II, digital usage includes digital usage which refers to the application of digital competencies related to certain contexts; (c) level III, transformation includes digital transformation that requires creativity and innovation in the digital world (Martin, 2009). Digital literacy content based on the level aspects of the three books is presented in Table 3.

Table 3. Content of Digital Literacy Aspects of Levels in Grade XII Biology Textbooks for Senior High School on the Concept of Genetic Material

No.	Biology Textbook for Grade XII	Results Findings	Aspect Levels		
			a	B	c
1.	Book A	Finding 1	-	1	-
2.	Book B	Finding 1	2	-	-
		Finding 2	-	-	1
3.	Book C	Finding 1	-	7	-
		Finding 2	-	-	1
∑ Sub-aspect findings			2	8	2

Information:
a. Level I, Digital Competence (skills, concepts, approaches and behaviors)
b. Level II, Digital Users (professional applications/disciplines)
c. Level III, Digital Transformation (creativity/innovation)

Table 3 showed the content of digital literacy aspects of the levels contained in the class XII Biology textbooks for SMA/MA, the concept of genetic material has a variety of different findings. Books published "A" has only one finding. Books published "B" and "C" have two varieties of findings. However, the book published "C" has the most number of findings compared to the other two published books. The findings of digital literacy content based on aspects of the most dominant level are found from the three sub-aspect books (b) level II, digital usage includes digital usage which refers to the application of digital competencies related to certain contexts.

An example of the findings of the level II sub-aspect, digital usage found in the three books is found in book published "A" in the form of an Independent Assignment feature regarding assignments to compile reports related to the giant chromosome of *Drosophila melanogaster* by searching for this information via the internet. Pierce (2002) states that polytene chromosomes occur as a result of repeated repetition of DNA replication but do not go through a cell division stage called endoreduplication, causing lots of multiple DNA synapses to each other. Meanwhile, regarding the function of polyethylene chromosomes proposed by Jain (2013) polyethylene chromosomes have a function to control physiological changes in an organism

because they contain genes in their chromosomes, the exchange between heterochromatin and euchromatin is called position effects which can cause mutations in animals.

Level II sub-aspects put more emphasis on technology used in learning as a source of learning to find information in completing a task. In line with Warsita's research (2013) the main purpose of learning technology is to solve learning problems or facilitate learning activities. Learning technology as software that is connected to an internet network in the form of systematic ways of solving learning problems is increasingly sophisticated and has a wide place in the world of education. The practical application of learning technology in solving learning problems has a concrete form in the presence of learning resources that facilitate students to learn.

The findings of the level I sub-aspect are found in the book published "B" in the form of an information search feature related to protein synthesis material. The level I sub-aspect places more emphasis on information seeking as new knowledge that is not related to completing a task. Martin (2009) states that Level I, digital competence includes digital competence which includes skills, concepts, approaches, and behaviors. The material content contained in the level I sub-aspect findings related to the function and role of enzymes needed in the DNA replication process, including helicase, primase, DNA polymerase, DNA binding protein, and ligase enzymes. Based on the theory according to Campbell, et al. (2008) the helicase enzyme functions to hydrolyze polynucleotide double chains into two single polynucleotide chains. The RNA primase enzyme functions to form the primary RNA in the DNA template chain. The DNA polymerase enzyme functions to assemble mononucleotide chains to form new DNA. DNA-binding proteins function to protect single-stranded DNA from physical damage and prevent renaturation or as the name implies (single-bonded) so that it does not bind anymore. Meanwhile, the ligase enzyme functions to connect nucleotides to the newly formed DNA chain.

In addition to the findings of the level I and II sub-aspects that have been analyzed from the three books, there are findings that include the level III sub-aspects. Examples of findings can be found in the book published "C" in the form of a Group Assignment feature regarding assignments to create protein synthesis simulations in animated form using the Power Point (PPT) or Macromedia Flash programs. Based on these results, according to the indicators the book provides directions for making assignments creatively and innovatively by involving the use of Microsoft Power Point or Macromedia Flash digital media, so that the levels aspects in sub-aspect (c) level III, transformation. Martin (2009) states that the sub-aspect level III of digital transformation includes digital transformation that requires creativity and innovation in the digital world.

Content of Digital Literacy Aspects of Models Biology Textbooks for Senior high School Grade XII on the concept of Genetic Material

The models aspect has three sub-aspects including: (a) universal literacy; (b) creative literacy; (c) literacy across disciplines (Alexander, 2016). Digital literacy content based on the level aspects of the three books is presented in Table 4.

Table 4. Content of Digital Literacy Aspects of Models in Grade XII Biology Textbooks for Senior High School on the Concept of Genetic Material

No.	Biology Textbook for Grade XII	Results Findings	Aspect Models		
			a	b	c
1.	Book A	Finding 1	-	22	-
		Finding 2	1	-	-
2.	Book B	Finding 1	-	15	-
		Finding 2	2	-	-
		Finding 3	1	1	-
3.	Book C	Finding 1	-	13	-
		Finding 2	1	-	-
		Finding 3	1	1	-
	∑ Sub-aspect findings		6	52	0

Information:
a. Universal literacy

b. Creative literacy
c. Cross-disciplinary literacy

Table 4 showed the content of digital literacy aspects of the models contained in class XII Biology textbooks for SMA/MA. The concept of genetic material has a diversity of different findings. The contents of digital literacy aspects of models are most commonly found in books published "A". However, books published "B" and books published "C" have more complex and varied digital literacy content than books published "A". One of the most complex findings has a wedge that contains the sub-aspects of (a) universal literacy and (b) creative literacy. The findings of the most dominant digital literacy content in the model aspect are found in sub-aspect (b) creative literacy. Meanwhile, the sub-aspect models that were not found in the three books were sub-aspect (c) literacy across disciplines.

Universal literacy emphasizes someone who is digitally literate. With regard to this Trilling and Fadel in Wijaya, et al. (2016) explained that several skills require students in the future related to information literacy, media literacy, and ICT literacy. Information literacy skills include accessing information more effectively and efficiently, being competent and critical of information and the ability to use information accurately and creatively. Media literacy skills include the ability to use media as a learning resource and use media as a tool for communication, work and creativity. ICT literacy skills include the ability to use ICT effectively as a research tool, communication tool, evaluation tool and understand the code of ethics for using ICT.

The most dominant sub-aspect that found from the three books on the model aspect is (b) creative literacy. An example of the findings can be found in book "A" page 101 in the form of a feature image with the caption "*Drosophila melanogaster is often used for genetic experiments. Source: www.shutterstock.com"*. Based on these results, it is in accordance with the book indicators presenting website link sources listed in code such as .org, .edu, .gov, .com, so that they are included in the model aspect (models) in sub-aspect (b) creative literacy. Alexander (2016) states that creative literacy is the second model in digital literacy, in this model digital literacy in the form of technical skills leads to richer content production, including video editing, audio creation and editing, animation, understanding of computing device hardware, programming, and copyright knowledge.

A sub-aspect models that is not found in the three textbooks is literacy across disciplines. Literacy across disciplines can be found by integrating several sciences. For example, Bioinformatics, a branch of science that covers various disciplines including computer science, mathematics, physics, biology, and medical science. Fatchiyah (2009) states that Bioinformatics is a science that studies the application of computational techniques to manage and analyze biological information. Includes the application of mathematical, statistical and informatics methods to solve biological problems, especially those related to the use of DNA and amino acid sequences.

CONCLUSION

Based on the results of data analysis and discussion, it can be concluded aspects of elements are most commonly found in books published A. Books published C have a more complex content than books published A and B. Aspects of skills are most commonly found in books published C. Books published B and C have more complex digital literacy content than books published A. Aspects of levels are most commonly found in books published C. Books published B and C have more digital literacy content complex compared to book published A. Aspects of models are most commonly found in book published A. Books published B and C have a more complex content than book published A.

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