8-2018

Secondary Biology Instruction in The General Senior Secondary Schools of Aceh Province Indonesia: An analysis of Teachers' Opinions and Teaching Practices Related to The Indonesia Biology Curriculum 2013

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Secondary Biology Instruction in The General Senior Secondary Schools of Aceh Province Indonesia: An analysis of Teachers' Opinions and Teaching Practices Related to The Indonesia Biology Curriculum 2013

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy in Curriculum and Instruction

by

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Abstract

My study was to discover the perceptions of general secondary senior high school biology teachers about the application of curriculum 2013. Their further opinions of biology topics and the instructional practices in the class have supported the findings of this study. In addressing this study, general senior secondary school (GSSS) biology teachers (n=286) from 22 districts in Aceh province randomly participated in my study. Thus, six (n=6) teachers were selected as convenience sampling to have a one-on-one phone interview. The data collected were analyzed descriptively (frequency and percentage) and thematically to answer the research questions.

The documents comparison between the U.S. Next Generation Science Standards Life Science (NGSS-LS) and 2013 Indonesian biology curriculum (IBC 2013) for senior secondary school showed similarity in the elements of comparison. Yet, the performance expectation in NGSS-LS is connected to three dimensions of framework and other ideas within disciplines.

Most GSSS biology teachers in Aceh province believed that the 2013 curriculum had offered the better system to improve the teaching and learning quality. The GSSS biology teachers agreed that almost all biology topics listed were significant and should be taught to senior high school students. However, some of them possessed ideas about an ideal curriculum that would include local contents, be designed by the biology experts whom fully understand of the biology contents and must be supported with adequate learning facilities or infrastructure. Teachers had taught those biology topics listed in the 2013 curriculum, with some challenges they faced. They had also used some teaching models and prefer to use various teaching models that focus on student-centered.

Although the new required assessment system is complex and detailed, most teachers had tried to apply various techniques of the evaluation in the classroom such as assigning paper tests and homework (to measure students' knowledge), observation and self-assessment (to measure students' attitude) and performance assessment (to measure students' skill). In terms of characters education assimilation, several characters such as religious, honest, tolerance, discipline, hard-working, creative, curiosity, communicative/being friendly, social and environmental awareness, and responsible have been applied at a different stage of instructional and in school's co-curricular activities.

Acknowledgments

The toughest part of my education journey was the time to finish this project, which could not be completed without the greatest support of the great people – friends, colleagues, and family -- who surround me. First, I would like to give my deepest gratitude to my advisor and dissertation committee chair, Dr. William F. McComas, for his encouragement and "never give up on me" attitude. I was an honor to be his student and to have had the experiences he and his colleagues provided during my study and time at the University of Arkansas. Thank you too to Dr. Stephen Burgin and Dr. Cathy Wissehr, who have provided me with knowledge, skills, and feedback to help me become a better science teacher and scholar. I offer my sincere appreciation to Aceh Government as the main sponsor of my doctoral study. Thanks to those who worked so hard arranging my scholarship. To Laila Musfira and Suci Handayani, thank you for always taking care of me. I also appreciate the support of the University of Syiah Kuala, LPMP and Dinas Pendidikan Aceh, Ratna Yulia, M.Ed, Zulbahri, M.Ed and Indonesian-Acehnese Teachers for their participation and support in my study. I am very lucky for having many great friends during my experiences in the United States, including Mr & Mrs. Schraeder, Mba Keukeu, Mas Teguh, Mba Rifi, Mba Oepik, Mba Tri, Mba Nana, Mas Wawan, Mba Nadia, Miranti, Zaura, Reza, Pat Kuhn, Khlood and many others. To my colleagues, Zulfikar, Salwa, Fanny, Dewi, Kak Mimie and Andi Ulfa, who helped me, thank you.

Dedication

This doctoral dissertation is dedicated to my parents M. Ali Markatam and Rustibah Bulan, my teachers, my lovely husband Suhartono, precious daughter Sofia Aleeya Suhartono, my sisters Dwi and Rama, my brothers Try and Yudi, as well as my friends.

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CHAPTER I

INTRODUCTION

Statement of Problem

The development of a national curriculum requires time, a great expense and a large investment in human resources. Indonesia has changed its national curriculum ten times since its independence (1945) with hopes of improving its education quality. These changes include Curriculum 1947 (Lesson Plan 1947), Rencana Pelajaran Terurai 1952 (Ravel Lesson Plan), Educational Plan 1964, Curriculum 1968, Curriculum 1975, Curriculum 1984, Curriculum 1994, Competency-based Curriculum 2004, Education Unit Level curriculum (KTSP) 2006, and Curriculum 2013.

The Indonesian government prioritizes spending at least twenty percent of its education budget at meeting requirements associated with the implementation of national education processes, especially in improving the quality of the education system (including curriculum and pedagogy reformation), education access and teachers' qualification enhancement (Widasara, 2013; The World Bank, 2014; Tobias et al., 2014). An observable effort in improving teachers' quality and professionalism can be found in the teacher certification program (improvement of teacher quality and welfare), continuous development of teacher professionalism (teacher education) through teacher performance group (called "KKG" in Indonesia) for elementary school teachers and teacher organization (MGMP) for secondary school teachers, and other professionalism trainings (management training, laboratory skill training, etc). Meanwhile, in a campaign to improve the quality of curriculum and pedagogy, the government has shifted from implementing a content-based curriculum to a competency-based curriculum, teacher-centered

learning to student-centered learning, and the centralization of content determination (Tobias et al., 2014).

My interests are focused on my home province Aceh, a semi-autonomous region on the northwest tip of Sumatra Island with an area of 22,377 square miles (57956.164 square kilometer) and a total population of 4.7 million people. The province is served by 13,143 general senior secondary school teachers (MoEC, 2016) who come from different ethnic groups (Encyclopedia Britannica Online, 2016) including the Acehnese (distributed throughout Aceh), Gayo (found in the central and eastern region), Alas (from SE Aceh), Tamiang (in Aceh Tamiang), Aneuk Jamee (concentrated in southern and southwestern Aceh), Simeulue (on Simeulue Island), and those of Chinese descent (Ministry of Home Affair's act No 39 years of 2015). Although Aceh is an autonomous province, there are no differences in the curriculum documents among Indonesian provinces because all of them use a single national curriculum document. The Aceh Educational Agency is mandated to implement the curriculum provided by the national government.

The implementation of the latest curriculum, based on the 2013 Ministry of Education and Culture (MoEC) Circular Letter (156928/MPK.A/KR/2013) clearly defines teachers as the most important element within the education bureaucracy whose professionalism is continuously developed and monitored (Anbarini, 2014; Sukemi, 2013). With this measured focus on teachers and teaching, it would be useful and be revealing to know what the teachers believe in regard to the content and teaching practices in which they are tasked to engage. In addition, by analyzing their perceptions of an ideal biology curriculum model, we would have useful information of points to consider when evaluating the new curriculum. Thus, it would be interesting to gain a deeper awareness of Acehnese teachers' perceptions of biology content and mandated teaching

practices with respect to the new 2013 curriculum. Rahmadhani et al. (2016) found that a teacher's knowledge of pedagogical content is correlated to the sustainability of content representation in the implementation of lesson plan and teaching strategies in Indonesian biology curriculum 2013 (IBC 2013). It would also be useful to gain a deeper appreciation of Acehnese teachers' perceptions of the biology content and mandated teaching practices (especially in the use of the scientific approach and inquiry learning) concerning the IBC 2013.

As a point of comparison for the Aceh-focused study reported here, it would be useful to consider the recommendations of the new Next Generation Science Standard (NGSS) from the U.S. National Research Council (NRC). I offer this view not because NGSS should be seen as a "best case" curriculum document per se, but because of the shared expertise directed toward its development and its recent emergence on the educational scene. One of the goals of the NGSS is to provide students with "an internationally-benchmarked science education, emphasizing content and practice across disciplines and grades" (NGSS, 2015). In NGSS, there are five life science topics in high school to refer to develope the understanding of key ideas of life science and the performance expectations based on the framework for K-12 science education. No study at this point has compared the biology topics advocated by the NGSS (or the biology science curriculum framework by the US state) and those featured in the Indonesian curriculum 2013. Therefore, it will be revealing to analyze their similarities and differences in curriculum structure, curriculum elements, breadth and perceived difficulty, along with other aspects that can also determine the way both countries develop and improve their science education curriculum. In addition, this comparison should provide useful insights to educators, teachers, and students in Aceh province –as a developing region – with respect to science education development in the United States.

Any curriculum is designed to improve the quality of education and provide the opportunities for students to compete internationally; therefore, the evaluation of curriculum implementation through the practitioners' perspectives, especially teachers' beliefs and practices of the biology content, should be investigated. Sowell (2000) stated that the purpose of curriculum examination and evaluation is to gather information about to what extent a curriculum has been implemented and resources are used, so as to provide the clarification of the curriculum implementation plans, and to assess the degree to which teachers perform their role. While there are many investigations targeting mathematics teachers' beliefs such as those reviewed by Handal (2003), there are few studies (Del Pozo et al., 2011; Roehrig et al., 2007; Verjovsky & Waldegg, 2005; Cronin-Jones, 1991) investigating teachers' beliefs in teaching science and fewer still with respect to biology content and teaching practices.

Purpose of the Study

This study reported the results of an evaluation of the senior secondary school (SSS) biology curriculum through an investigation of teachers' perceptions of the biology topics, which included three essential aspects: content, instructional strategy, and assessment. Therefore, the following descriptions are provided to support the scope of this study:

a. *Value expressed by teachers regarding the biology content:* the degree of importance of biology content arranged in the 2013 curriculum.
b. *Teachers' perspectives:* teachers' feelings of the contents and practices, what they find challenging, what support is provided to help them in the implementation process, and what aspects of curriculum implementation work well for the students.

As defined in the Act of the Republic of Indonesia Number 20, Year 2003 National Education System, this current Indonesian curriculum defines the plans and regulations about the

aims, content and material of lessons and the method employed as the guidelines for the implementation of learning activities to achieve given education objectives (Article 1, Verse 19). At this point, there is a relationship between a curriculum and an instruction that is defined as "what is taught" and "how it is taught" (Sowell, 2000, p.4). In Johnson's model (Johnson, 1967), the curriculum plan clearly guides the instruction with individual teachers making the final selection of learning activities and instrumental content. Additionally, analyzing teachers' views and actions regarding biology content is found in the four major categories of belief structures offered by Cronin-Jones (1991). Teachers' thoughts/perceptions and attitudes toward curriculum content influence the implementation process of a curriculum (Cronin-Jones, 1991). Thus, those underlying statements represent the conceptual framework that teachers' belief of the content determines their final selection of teaching technique to obtain the learning goals mandated/planned in the curriculum.

In brief, the purpose of this study was to discover Indonesian, especially Acehnese teachers' general perceptions regarding biology topics and instructional strategies mandated in the IBC 2013 for senior secondary school.

Significance of the Study

Teachers are able to have their final decision about what happens in the classroom using the curriculum as their guideline. Mansour (2009) has found that teaching practice is indirectly yet strongly influenced by what teachers believe. The result of this study can provide information about what teachers value towards the biology contents and how their perceptions influence the instructional process in the classroom they are asked to engage in to support the curriculum evaluation. Also, the result of this study would assist the curriculum implementation unit of Aceh Province (also called the National Education Bureau and the Education Quality Insurance Board)

in monitoring the 2013 curriculum implementation with a particular focus on the Biology curriculum.

Furthermore, a comparison between the Indonesia 2013 Curriculum and the NGSS life science framework will provide information to Acehnese teachers and students about the expectations regarding biology learning advocated elsewhere. In addition, many graduates from Indonesian secondary schools might like to pursue further learning at the university level, and some reference to NGSS could prove useful in this regard particularly for the U.S. In addition, the core ideas of life science NGSS has been developed consistently with the U.S and international assessment framework, such as the National of Education Progress (NAEP), the Program for International Student Assessment (PISA), and the Trends in International Mathematics and Science Study (TIMSS) (NRC, 2012). Teachers with similar backgrounds in Indonesia can also use the information from this study to reflect on and improve their own practices.

Research Questions

This study addressed the following research questions:

1. How does the Indonesian biology curriculum 2013 content compare with related aspects of the U.S. Next Generation Science Standards (NGSS)?
2. How do Indonesian teachers in Aceh Province value aspects of the required biology content?
3. What aspects and with what frequency do Indonesian-Acehnese teachers teach the various aspects of the biology curriculum 2013?
4. What instructional methods are used by these Indonesian-Acehnese biology teachers to support students in understanding biology?

5. What general perceptions are reported by these Indonesian-Acehnese teachers regarding the required biology assessment in the Indonesian curriculum 2013 documents?
6. How do Indonesian-Acehnese biology teachers integrate the required aspects of character education into biology instruction?

Brief Overview of Research Method

This study is focused on the Curriculum 2013, the most recent curriculum implemented in Indonesia. This curriculum has two dimensions: (1) content/teaching materials and objectives' plans and regulations, and (2) methods of learning activities. A review of the related literature has been done to generate information about the comparison between the IBC 2013 content and the related aspects of the Next Generation Science Standards (NGSS) in the U.S. An instrument (see Appendix A) with both closed and open-ended questions was used as the primary data collection tool in this study. The instrument was designed to gather specific information on teachers' perspectives and teaching practices of the biology curriculum content. The perceptions of GSSS biology teachers gathered from responses towards thirty-four biology topics summarized from IBC 2013 for senior secondary school.

The instrument consisted of three parts: (a) background information of respondent; (b) perceptions/view of respondents about biology topics (quantitative); and (c) open-ended questions, which purposely gather information about teachers' general view of character integration technique in teaching and the standards of biology assessment. In addition, interview questions were provided for this study to support the findings found in the instrument.

The population relevant to this study consisted of 1,154 GSSS biology teachers from 436 schools (public and private) in 23 districts. From this group, I selected a representative sample size (n=288) based on a confidence level of 95 percent and the margin of error of 5 percent.

Those teachers have been selected from the latest database of biology teachers in Aceh province provided by the Education Quality Insurance Board of Aceh province (also referred to as LPMP), which was specifically provided by my colleagues working as the information division staff and biology instructor.

To examine the content validity of the instrument used, a peer review was conducted through instrument checking by a professor from Curriculum and Instruction Department of the University of Arkansas, three professors from Syiah Kuala University (USK)—two college professors from Biology Education Department and one from Indonesia Study Department, and one biology instructor working at the Education Quality Insurance Board. Thus, a pilot study was conducted to assess the reliability of the questionnaire in order to determine the Cronbach alpha coefficients which showed the values above 0.70.

Assumptions of the Study

For this study, I assumed that the survey questionnaire has clear instruction and use easy and correct sentences to be understood. An underlying assumption is that all Indonesian-Acehnese biology teachers have been assigned same topics of biology in the IBC 2103. In addition, I trusted that the biology teachers would give honest respond to all questions.

Limits on Generalizability

The results of this study might not apply to opinions and implementation of the biology curriculum beyond Aceh because the preparation and nature of biology teachers in Aceh may be different from biology teachers from the other provinces in Indonesia, yet no other teachers were involved as subjects in this study. Aceh province is one of the autonomous provinces of Indonesia, so the National Education Bureau of Aceh has school policies which may be different

from other schools in Indonesia. Yet, the findings of this study should generalize well with respect to biology teachers' perception of the biology content and action within Aceh province.

Delimitations

Although using the same science curriculum, there are two groups of secondary schools in Indonesia, namely general secondary school (GSS) and Islamic-based secondary school (ISS). Since those schools are organized in two different ministries (Ministry of Education and Culture for GSS and Ministry of Religious Affairs for ISS), this study survey focused only on biology teachers from general senior secondary school (GSSS) as per the limitation to the complex access on wide number of those schools (nGSSS= 436, nISSS= 209) and their geographical area and funding. This study was not purposively to evaluate teachers' performance or to generate a judgement related to the implementation of biology curriculum 2013. Rather, the study was intended to explore Indonesia-Acehnese biology teachers thinking about the changes in the new curriculum design. Due to no direct investigation to the real classroom investigation, the honest and critical responses from the subjects to not provide good opinions (because of their social manner bias) were the key answers of this study.

CHAPTER 2

REVIEW OF THE LITERATURE

The Concepts of Curriculum

Numerous definitions of curriculum have been well-defined and explained for curriculum studies. These include the substances should be taught (Null, 2017), the epitome of all knowledge, skills, and attitudes as a product of practitioners (educators and politicians) (Modebelu, 2017) which have been developed as consequences of the improvement in the education system. The development of curriculum concepts is also initiated by the extensive changing of a curriculum to properly fit into the changes of society and the technology movement (Kelly, 2009).

In his Key Concepts for Understanding Curriculum, Marsh (2009) states that there has been a constant struggle among experts and educators throughout a course of history in order to define what a curriculum is. Despite the tendency of fitting curriculum with the trend of a period which leads to a divergent and a variety of views, it is often the case that the definition is incomplete (meaning that it may successfully cover certain issues on the one hand but fails to address other issues which may as well be significant). He provides a brief analysis of some sample definitions of curriculum by posing the points they might include:

> "Curriculum is the 'permanent' subjects that embody essential knowledge; Curriculum is those subjects that are most useful for contemporary living; Curriculum is all planned learnings for which the school is responsible; Curriculum is the totality of learning experiences so that students can attain general skills and knowledge at a variety of learning sites; Curriculum is what the students construct from working with the computer and its various networks, such as the Internet; Curriculum is the questioning of authority and the searching for complex views of human situations" (p.4).

Kelly (2009) mapped the curriculum concept into five sorts of explanation, including: (1) *the educational curriculum*—the definition of curriculum should properly fit the 'educational'

term, which is defined as "of what teaching and instruction is to be offered and sometimes also what its purposes, its objectives, are" (p. 2); (2) *the total curriculum*—it determines curriculum as the entire program of an educational institution, which triggers the school to not only concern with a collection of subjects or individual curriculum aspects, but as a total scheme that may include the goals, the process and the other aspects; (3) *the 'hidden' curriculum*—it constitutes an unwritten or unexposed agenda that is delivered collaboratively with something that has been consciously planned and organized. In this case, "the curriculum is 'hidden' only to or from the pupils, and the values to be learnt clearly form a part of what is planned for pupils" (p. 5); (4) *the planned curriculum and the received curriculum*—the planned curriculum is defined as what is written in the syllabus or lesson plan; while the received curriculum is the real thing that is experienced by students. Although the received curriculum is concerned more significantly to pupils, curriculum implementation will be a success if it fills the gap between its theory and practices; (5) *the formal and informal curriculum*—the formal curriculum comprises the formal activities that have been organized in a certain timetable, while the informal one includes the other activities excluded from the timetable.

According to Bordage and Harris (2011), curriculum is identified as a complex entity and a process that consists of five keys elements: the acquisition of competencies—defined as attitudes, knowledge, and techniques to learning practice, skills of communication and enhancement; learners; learning conditions—which traditionally include content selections and organization, teaching strategies and methods, while in additional conditions may include teaching materials and equipment, and others; assessment—formative and summative; and the socio-politico-cultural contexts—such as values and practices related to the society condition. In addition, the aspects of curriculum development and implementation are also viewed in

epistemological perspectives, which consist of curriculum content—including all forms of knowledge acquisitions, curriculum implementation process—internalization and experiences, and curriculum outcomes—ways of knowing (Mugisha & Mugimu, 2012).

The Reasons of Curriculum Comparison

Why do we need comparison studies of curriculum? This thought came up as logic answers in responding to the continuous development and changes to create a better living, especially related to the process of educating the human beings. Curriculum comparison is also conducted as an interest to the education system and approaches adopted in various countries in developing their education system, primarily the pupils' achievement in various international performances competitions (Ruddock & Sainsbury, 2008). Hall (2014) added that to enable the understanding of the real process of teaching, the scope of content and assessment, and the connection of theory and practice applied, curriculum analysis is conducted as powerful and useful tools in providing the information.

The comparison analysis has been conducted in various ways, such as different curricula have been used in the internal country itself, or between two or more curricula from various countries. Several studies of curriculum analysis have been done to differentiate underlying focus, such as rationale and goals of the curriculum framework of 21st century competence (Tanriverdi & Apak, 2010; Voogt & Roblin, 2012), strategies for implementations and assessment (Tanriverdi & Apak, 2010; Voogt & Roblin, 2012; Hall, 2014), curriculum materials and content (Rossi et al., 2009; Tanriverdi & Apak, 2010; Hall, 2014), and learning conditions such as methods and technique (Tanriverdi & Apak, 2010). Therefore, there have been several methods used to analyze the curriculum including critical discourse analysis in analyzing an official syllabus in one of Australia states (Rossi, et al., 2009), the use of benchmarking,

evidencing, knowing and applying (BEKA) in analyzing curriculum objectives, content and assessment (Hall, 2014), and documents analysis (Ruddock & Sainsbury, 2008; Tanriverdi & Apak, 2010).

Therefore, my perspective aligns with the purposes of curriculum comparison that is stated by Ruddock & Sainsbury. There was no intention to label one intended document is "better" than the others.

Indonesia Education System: Curriculum Reformation Timeline

In Indonesia, the education system is divided into basic formal schooling (years 1-6) and secondary (junior secondary school or years 7-9 and senior secondary school or years 10-12), which are organized and supervised by two different ministries. The *Ministry of Education and Culture or MoEC* (Kementerian Pendidikan dan Kebudayaan, Kemendikbud) organizes general basic and secondary schools, while *Ministry of Religious Affairs* (Kementerian Agama, Kemenag) arranges the education of Islamic-based basic and secondary schools. Yet, both ministries apply the same curriculum for all subjects (which are arranged by the MoEC), except that the Islamic-based subjects are taught only in Islamic-based schools. For a general view of the education curriculum system in Indonesia, please review Figure 2.1. Thus, to support the curriculum implementation, the Indonesian government has provided teachers with a complete set of curricula including a guideline module, modifiable syllabus (including the graduation standards, competency standards, topics, teaching guidelines, types of assessment, time allocations, and media/resources guidelines), lesson plans (their format and examples), and teacher's subject books. Therefore, in this study, I focus on gathering information regarding the science (biology) curriculum for general senior secondary school.

The secondary science curriculum framework in high school is a continuation of the competences started in elementary and middle schools, in which science is taught as a one-unit subject. In high school, however, science is taught in three different subjects; physics, chemistry, and biology. In middle schools, science is about learning a systematic nature, emphasizing not only a mastery of knowledge in the form of a collection of facts, concepts, or principles but also a process of discovery. Science learning process aims at providing direct experience to develop competence to explore and understand the universe scientifically. Science instruction promotes inquiry to help learners gain in-depth understanding of the surrounding nature. The science learning approach used in high schools is similar to that is used in lower secondary school: inquiry.

According to the Indonesian Ministry of Education and Culture of Republic of Indonesia [MoEC] (n.d), the changes in Indonesian curriculum which have taken places several times since the nation's independence as a Republic in 1945 may be categorized into three major domains consisting of Kurikulum Rencana Pelajaran or Subject Plan Curriculum (1947-1968), Kurikulum Berbasis Tujuan or Purpose-oriented Curriculum (1975-1984), and Kurikulum Berbasis Kompetensi (Competency-based Curriculum) dan Kurikulum Tingkat Satuan Pendidikan or School-based Curriculum (2004 and 2006).

During the subject plan curriculum time (1947-1968), the development of education system in Indonesia was still influenced by the colonial era statutes of the Dutch and Japanese occupation while emphasizing "Pancasila" (state ideology) and "Undang-undang Dasar 1945" (constitutional law). The science curriculum reformation at this era occurred because of several reasons including the low number of students who went to school, the quality of education, the quality of graduation, and the correlation between graduate skills and the real need in the work

field (Mariana & Praginda, 2009). The curriculum used in this period consisted of (a) “Rencana pelajaran” (Lesson Plans) 1947 as the first curriculum in Indonesia which emphasized education values and attitudes to build the awareness of nationality, subject contents related to basic daily life, as well as physical education and arts; (b) “Rencana pelajaran terurai” 1952 as the improvement on the previous curriculum, which highlighted the link between lesson plan and the subject content based on daily life experiences. This curriculum promoted five classifications of study, which include morality, intelligence, emotion/arts, general skills, and physical education; (c) “Rencana Pendidikan” (Education Plans) 1964, which emphasized active, creative and productive learning on facts and practical functions by focusing on the development of morality (society education, religion/characters), intelligence (local language, Bahasa Indonesia language, counting, and nature), emotional and artistic (arts) education, skills education, as well as physical and health education; and (d) “Kurikulum” (Curriculum) 1968 as the revision of the education plans of 1964, in which the science curriculum development involved physics, biology, and chemistry.

The second curriculum reform was the “Kurikulum Berbasis Tujuan” (Purpose-Oriented Curriculum) (1975-1984), or commonly referred to as the 1974 Curriculum Reformation. The focus of this curriculum period was the change of education system from one based on subject/lesson plans to a one based on purposes/goals. The purpose-based curriculum emphasized only on essential contents or subject materials from the disciplines. Education functioned to manage and transmit the old knowledge, technology, and culture values to the next generations. In this curriculum era, three kinds of curriculum were respectively in use, namely the 1975 curriculum, the 1984 curriculum and the 1994 curriculum. The science curriculum reformations at this period era were marked by several key points including the majoring of

science or social studies based on students' interests in high schools, the decision to place biology, physics, chemistry and mathematics as the core subjects (among 16 other core subjects) to be taught in high schools, and the application of inductive inquiry and skill process approach in scientific teaching which emphasized critical thinking skill through discussion and questioning (Mariana & Praginda, 2009). In addition, the government also built a basic science team to develop science curriculum at school.

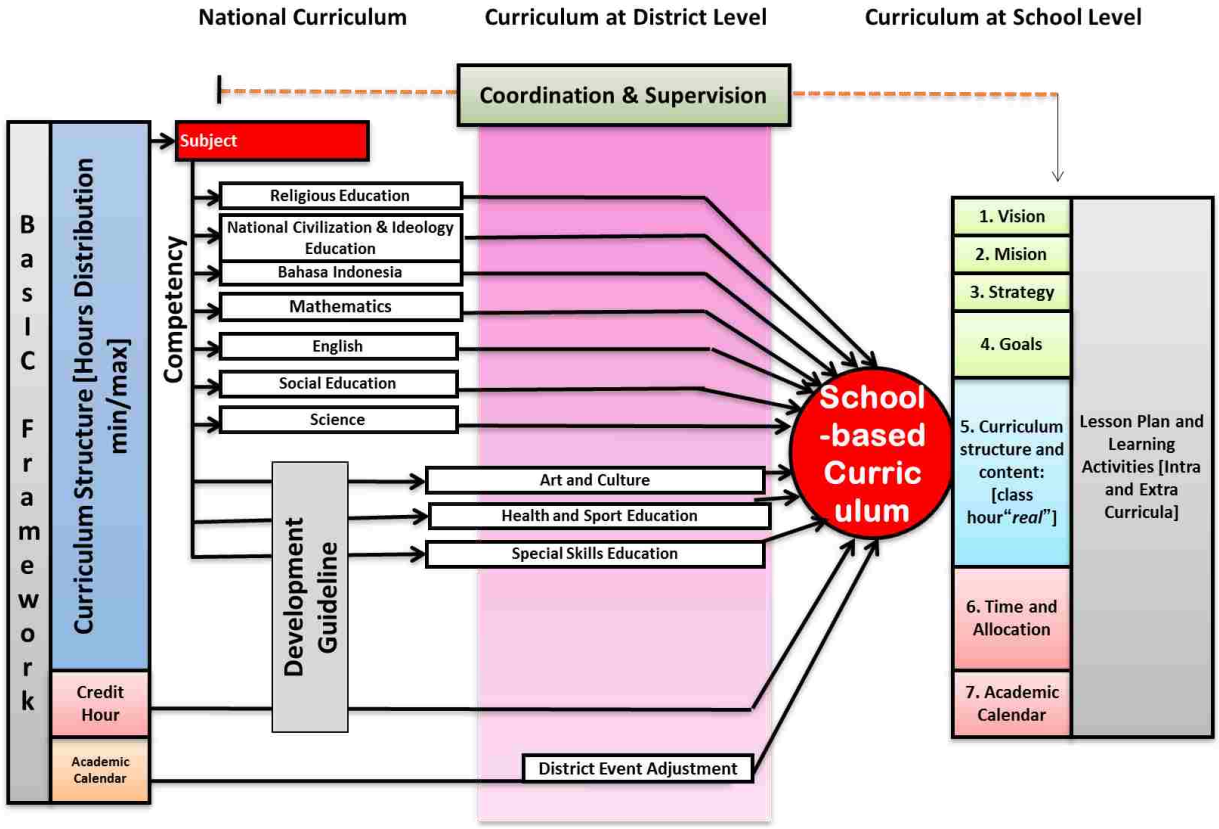

Figure 2.1: Translation (to English) of basic framework of Indonesian curriculum structure provided by the Ministry of Education and Culture (MoEC, 2012b)

The third curriculum reform in Indonesia was "Kurikulum Berbasis Kompetensi dan Kurikulum Tingkat Satuan Pendidikan" (the Competency-based Curriculum and the School-based Curriculum). Competency is defined as the integration of knowledge, skills, values, attitudes, and interests that are reflected into daily thoughts and attitudes. The classification of

competencies in this curriculum included: (1) factual knowledge related to terminologies, specific details, and basic elements of knowledge; (2) conceptual knowledge related to classifications, principles of procedures, and information about theories, models, and paradigms; (3) procedural knowledge related to subject-specific skills, algorithms, subject-specific techniques and methods, and appropriate procedure usages; and (4) metacognitive knowledge related to strategies, cognition, and self-concepts. In science classroom, competencies are classified into science concepts, scientific processes, attitudes and values of science, and the implementations of science in daily life (Mariana & Praginda, 2009). The basic framework of this curriculum is as illustrated in Figure 2.2.

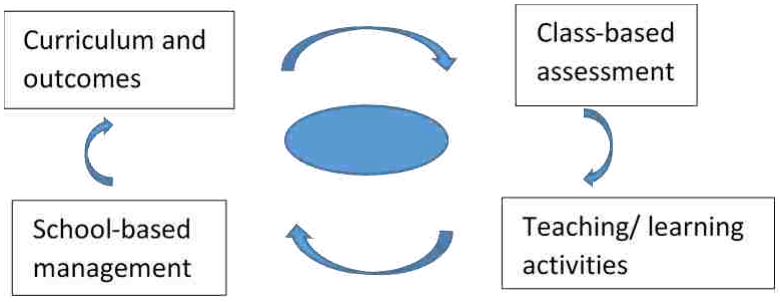

Figure 2.2: The basic framework of the Indonesian Competency-based Curriculum 2004 (MoEC, n.d.)

Meanwhile, the school-based curriculum refers to standards of content, and standards of graduation competency for elementary and secondary school. The school-based curriculum was decentralized; the curriculum framework was designed by the national government and fully developed by the school. There were six important components of the school-based curriculum: vision and missions, educational goals, academic calendar, the curriculum structures—including subjects, local contents, self-development activities for students, the arrangements of credit by unit, majoring interests and graduations, life-skill education, supremacies of global/local-based

education, syllabus, and lesson plans. For five years long, schools in Indonesia applied the school-based curriculum.

The Indonesian government released the latest nationwide competency-based curriculum in 2013, namely Curriculum 2013, that served a purpose as an instrument to guide learners to face the internal (education reformation condition) and external challenges (globalization issues) (Syarif, 2015). In general, Curriculum 2013 has the same structure as school-based curriculum that compiles operational curriculum and is implemented in each educational unit and serves as a guideline for the implementation of the three domains of learning activities including attitudes, knowledge, and skills (MoEC, 2014). According to Ministry of Culture and Education of the Republic of Indonesia, within the framework of curriculum development in 2013, four out of the eight national education standards (as stipulated in the Law on National Education System) have significantly changed in the latest Indonesian curriculum 2013 (Nuh, 2013; Prihantoro, 2015; Syarif, 2015). These include competencies related to the (1) graduate standards (including attitudes, knowledge, and soft and hard skills); (2) content standards—the criteria concerning the scope of the material to be included in instruction and level of competence to achieve the competencies of graduates on the level and type of education. Competency level 5-6 is the highest level for upper secondary school (high school); (3) standards of learning process (including questioning, observing, experimenting, informal learning, role model in teaching attitudes, etc.); and (4) standards related to assessment— the criteria regarding the implementation of learning in the educational unit to achieve standards of graduation competencies. Education assessment standards also include mechanisms, procedures and instruments criteria of assessment to evaluate students' learning outcomes.

According to Syarif (2015), the curriculum 2013 is developed based on several factors: (1) internal challenges—related to educational conditions associated with educational demands of eight National Standards of Education including content standards, process standards, graduate competency standards, educator and educational staff standards, facilities and infrastructure standards, management standards, financing standards, and educational assessment standard. Other internal challenges are related to the transformation of productive age population into a human resource that possesses competence and skills through education in 2020-2035; (2) external challenges—related to the flow of globalization and environmental issues, advances in technology and information, the rise of creative industry and cultures, and educational development at the international level. Current globalization will shift the pattern of community life from agrarian and traditional commerce to modern and industrial one. External challenges are also related to the shift of world economic power, the influence and impact of techno-science as well as quality, investment, and transformation of education. Indonesia's participation in the study of International Trends in International Mathematics and Science Study (TIMSS) and Program for International Student Assessment (PISA) since 1999 has yielded an unsatisfactory result. This is due to the fact that a large number of test materials employed in TIMSS and PISA are not integrated in the Indonesian curriculum; (3) perfection of thinking patterns—through reinforcing learning pattern that is centered on the students, interactive and networking learning pattern, active learning-seeking, self- and group-learning pattern, multimedia-based learning, classical-mass based learning pattern focusing on developing potentials specific to each learner, multi-disciplinary learning pattern and critical learning pattern; and (4) reinforcement of curriculum organization—by reinforcing collaborations among teachers, strengthening school management by appointing capable school principles as educational leaders and improving

facilities and infrastructure for better management and learning process; (5) Reinforcement of biology core ideas by reducing irrelevant materials as well expanding the relevant materials for learners; and (6) developing relevant characteristics of the IBC 2013 for Indonesian learners.

Factors Affecting Curriculum Implementation

After defining the concept of curriculum, an understanding of curriculum implementation and factors that might affect its success would be discussed. According to Durlak and DuPre (2008) *implementation* "refers to what a program consists of when it is delivered in a particular setting" (p.329); whereas Katuuk (2014) viewed *implementation* as an instrument (to make ideas into real or to reach the curriculum objectives) and a process (efforts to execute curriculum objectives in the learning process). Katuuk (2014) also mentioned several factors that influence curriculum implementation. They include curriculum implementation plan, curriculum documents, teachers, facilities/infrastructure, school cultural climate, school principals, and administrative factors. Durlak and DuPre (2008) similarly described that an effective program implementation is influenced by factors at community level (such as funding, politic, and policy, etc.), characteristics of provider involving "perceptions related to the need for and potential benefits of the innovation, self-efficacy, and skill proficiency" (p.336), characteristics of innovation (such as the ability to adapt and fit into the program user/organizations), organization process in general (such as positive work climate, program sharing/socialization, etc.), programs coordination and communication (sharing process), effective leadership and training as well as technical assistance related to administrative factors.

The science curriculum in Aceh province was based on "Qanun" (Law) Aceh No. 11 Year 2014. The Qanun stated that the education system of Aceh province is conducted based on the national education system with the adaptation of the regional socio-cultural values. As far as

Aceh is concerned, the curriculum is especially designed not to conflict with the Islamic laws. The region's education standards are the minimum criteria based on not only national education standards but also the specificity and privileges of Aceh province (Aceh Secretariat of Law Bureau, 2014). According to Adam (2014), the education vision of the Aceh government is to develop dignified, prosperous, fair, and independent citizens of Aceh, a goal that is based on the manifestation of the Helsinki Memorandum of Understanding[1]. In addition, the implementation of the national curriculum in the region allows the addition of local contents appropriate to the needs of the districts.

Since the culture of Acehnese society is strongly bonded to Islam, the implementation of science curriculum must be supported by Islamic values. According to Ibrahim and Zubainur (2015), teaching activities in Aceh are influenced by the culture and Islamic traditions and values, as stipulated by the laws that guide the curriculum implementation. In this case, school climate or culture is the factor that may affect the implementation of curriculum in Aceh, even though Ibrahim in Ibrahim and Zubainur (2015) also explained that there is no significant difference in the implementation of science curriculum before and after the implementation of Islamic laws, arguably due to the shift in community values in the modernization era.

Curriculum Implementation: Science (Biology) Teachers' Beliefs in Curriculum Content

When a new curriculum is introduced into schools, there are changes in the structures, programs, and practices of the teachers and school's organization. Based on the literature review above, my study result might be related to those factors, which will be discussed further. These factors, especially teachers, are influential in the implementation of biology curriculum 2013. As

[1] This Memorandum of understanding was crafted between the government of the Republic of Indonesia and the Free Aceh Movement and signed in Helsinki 15 of August 2005

widely accepted, teachers, whose knowledge, experiences and competencies, are critical to any curriculum improvement effort (Koto, 2013), play the most important role in the curriculum implementation process, Teachers are an essential factor to implement what has been written in the documents and to transform it into an actual action called learning process for students (Ariedi, 2014). In addition, developing teacher skills for new curriculum implementation requires a strong and good management that includes the development of professional, pedagogic, personal and social competence (Katuuk, 2014).

Over the past several years, many studies have highlighted the relationship between teacher beliefs and actions that affected the curriculum implementation. Previous studies found that teacher beliefs, attitudes, depth of knowledge, and length of teaching and experiences had influenced on science curriculum design, implementation and reformation (Roehrig & Kruse, 2005; Cheung & Ng, 2000; Cronin-Jones, 1991). Verjovsky and Waldegg (2005) also stated that teacher's daily attitudes in classroom were guided by the degree of coherence between beliefs and practices of the curriculum implementation. In addition, Mansour (2009) has stated in a brief result of his study that the relationship between teachers' beliefs could be contrary to priority, indirectly affect teaching practice, and context-dependent.

Regarding teacher beliefs and practices, Mansour (2009) believed that some important points for science teacher and science curriculum development to consider are (1) the importance of identifying and minimizing the constraints that affect teacher beliefs and practices in a classroom, (2) awareness of teacher's experiences as significant factor in understanding the relationship between teacher beliefs and actions, and (3) classroom environment settings and school administrators.

An important aspect of improving education quality lies in the roles that teachers must have in curriculum implementation. In curriculum implementation, teachers play the four roles of implementer, adapter, developer, and researcher (Alawiyah, 2016). Alawiyah also found that there is a shift of teachers' roles in curriculum from implementers, adapters, and developers (in the previous curriculum known as KTSP 2006) to implementers in Curriculum 2013. In addition, Nurmalasari et al. (2014) in her descriptive case study of teachers' role in curriculum 2013 implementation found that in the implementation of a curriculum, teachers play their roles in discussing and designing lesson plans, directing instructions, facilitating learning process, teaching character education, guiding students to learn the scientific approach, selecting and applying various teaching methods, media, and sources, applying authentic assessment and other assessment strategies, and providing remedial assistance to students.

On the other hand, there are always different perceptions of the changes from one curriculum to another. The term perception often called by the perspective, view, or assumption because in perception, there is opinion of someone relating one thing or certain object. Perception is the process which is preceded by sensing, is the process that exists accepted by the stimulus of the individual through sensory organs or can be called sensory processes (Prabowo, 2011). Prabowo (2011) also explained two factors that influence perception: (1) functional factors are factors that influence individual in giving perception, such as the needs, past time experiences, and the other things which called as personal factors; and (2) structural factors, which derived from the stimulus, physic, and nerve effects that inflicted to individual nervous system.

Based on Prabowo (2011) explanation, teachers' belief is determined as one of the functional factors. Teachers' beliefs influenced teachers' behaviors in the instructional process to

determine the success of curriculum information (Isthofiyani et al., 2014). Based on the studies above, there seems to be a strong need to know more about teachers' beliefs regarding the instructional process including the topic chosen and strategies advocated for reaching the learning goals as required by the new curriculum document.

Curriculum Implementation: Instructional Strategy, Assessment and Character Education as a Unique Indonesian Curricular Element

The Act of the Republic of Indonesia Number 20, Year 2003 on National Education System, defines curriculum as a set of plans and regulations about the aims, content and material of lessons as well as the method employed as the guidelines for the implementation of learning activities to achieve given education objectives (Article 1, Verse 19). The development of curriculum is based on national education standards in pursuing national education goals (Article 36, Verse 1), which consist of the standard of the content, process, graduate outcomes, educational personnel, facilities and equipment, management, funding, and educational assessment, all of which should be improved systematically and regularly (article 35, verse 1).

Based on the definition given by the Act of the Republic of Indonesia, the concept of curriculum in Indonesia, especially in Aceh province, refers to two dimensions: (1) content/teaching materials and objectives' plans and regulations, and (2) methods of learning activities. Referring to Walker (1990) in Marsh (2009), the Indonesian curriculum has included three essential aspects of a curriculum consisting of content, aims, and organization.

In Indonesian secondary school, biology as a part of science subjects has the characteristics of scientific knowledge, teaching the science of living things and life processes inductively and deductively. Thus, the aims of biology learning are to:

- form a positive attitude towards biology to realize the regularity and beauty of nature and praise the greatness of God Almighty;

- foster scientific attitude that is honest, objective, open-minded, resilient, critical, and cooperative;
- gain experience in applying the scientific methods through experiments, which allow students to test the hypotheses by designing experiments through the installation of instruments, collecting, processing and interpreting data, and presenting the result;
- increase awareness of the advantages and disadvantages of the application of biology to individual, society, and the environment as well as to recognize the importance of managing and conserving the environment for the welfare of society;
- understand the concepts, principles, laws, and theories of biology and interrelationships and its application to solve problems in everyday life and technology.

Biology should be learned in scientific inquiry to foster students' ability to think, practice, behave, and communicate it as an important aspect of life skills. Therefore, biology as a subject in high school / MA / SMK emphasized providing direct learning experience through the use and development of process skills and scientific attitude. Models of teaching or teaching strategies have been invented by many developers (redevelopers). Joyce et al. (2014) defines models of teaching not only as a learning environment but also a behavior portrait of teachers when applying any models as their instructional strategies. The models of teaching that have been grouped by Joyce et al. are shown in Table 2.1.

Table 2.1: Models of teaching (Joyce et al., 2014, pp.26-33)

Group	Teaching Models	Sub-Teaching Models
The social family (models)	Partners in learning	Positive interdependence Structured inquiry
	Group investigation	
	Role playing	
	Jurisprudential inquiry	

Table 2.1. (Cont.)

Group	Teaching Models	Sub-Teaching Models
The personal family (models)	Nondirective teaching	
	Enhancing self-esteem	
Information-processing models	Inductive thinking (classification oriented)	
	Concept attainment	
	Mnemonics (memory assist)	
	The picture-word inductive	
	Advance organizers	
	Scientific inquiry	
	Inquiry training	
	Synectics	
The behavioral system family	Mastery learning	
	Direct instruction	
	Simulation	
	Social learning	
	Programmed scheduled (task performance reinforcement	

As stated in the guideline book for Indonesian curriculum 2013 (Syarif, 2015), science is taught in Indonesian high schools using scientific-based approach, such as discovery learning, project-based learning, problem-based learning, and inquiry learning, while authentic assessment is used as the basis of teaching evaluation. Moreover, research on science or biology teaching in Indonesia has shown that inquiry-based learning, unaccompanied or collaborated with other teaching techniques, has resulted in differences in students' achievements, science skill process and critical thinking constructions (Sutama et al., 2014; Rahmasiswi, 2015; Nur et al., 2016; Purwati et al., 2016; Lasmo et al., 2017). The research claims that the improvement can be seen from the ability of students that had significantly improved from the first cycle to the last cycle in action class research. Additionally, the Indonesia GSS 2013 Biology curriculum has also directed Biology teachers to apply project-based learning, discovery learning, and authentic assessment. One of the studies was conducted in order to see if project-based learning (PBL)

could influence students' outcomes in learning biology. In learning using the project-based learning, students are guided to take an active role in different kinds of learning activities. They are able to have a chance to combine the knowledge with skill elements into the study process to produce the knowledge and skill to plan, to solve the problems and to communicate about process or product. Not only are the students able to master the content of the subjects, but they also have the chance to experience learning through skill development process and scientific attitudes.

One of the most basic and challenging tasks that teachers face in their work is the process of assessment. Classroom assessment includes all the process involved in making decisions about students learning progress. It includes the observation of students' written work, their answers to questions in class, and performance on teacher-made and standardized tests. However, most classroom teachers assume that assessment is simply to measure student's achievement on a certain subject (Koto, 2013).

Authentic assessment has been introduced to the Indonesian education system since 2013. It is believed that this type of assessment can develop the students' knowledge and help them to be ready for the global challenges. An authentic assessment has been applied due to its relevance to the scientific learning approaches. Authentic assessment tends to focus on complex or contextual tasks, allowing learners to demonstrate their competencies which include attitudes, knowledge, and skills. In other words, authentic assessment is the assessment of performance including portfolio and project assessment. Therefore, this authentic assessment could assist teachers to plan a remedial, enrichment, and counseling for students (Syarif, 2015). A study by DiMartino et al., (2007) indicates that local authentic assessment is given a fold formula, including scores, program information, state exam results and some other data, in order to make

graduation decisions. In their research, they found that the use of authentic assessment in classroom has led to students' high-level thinking skills, expertise, relevance, and instructional fluency. Authentic assessment has also increased opportunities for students to develop global awareness, community involvement, and learning skills. However, not as fancy as it sounds, authentic assessment in the Indonesian education system particularly in biology classrooms is not well implemented. Three major reasons why this assessment is not successfully implemented in some schools in Indonesia are (1) there are no significant evidence that teacher learning design is created on the basis of the integration of assessment and instruction, (2) there are only limited tools for authentically assessing students; teachers are still using paper and pencil tests, and (3) the quality and availability of the alternative instruments such as graphic organizer, portfolio, journals still need to be improved.

Furthermore, teaching-learning process is tangled with the character education teaching. Character education has been implemented obliquely since long time ago in a classroom without certain measurement. Yet, many national and social issues regarding immoral behaviors, such as national examination corruption, bullying cases, and drugs abuse have encouraged our government and educators to create certain policies as responses to these moral/social problems.

The idea of character education can be applied in all of the formal or non-formal education settings. It means that the development of character education involves the responsibility of the government and the whole society. The characteristic descriptions of Curriculum 2013 have orientation in developing the character education of students. Educational character teaches students how to be their best-self and how to do their best work (Tannir & Anies, 2013). Therefore, teachers are encouraged to teach the values of character education. The

following are the values that should be integrated into science teaching-learning process for students to implement inside and outside the schools.

Table 2.2: Character educations for high school biology subject (MoEC, n.d.)

No	Values	Descriptions
1	Religious	Attitudes and behaviors of obedience towards the religious practices, attitudes of tolerance towards other religious practices and live in harmony with the people from other religions.
2	Honesty	Attitudes, which are based on the efforts to make oneself trustworthy in daily practices, activities, and works.
3	Tolerance	Attitudes and actions that respect the differences in religions, ethnicity, opinions, behaviors and other people practices
4	Discipline	Attitudes that show obedience towards rules and regulations
5	Hard work	Attitudes that show genuine efforts in overcoming problems in learning and duty, as well as in completing tasks thoroughly
6	Creative	Thinking and implementing something which results in a new invention from what one has acquired
7	Independent	Attitudes and behaviors which show one' independence to other people in completing his/her tasks
8	Democratic	The way of thinking, behaving, and acting which reflects equality in obligations and rights among all people
9	Curious	Attitudes and behaviors that show the will to find out more about everything that one sees hears and studies
10	Spirit of Nationalism	The way of thinking, acting and behaving that upholds the needs of the country is always above other needs
11	Patriotic	Attitudes and behaviors that show the loyalty, care and high respect for national language, physical environment, social life, culture, economy, and politics
12	Appreciative to Achievement	Attitudes and behaviors that encourage one to produce something that is useful to the society and also respectful of others' creativity
13	Friendly / Communicative	Attitudes which show the willingness to communicate, engage and cooperate with other people
14	Peacekeeping	Attitudes, speech, and action which can make other people feel comfortable and safe while being around one
15	Love of Reading	A habit of spending some time reading something that is useful for him/her
16	Care for the Environment	Attitudes and behavior which show the will to avoid damaging the surrounding environment and also the efforts to repair the damage to the environment
17	Social Care	Attitudes and behaviors that show the will to help others and to give aids and goods to other people who are in needs
18	Responsibility	Attitudes and behaviors that reflect the obedience in doing one's responsibility towards oneself, him/her family, society, environment and god.

The Perspective of Religious Aspects in Science Education

The relationship between religion and science has long debates so that it needs bridging the gaps by enhancing how science and religion are taught. Some of the adequate literature that addressed the issue are works of Mansour (2008) and Billingsley et al. (2014). Mansour in searching the gaps tends to examine personal belief and experience of the teachers because they are somebody who transforms some knowledge. Meanwhile, Billingsley et al. (2014) point out some new insights although they approached their research by interviewing the teachers. Affected by the issue of whether science and religion compete or correlate with each other, Billingsley examines how science and religion are taught by science and religious education teacher to find curriculum design and teaching. Interviewing 16 teachers in a secondary school in England, they highlighted that there is little collaboration in the curriculum that involving science and religion. Then, although there is no collaboration, the students are influenced by their religious understanding in the process of learning science.

Thus, according to Billingsley et al., (2014), there is difficulty in teaching both science and religion as both are in debates. There can be many opinions of what science is or what religion is that become challenges for the teachers that they should face. He also added that the challenges, as well as the solutions for the gaps, are the teachers of science or religious education should have competence in both subjects. Also, the teachers should not feel unconfident to share with each other. In addition, the teachers should not focus on the tension of science and religion, but they should give an explanation why there are distinctions of views about the subjects. Reflecting to what Billingsley suggests, I see that practically sometimes the teachers of science do not consider that religion also has an important role in science, or religious education teachers does not think that science is also significant in understanding religion.

To elaborate the relationship of science and religion, we can refer to the frontier scholars, Lynn White from Christianity and Seyyed Hussein Nasr from Islam who contemplated the relation of human and nature (Jenkins, 2009). Lynn White argues that historical roots of the ecological crisis lie in the religious cosmology of anthropocentrism and instrumentalism view of nature in western Christianity (Jenkins, 2009). In other words, religion has important role in constructing knowledge about nature. Consequently, this hypothesis influenced religious people to reexamine their religions, including scholar from Islam, Nasr. Nasr is frontier in Islam who addresses the relation of religion and nature by his influential work, Religion and the Order of Nature of 1947 (Nasr, 1996). It is likely Nasr agrees with Lynn White's criticizing modernity that influenced by Western Christianity. On the other hand, Nasr (2017) in his paper has invited us to resacralize the nature because he saw that ecological crisis had been exacerbated by the reductionist view of nature that has been advanced by modern secular science. Therefore, in this sense, I agree that science and religion should coexist together, and this view should be transformed to the student.

In the context of Indonesia, religion has important role in several aspects as well as in education. As part of the vision of elected president in 2014, the president pointed to the importance of character education, moral education, and ethics education that put forward the values of Indonesia's national motto "Bhinneka Tunggal Ika" ("Unity in Diversity") (Suhadi et al., 2015). This issue is implied it 2013 Curriculum as applied government. There is the responsibility of the teachers of any subjects to encourage the students to have character, moral and ethics impacts. Importantly, what happens in Indonesia relates to what Billingsley suggests through his findings, that there should be a collaboration among teachers of any subjects to maximize how to teach their students.

The U.S. Next Generation Science Standards: Its Development and Studies

The development of science curriculum in the states of the United States began two centuries ago, influenced by European educational theories and ideas during the eighteen and nineteenth centuries, such as the scientific discoveries, textbooks, and the technological apparatus (DeBoer, 2003). Currently, schools in the United States implement the Next Science Generation Standards (NGSS) that was developed by the National Research Council (NRC), the National Science Teachers Association, and the American Association for the Advancement of Science, with collaborative work from states and other stakeholders in science, science education, higher education, and industries. The NGSS began by developing a Framework for K-12 science education, preparing students for college and careers (NGSS Lead States, 2013). The NGSS framework presents the three dimensions to form each standard including practices—specific knowledge and skills when conducting an investigation; crosscutting concepts, and disciplinary ideas (NRC, 2012). The performance expectations (PE) are statements about what students *should know and be able to do* (NSTA, 2014) about the instruction, which combines those aspects in the connection box. PEs are designed to guide the development of assessments, so they are not teaching strategies nor the objectives of a lesson. According to the NSTA (2014), the foundation boxes explain the learning goals that includes the most essential ideas in the major science disciplines that all students should understand during the years of school (DCIs), the statement about the construction of the PEs (science and engineering practices) and "statements about the ideas such as pattern and cause-effect, which are not specific to any one disciplines but can cut cross them all" (crosscutting concepts). For instance, for the LS1.A structure and function, the crosscutting concepts are the use of models (such as physical, mathematical, computer model) to create energy, matter, and information flows at different

scales. The foundation box "identifies other topics in NGSS and in the Common Core State Standards (CCSS) that are relevant to PEs" (NSTA, 2013). The foundation box consists of several statements regarding the "connections to other disciplinary core ideas in this grade level, articulation of disciplinary core ideas across grade levels, and connections to the Common Core State Standards" in mathematics and language arts.

According to the National Research Council (2012), the Next Generation Science Standards (NGSS) are K–12 science content standards comprising a set of the expectations for what students should know and be able to do (www.nextgenscience.org). The NGSS aims to provide opportunity in science education and student's achievement improvement that emphasizes research-based and up-to-date science standards as its rationale to develop an in-depth understanding of content and to develop key skills—communication, collaboration, inquiry, problem-solving, and flexibility—that will serve them throughout their educational and professional lives. Therefore, the practices of science and engineering in the NGSS have rationales as follows:

- To help students understand the development of scientific knowledge and the work of engineers and their relationship such as the use of several approaches to do investigations of worlds' phenomena.
- To make students' knowledge more meaningful by understanding the science and engineering crosscutting concepts and disciplinary ideas.
- To broad students' interest and curiosity of science and engineering creative works to challenge and solve the world's phenomena, such as climate change, energy renewal, diseases prevention and treatment, fresh water and food supply conservation, thus motivating them to continue their study.

- To educate students about the importance of scientific products' development (application) and establishment, not the products themselves (the sciences facts) or the peripheral importance of engineering.

In addition, to support teachers in reaching the goals, there are eight essential practices of science and engineering in science learning process (NGSS Lead States, 2013) named in the document:

- Asking questions (for science) and defining problems (engineering)
- Developing and using models
- Planning and carrying out an investigation
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations (for science) and designing solutions (for engineering)
- Engaging in argument from evidence
- Obtaining, analyzing, and communicating information

Moreover, the NGSS provides guiding principles for K-12 science including an emphasis on the interconnection of practices and experiences of nature and coherence of science concepts across K-12, the intention of content understanding and application, the integration of science and engineering and the alignment between NGSS and Common Core (McComas, 2013).

However, Reiser (2013), as discussed by Lederman & Lederman (2014), stated that providing the framework for K-12 and adopting NGSS should be followed by the enforcement on professional development (PD) of science teachers and teaching practices. In their study, they found four effective PDs for teacher's classroom practices consisting of the deep direct links to the subject matter, which require teachers to connect their science teaching practices into specific

scientific context; PD should be an active practice of problem-solving and analysis instead of making teachers a role model; PD should focus on giving a chance for teachers to apply ideas of their own in teaching practice changes; and PD should be able to connect to "practice [which] requires that teachers explore what a coherent system of student learning, classroom teaching, assessment, and curriculum materials needs to achieve, and work on changes across these corresponding parts of a system" (p.15). Furthermore, Bowman and Govett (2014) add that teachers' PD should be in the direct company of scientists to understand the knowledge and skills required in teaching science.

There are also several studies that have been conducted on the framework and NGSS implementation, such as the difficulties and misconceptions on the NRC content standards (Sadler et al., 2013), the impact of PD workshop on high school teachers' Pedagogical Content Knowledge for scientific argumentation (McNeill & Night, 2013), and on teachers' instruction planned through their understandings of the NGSS (Lo et al., 2014), challenges and opportunities for the design and use of assessment to assess performance expectations that link science practices, cross-cutting concepts, and core content knowledge (Pellegrino, 2013).

Summary of Literature Review

This literature review section begins by introducing readers to the curriculum concept and comparison analysis studies, also the educational context in which the study will take place by discussing general features of the education system in Indonesia as well as the latest curriculum currently being implemented. Also, I discussed the history and development of curriculum in Indonesia and science curriculum implementation related to science (biology), teachers' beliefs on curriculum contents, science teaching practices, and assessments, as well as character education integration in teaching and learning. The perspectives of religious aspects in science

curriculum have been mentioned to expand the information of character integration in teaching and learning science. Further, an overview about the Next Generation Science Standards (NGSS) and its studies have served the purpose of comparing several aspects of Indonesian biology curriculum 2013 and the NGSS-Life Science. Summary of literature review, gaps in literature, conclusion and research motivations have been provided in this chapter.

Gaps in Literatures

Although there has been a study on primary school teachers' response on the curriculum implementation in Indonesia, it was related to the competency-based curriculum namely curriculum 2004 which has no longer been implemented in Indonesian education system. Additionally, comparative studies of the United States' school curriculum and Indonesia's curriculum 2013 or the Australian and Indonesia junior high school curriculum 2013 have been conducted with a different focus and a different case study area. The comparison found between the Australian curriculum and Indonesia Science Curriculum 2013 for school years of 7-9 by Michie (2017) is as follows:

> "When compared to the Australian Curriculum, the Science Curriculum reveals that the contents are similar, as are key ideas and skills, and each curriculum has its approach to assessing achievement. Sustainability is a major cross-curriculum feature of both curriculums" (p.83)

There is no exact study relating to the comparison between the NGSS-Life science standards and Indonesian biology curriculum 2013 at the senior secondary school level. Finally, I have not found any studies discussing teachers' opinion of an ideal curriculum and proper curriculum topics which should have been taught, especially by Acehnese biology teachers.

Conclusion and Research Motivations

A curriculum has significant roles in education. Curriculum development is also a dynamic process that keeps changing to adjust the world requirement for better education and to fit in the countries in which it is implemented. In Indonesia, the curriculum has been reformatted ten times since the Independence Day in 1945 and has been developed to meet the better education system. Further, as an agent of curriculum empowerment, the government should have considered teachers' belief as an important factor for implementation of curriculum. Teacher professional development is an essential aspect to support curriculum implementation. Proper training and teachers' access to adequate information would lead to the successful implementation of a new curriculum. By reviewing other science standards/curricula from other countries—in this case, that of The United States of America—and collecting teachers' opinion relating to curriculum content and teaching strategies, there is a potential to analyze what teachers are actually dealing with in implementing a new curriculum design.

CHAPTER 3

RESEARCH METHODS

Introduction

To address the purposes of this study, this chapter provides the nature of study, specific methods to answer the research questions including sampling procedure, instruments, document analysis, and data collection procedure. Research questions asked in this case studies were prepared to gather senior secondary school teachers' opinion in relation to their efforts in implementing the new curriculum 2013. This study has also inquired the comparison between the next generation science standards and Indonesian high school biology curriculum 2013. Therefore, the guiding research questions in this study are:

1. How does the Indonesian biology curriculum 2013 content compare with related aspects of the U.S. Next Generation Science Standards (NGSS)?
2. How do Indonesian teachers in Aceh Province value aspects of the required biology content?
3. What aspects and with what frequency do Indonesian-Acehnese teachers teach the various aspects of the biology curriculum 2013?
4. What instructional methods are used by these Indonesian-Acehnese biology teachers to support students in understanding biology?
5. What general perceptions are reported by these Indonesian-Acehnese teachers regarding the required biology assessment in the Indonesian curriculum 2013 document?
6. How do Indonesian-Acehnese biology teachers integrate the required aspects of character education into biology instruction?

Nature of Study

The study was based on a survey of teachers' opinions about their beliefs on biology curriculum contents and teaching strategies in supporting their actions. Creswell (2012) states that a survey study is used to describe trends in population, such as to identify important beliefs, attitudes, opinions, behaviors, or characteristics of individuals or population. Furthermore, a mixed-methods approach was used in this study to investigate teachers' opinions and practices of content and process in senior secondary biology curriculum in Aceh located at the western end of the Island of Sumatra in Indonesia. A mixed-methods research in general is an investigation that involves the integration of quantitative and qualitative data collection, analyses, and interpretation in a single study or a series of studies to provide better understanding of the research problem (Leech & Onwuegbuzie, 2009; Creswell & Tashakkori, 2007; Creswell, 2012; Creswell and Plano Clark, 2011).

Mixed-method research also allows researchers to use multiple approaches to answer research questions (Creswell, 2009). Also, this research was considered as a phenomenological study because I investigated teachers' opinions and actions as well as their experiences and interpretations of the educational process (Merriam, 2009; Hatch, 2002). The purpose of mixed-methods in my study was a complementarity (i.e., using quantitative and qualitative techniques to elaborate, enrich, and illustrate the data gathered) (Onwuegbuzie & Leech, 2006).

Furthermore, my study is best classified as partially mixed-concurrent equal status design because (1) qualitative and quantitative data were collected and analyzed approximately at the same points in time [qualitative analysis was used to answer research question no. 1 and to enrich research questions 2, 3 and 5, while the quantitative analysis was used to analyze research questions 2, 3, and 4]; (2) qualitative and quantitative analyses were mixed when making a meta-

inference from separate quantitative and qualitative findings (3) the qualitative and quantitative components were at the same weights of this study (Leech and Onwuegbuzie, 2009; Onwuegbuzie & Johnson, 2006).

Ethical Considerations

This study has been approved by the University of Arkansas Review Board, IRB#16-06-791 (Appendix A). A permission letter about the survey process, attached with field research approval letter from National Education Agency of Aceh Province (NEA-A), and a support letter from my advisor, have been sent to the head of NEA-A in each district as a formal information to be announced to the headmasters and all General Senior Secondary School (GSSS) biology teachers at their districts.

Data Collection Procedure

The first stage of my procedure was to examine the documents and relevant articles to find possible similar and different components of the latest Indonesian Biology Curriculum and Life Science Framework of the Next Generation Science Standards. The information found provided a vital foundation for this study and is generally discussed in Chapter 2. The number of questionnaires distributed to each district was based on half of the total number of biology high school teachers at that district (these data were unofficially provided by the National Education Bureau of Aceh province). A cover letter (Appendix B) from the National Education Bureau of Aceh province and the consent form were attached to the questionnaire to encourage response and to help subjects understand that this work had official support. Thus, those questionnaires were mailed to the persons in charge (PIC) at each district to be presented in monthly biology teacher meeting (MGMP). Afterward, the PICs were returned the questionnaires in a week by mail. Creswell (2012) states that a questionnaire distributed by mail is a straightforward way to

reach a wide range of geographical sample of a population. For several districts, I was directly involved in the meetings and collected the questionnaires.

The distribution and data collection process took almost four months (August to November), because of some reasons such as the idle school time in the Aceh during fasting month (Ramadhan in Islamic lunar calendar) and missed teachers' meetings or unfixed meeting schedules in several districts. To overcome this challenge, the PICs were distributed the questionnaires and were collected 3-5 days after at the schools. Besides, respondents from rural area returned the questionnaire directly to the researcher or PICs by mail. The follow-up telephone conversation was conducted if potential subjects did not give any responses after the given specific time. On the other hand, in the process of data collection, I could not get enough access to one district in Aceh due to a flood disaster that occurred at that time, unavailable PIC, and lack of cooperation among teachers and school alumni. Thus, generalizability to the entire province is limited because of these issues.

Meanwhile, the interviews were conducted using semi-structured questions (Appendix A) by phone. Teachers who have been trained by the Education Quality Insurance Board of Aceh province (EQIBA) to use the biology curriculum 2013 were asked their willingness to participate in the interview process. Several teachers refused to be interviewed because of their lacks of time. Therefore, the number of selected interviewees was based on the saturation responses given. Collins explained that saturation refers to the degree of confidence that all meanings from the collected data were extracted from the sample used in the study and it could occur using a small purposive sample (personal communication, April 15, 2015). In this case, all interviewees offered similar responses to the questions given. Furthermore, according to Collins (2010), the minimum sample size recommendation for a phenomenological qualitative research design is ≥ 6

or ≥ 10. Moreover, a convenience-sampling scheme was used due to the respondents' willingness (Collins, 2010) to participate in the interview part.

Research Settings and Subjects

Sampling (sample size and sample scheme) is vital in this study to assist in ascertaining high-quality inferences drawn from underlying data (Collin, Onwuegbuzie, & Jiao, 2006). In this study, I conducted a concurrent design using identical samples for the quantitative and qualitative components (Collin, Onwuegbuzie, & Jiao, 2006). The teachers who are the subjects in the study were GSSS biology teachers in Aceh. There were 1,154 GSSS biology teachers scattered across 436 schools (public and private) in 23 Aceh districts (Figure 3.1). The selected sample size was based on a confidence level of 95 percent and the margin of error of 5 percent, which is counted N=288 as the representative sample size (Creative Research System, 2012). The teachers were selected from the latest database of biology teachers in the Aceh provided by the Education Quality Insurance Board of Aceh (EQIBA). From the source information given, the ratio of female and male general secondary school teachers in Aceh province was 2:1, and there was no exact information of the ratio of female and male biology teachers that could be accessed in specific. Subjects were asked to fill in the questionnaires consisting of closed-ended and open-ended questions. The number of questionnaires distributed for each district was based on half of the total number of biology teachers' distribution in each district (approximately 600 sets of questionnaires). The assumption was that by distributing fifty percent, I would reach the total sample needed from the population.

From approximately five hundred sets of questionnaires distributed, there were two hundred and eighty-nine (n=289) questionnaires returned, including three invalid ones due to incomplete responses on the background information at part two of the questionnaire's question.

Therefore, the final sample size was 286. Table 3.1 shows that the sample of this study was dominated by female teachers (n=228). Additionally, majority teachers at the age of 35-44 years old (n=91) were the subjects of this study, yet some of the teachers refused to specify their ages (n=39). In this case, based on field observation, it seems that many senior teachers did not want to mention their ages.

Figure 3.1: Map of cities and districts in the Aceh Province of Indonesia (Petatematikindo, 2013).

The number of public schools in Indonesia and Aceh is higher than that of private schools. Because of this, most of the subjects in this study were teachers from public schools (n=254), while the others were teachers from private ones (n=32). Although several teachers did not provide their school locations (n=44), it is clear that the number of subjects from rural

locations (n=95) in this study was slightly different from that from urban areas (n=83). Moreover, approximately eighty-eight percent of biology teachers in Aceh hold bachelor's degrees (n=224) even though a majority of them did not mention their graduation years (no response, n=90).

Most of GSSS teachers had more than 15 years of teaching experiences (n=80), yet the latest curriculum (Curriculum 2013) as well as the integration of character education in teaching strategies is still quite new to them because this curriculum has just been implemented since 2013.

Table 3.1: Demography of subjects of GSSS Biology teachers

Characteristics	Number of Subjects (%)
Genders	
Male	48 (16.8)
Female	228 (79.7)
No response	10 (3.5)
Ages (year)	
25 - 34	69 (24.1)
35 - 44	91 (31.8)
45 - 54	69 (24.1)
55 - 64	18 (6.3)
No response	39 (13.6)
Types of GSSS	
Public	254 (88.8)
Private	32 (11.2)
School Locations	
Rural	95 (33.2)
Sub-urban	64 (22.4)
Urban	83 (29.0)
No response	44 (15.4)
Highest Academic Qualifications	
Bachelor	254 (88.8)
Master	26 (9.1)
Doctoral	0 (0.0)
Other	1 (0.3)
No response	5 (1.7)
Years of Graduation	
1984-1990	20 (7.0)
1991-1997	31 (7.0)
1998-2004	61 (21.3)
2005-2011	56 (19.6)
2012-2018	28 (9.8)

Table 3.1. (Cont.)

Characteristics	Number of Subjects (%)
No response	90 (31.5)
Lengths of Teaching Biology	
<1 year	18 (6.3)
1-5 years	37 (12.9)
6-10 years	78 (27.3)
11-15 years	67 (23.4)
>15 years	80 (28.0)
No response	6 (2.1)
Lengths of Curriculum Usage	
None	48 (16.8)
< 1 month	30 (10.5)
1-5 months	88 (30.8)
6-10 months	34 (11.9)
>12 months	81 (28.3)
No response	5 (1.7)
Lengths of Character Integration	
None	33 (11.5)
< 1 month	34 (11.9)
1-5 months	73 (25.5)
6-10 months	45 (15.7)
>12 months	95 (33.2)
No response	6 (2.1)

Description of the Survey Instrument

A survey with both closed and open-ended questions was the primary data collection tool in this study (see Appendix A1 for the English version and Appendix A2 for Bahasa). The instrument was designed to gather specific information on teachers' perspectives and teaching practices of biology curriculum contents. Basically, the instrument was divided into three parts: (a) background information of respondents; (b) perceptions/view of respondents about biology topics (quantitative); and (c) semi-structured questions, which purposely gather information about teachers' general views on character integration techniques in teaching and the standards of biology assessments (qualitative). Furthermore, open-ended questions, adapted from Coenders, et al. (2008), were prepared for this study. I adapted and modified the interview

questions from Coenders because they were designed to find information about teachers' beliefs regarding curriculum content and thus aligned well with the goals of my study.

The background information part was designed to gather certain demographic data including the background of subjects, personal details (gender, age, type of school – public or private, and school location – rural, sub-urban, urban); educational backgrounds (highest academic qualification and year of graduation); and teaching experiences (length of teaching biology, experiences using the 2013 Biology Curriculum and teaching experiences with character integration). All information in this part was transformed into nominal and ordinal data scale for the data analysis.

The quantitative parts of the instruments consisted of thirty-four (n=34) biology topics extracted from the Senior Secondary Biology 2013 Curriculum of Indonesia (SSBCI 2013), and simply presented below (Table 3.2) based on branches of biology knowledge written by the Indonesian Biologists Consortium (Konsorsium Biologi Indonesia, 2015). The purpose of the table was to overview the proportion of biology topics taught in 2013 Indonesia biology curriculum. In Part II (A), a "Yes and No" answer was used to gather the information on whether those biology topics were taught. Moreover, the ordinal data scale was used by involving of 5-Likert scale (Strongly Important, Important, Neutral, Less Important, and Not Important) to gather teacher's opinions on the importance of biology topics in facilitating students' knowledge construction. Furthermore, the questions in Part II (C and D) required the subjects to tick (√) in the space to indicate each of the teaching strategies reflected in the classroom practices and assessment techniques respectively.

Table 3.2: Groups of biology topics listed from SSBCI 2013 for the survey instrument

Branches of Biology	Item Number	N Items
Biology cell and molecule	2, 21,28	3
Physiology	13-15,26	4
Genetics	1,22,23,27	4
Structure and Development	3-12, 20,29	12
Biosystematics and Evolution	24,25,30-34	7
Ecology	16-19	4

Furthermore, the qualitative parts of the instrument consisted of three questions. The first questions ask the subjects about their perceptions on the standards of biology assessment in curriculum document. They consist of several derived questions: (a) Do you use any different strategies (not mentioned above) to teach any biology topics? Please explain; (b) How do you integrate the character values in your teaching? Provide examples, (c) What do you think of the assessment that is required in the biology curriculum? Please explain your response. In addition, to enrich the information of the questionnaire, a set of semi-structured interview questions was used during one-on-one interview section including questions about the essential elements that should be presented in teaching practice, the challenges/problems and opportunities arising in the implementation of curriculum and their consideration of an ideal biology curriculum in terms of representative biology contents.

Validity and Reliability of the Instrument

A valid measurement is necessary if the results of any study are to have utility. A valid instrument is one that measures what it is supposed to measure. To examine the content validity of the instrument used in this study, a peer review was conducted to check the content validity of the instrument. A professor from Curriculum and Instruction Department of the University of

Arkansas, three professors from Syiah Kuala University (USK)—two college professors from the Biology Education Department and one from Indonesia Study Department, and one biology instructor who is working in the Education Quality Insurance Board provided content-related validity (Creswell, 2012) for the instruments. In addition, member-checking has been conducted to validate the interview questions. Thus, a pilot study had been conducted to assess the questionnaire reliability. Seventeen (n=17) teachers who were not part of the study samples were asked to review the questionnaire to determine the Cronbach's alpha coefficients. Those selected seventeen teachers had implemented or had been trained to adequate information and skill to apply the biology curriculum 2013. Table 3.3 shows the coefficient values for each construct category measured. All the alpha coefficients showed values above 0.70, meaning that those construct categories had high reliability.

Table 3.3: Cronbach's alpha values for the measured construct of biology topic items

Categories of Construct	Alpha Coefficient
Topic taught	0.89
Level of importance	0.87
Teaching strategy	0.92
Assessment (attitude)	0.98
Assessment (knowledge)	0.99
Assessment (skill)	0.94

Specific Methodology to Address Research Questions

The visual summary of research questions and data source applied to this study is depicted in Figure 3.2 below:

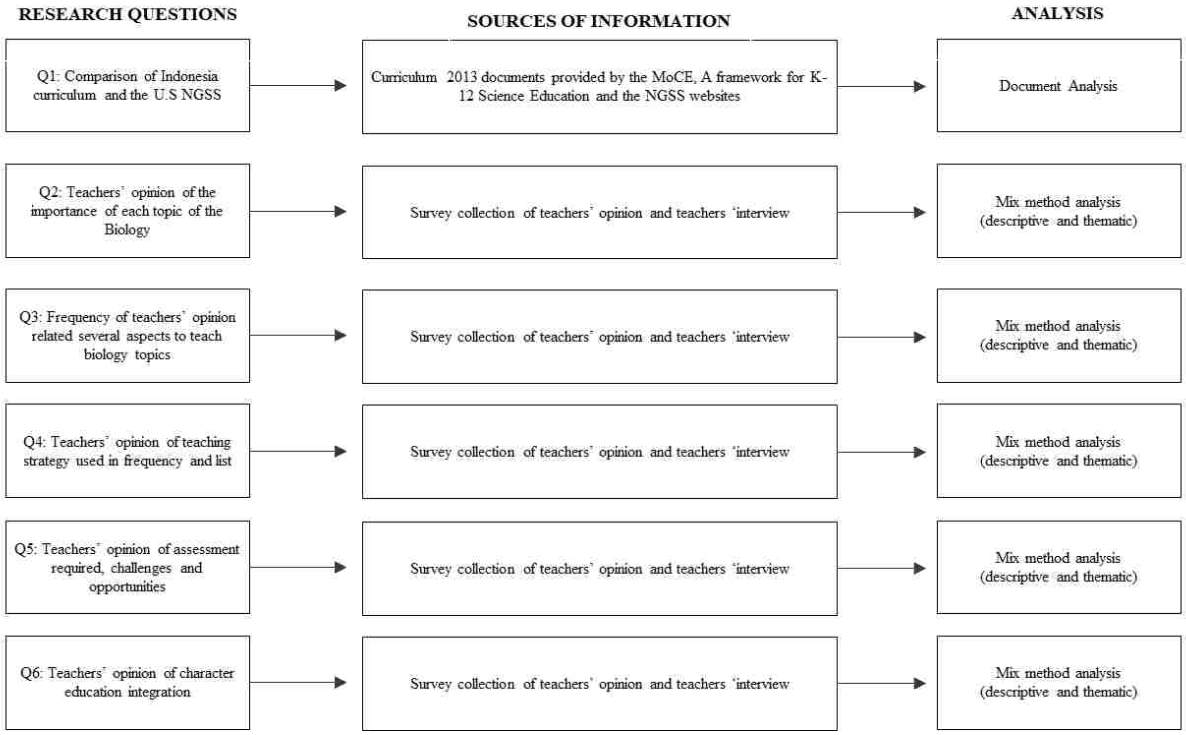

Figure 3.2: Overview of diagram of research sources and procedure in addressing research questions.

***Research Question* 1**: How does the Indonesian biology curriculum 2013 content compare with related aspects of the U.S. Next Generation Science Standards (NGSS)?

I was engaged in a study of the relevant literature to generate information in order to compare the Indonesian 2013 biology curriculum documents and the related aspects of the Next Generation Science Standards (NGSS) in the U.S, which was presented descriptively. The Indonesian curriculum documents used included the training material of 2013 biology curriculum for teachers, biology syllabi, and the biology books for students and teachers provided by the Indonesian Ministry of Education and Culture; while the website of NGSS at www.nextgenscience.org and *A Framework for K-12 Science Education* were used as comparison documents. The comparison elements were adapted from Ruddock & Salisbury (2008) points of comparison between the primary core curriculum in England and those of other

high-performing countries such as Singapore, Hongkong, the Netherlands, etc., which are supported by the National Foundation for Educational Research. Thus, although there is no clear definition for each element of comparison, Ruddock & Sainsbury has given adequate results to read. Therefore, both NGSS standard and Indonesia biology curriculum documents were synthesized and reported.

***Research Question* 2**: How do Indonesian teachers in Aceh Province value aspects of the required biology content?

The GSSS biology teachers' perceptions of the importance of each topic of the Biology 2013 curriculum content were transformed into frequency and percentage data information from the questionnaire part II (B). Additionally, the theme construction of interview question no.3 regarding ideal curriculum content enriched the information about teachers' view of the 2013 biology topics mandated in the curriculum.

***Research Question* 3**: What aspects and with what frequency do Indonesian-Acehnese teachers teach the various aspects of the biology curriculum 2013?

Accumulated GSSS biology teachers' responses to Part II (A) were analyzed and resulted in frequency and percentage data information of the value of biology contents of the 2013 curriculum. Furthermore, the interview questions related to Q2 about the challenges and opportunities in the 2013 curriculum implementation process were analyzed to form themes of factors that might affect their perceptions to teach such biology topics.

***Research Question* 4**: What instructional methods are used by these Indonesian-Acehnese biology teachers to support students in understanding biology?

The strategy implemented in teaching biology curriculum contents was analyzed using the Microsoft Excel® spreadsheet to find the frequency of teacher responses. Thus, the open-

ended questions (Part III, Q1) of the survey form and the interview question no.1 were analyzed thematically based on the models of teaching by Joyce, et al. (2015) to expand the quantitative part responses.

***Research Question* 5**: What general perceptions are reported by these Indonesian-Acehnese teachers regarding the required biology assessment in the Indonesian curriculum 2013 document?

Descriptive statistics in the form of frequency and percentage table were produced using the Microsoft Excel® spreadsheet to sum the most types of assessments that GSSS biology teachers used in their classes. Meanwhile, their open-ended responses (Part III, Q3) about the assessment required in the Biology Curriculum 2013 were presented in themes/categories.

***Research Question* 6**: How do Indonesian-Acehnese biology teachers integrate the required aspects of character education into biology instruction?

Thematic analysis was used to analyze the open-ended Q2 of the survey, by applying the modification steps of an instruction model and the required character education in the Biology Curriculum 2013 as the theme categories. This analysis would present the connection of the character education applied by teacher at a certain instructional step.

Data Entry, Reduction, and Analysis

All demographic data information and quantitative data on teachers' perceptions gathered from respondents were tabulated into an Excel® spreadsheet and analyzed to provide a descriptive picture of the subjects. Then, the demographic data were analyzed descriptively using the SPSS® Statistic Data Editor, and the missing data would be reported with the number "9". The quantitative and open-ended data were exported into an Excel® spreadsheet while the interview transcriptions were written in the MS Word® document. For the open-ended data, I

entered all the responses and highlighted the identical words and or similar sentences to be categorized. Thus, I created themes to give sense/meaning for the responses. As for the interview responses, the interview transcript that had been collected was initially reviewed. Afterward, category construction was conducted inductively and was responsive to the certain teaching and learning theory and the research questions. According to Merriam (2009), the themes constructed during data analysis should meet several conditions: responsive to the purpose of the research, exhaustive, mutually exclusive, sensitive, and conceptually congruent.

Therefore, the data analysis result will be presented and described in Chapter 4. Introduction and chapter organization will also be provided.

CHAPTER 4

RESULTS AND ANALYSIS

Introduction

The purposes of this study of General Senior Secondary School (GSSS) Biology teachers' perspectives and practices were to determine teachers' general perceptions of the importance of the required biology topics; to assess teaching strategies used to teach biology topics and to integrate the required character education component into classrooms; to gather teachers' general opinions of the biology assessment required in the curriculum; and to determine the differences and similarities between Indonesia Biology curriculum 2013 and the corresponding life science framework within the U.S. Next Generation Science Standards (NGSS). Additionally, the comparison mainly aimed to see the biology content (biology teaching materials) listed from both countries, and not to identify the "better" sets of standards.

In this chapter, I have started the presentation of the data analysis result by each research questions and provided the conclusions at the end of each question. The result provided might include any ideas acquired from the field note observation.

Result

Research Question 1: How does the Indonesian biology Curriculum 2013 content compare to the related aspects of the U.S. Next Generation Science Standards (NGSS)?

Since the NGSS life standards are not curricula per se, I selected only several elements that could possibly be compared with the Indonesian biology curriculum 2013 (IBC 2013). A general comparison of the Indonesian biology curriculum and the U.S. NGSS Life Science was performed by inspecting several documents side by side. Therefore, Table 4.1 describes a summary of findings regarding the NGSS standards and Indonesia biology curriculum.

Table 4.1: Summary of the comparison between the NGSS (life science) and Indonesia curriculum 2013

Comparison Element	**USA NGSS (Life Science) Standards**	**IBC 2013 (Senior Secondary School)**
Structure of the Document	The standards were organized by performance, foundations, and coherence; comprising three science learning dimensions consisting of the crosscutting concepts, science and engineering process, and five disciplinary core ideas of life sciences	Developed based on graduate competency standards and subject competency standards; learning process increases in complexity at each grade level and uses a scientific process approach
Content—comparison of curriculum elements corresponding to scientific inquiry	Similar (provided in Table 4.6)	Similar (provided in Table 4.5)
Content – comparison of curriculum elements corresponding to life processes and living things	Similar (see Table 4.7)	Similar (see Table 4.7)
Breath and Difficulty of the biology materials	deeper/more detail	Somewhat broader yet shallow
Order of teaching (class level or grade) and when a certain topic is taught	Grade 9-12 The standards are clearly written, pointed to the range of grade 9-12	Grade X-XII The competencies and topics required are certainly stated and organized for each grade level
Integration of subjects	Clearly seen in the NGSS life science by checking the “crosscutting concept” required and the box of “connection to”	There is no crosscutting concept and the integration of other subjects into the biology topics in the 2013 biology curriculum is stated implicitly, such as some mathematical calculations and minimal physics concepts.
Mandatory or Recommended Time for Subjects	Not mentioned	Allocated teaching time is about 3-4 hours meeting per week, each hour being 45 minutes long.
Compulsion of Teaching Methods	Wide range of instructional strategies	Using various instructional strategies with a scientific approach

For the element of structures being compared, the high school IBC 2013 is designed for grade X-XII or age range of 16-18. The structure of core teaching content (topics) is arranged in blocked grade (Table 4.2). This means that a group of core teaching content has been assigned for each grade level. In addition, the spiral structure is applied to the complexities of the core

teaching content. Students are taught biology concepts progressing from easy to difficult ones, and the same content topic may be discussed at different grade levels. Thus, the biology content is learned based on a scientific approach as described in Table 4.3 below. As mandated in IBC 2013, the biology learning process must emphasize the development of attitude, knowledge, and skills through scientific methods. The development of those activities was associated with the Bloom's taxonomy domain as the indicator to achieve the competencies goals.

Table 4.2: The teaching content structure in block of grade of high school biology curriculum

Grade X*)	Grade XI	Grade XII
The scope of biology, scientific methods, and safety work	Cell structure and function	Growth and development
Indonesia biodiversity	Plant structure and function	Enzyme and Metabolism
Virus	Vertebrate (animal) structure and function	Genetic material and substances
Bacteria (Archaebacteria & Eubacteria)	Movement system of human and vertebrate	Cell division
Protista	Circulation system on human and animal	Heredity law on Mendell
Fungi (Mushroom)	Human digestive system	Heredity Patterns and Cross Over
Plant kingdom	Respiration system on human and animal	Heredity in Human
Invertebrate	Excretion system on human and animal	Mutation
Ecosystem/Ecology	Nerve and coordination system on human and animal	Evolution theory
Environmental (climate change & waste recycle)	Human reproduction system	Biotechnology
	Immune system	

*) grade I-VI is 7-12 years old, grade VII-IX is 13-15 years old, and grade X-XII is 16-18 years old

Table 4.3: The details of activities in the biology learning process in the high school biology document

Attitude	Knowledge	Skill
Receiving	Recalling	Observing
Conducting	Understanding	Questioning
Appreciating	Applying	Trial and error
Comprehending	Analyzing	Thinking
Applying	Evaluating	Presenting
		Creating

On the other hand, Next Generation Science Standards is explicitly not a curriculum but does provide a wide number of suggestions about content that should be contained across the science disciplines and grade. The structures of the NGSS standards are based on three dimensions: science engineering practices, disciplinary core ideas (DCIs) that describe core ideas of science disciplines, and crosscutting concepts linked the core ideas concepts to other domains of science in and across this grade-bands, also the connection with common core standards of ELA/literacy and mathematics. Aspects of all three dimensions are included in each performance expectations (PEs). The NGSS standards are organized into grade levels (kindergarten, grade 1-5) and grade bands (6-8 and 9-12). Grade band 9-12 sets as high school level. Life science (LS) is one of four domains that are organized in the PEs, which consists of four primary foundation concepts or disciplinary core ideas (Table 4.4). Moreover, more detail explanation of the DCIs was explained in corresponding of the scientific inquiry comparison.

Table 4.4: Specific disciplinary core ideas of life science (www.nextgenscience.org)

Grade 9-12			
LS1. Structure and properties from molecule to organism	LS2. Interactions, energy, and dynamics in ecosystem	LS3. Inheritance and variation of traits (Heredity)	LS4. Unity and diversity in biological evolution
• LS1A Structure and function • LS1B Growth and development of organisms • LS1C Organization for matter and energy flow in Organisms • LS1D Information processing	• LS2A Interdependent relationships in ecosystems • LS2B Cycles of matter and energy transfer in ecosystems • LS2C Ecosystem, dynamics, functioning, and resilience • LS2D Social interactions and group behavior	• LS3A Inheritance of traits • LS3B Variation of traits	• LS4A Evidence of common ancestry • LS4B Natural selection • LS4C Adaptation • LS4D Biodiversity and human

Next is the basic differences of curriculum content related to scientific inquiry between the IBC 2013 and the NGSS Life Science standards. In IBC 2013, according to Syarif (2015), scientific inquiry for senior secondary school is an organized learning using a scientific process approach including observing, questioning, experimenting (including data collection), associating (using inductive reasoning rather than deductive), and communicating. The IBC 2013 has organized learning descriptions of scientific approach process in Table 4.5. Besides, the NGSS life science sections include both scientific learning and the engineering processes as types of inquiry, which has a detailed explanation of performance expectation for each practice. Also, I added the description of the science-practice (without its differentiation from the engineering one) to make similar comparison point with IBC 2013, which can be seen in Table 4.6. Based on the analyzing result from two tables provided (Table 4.5 and Table 4.6), the points of practices that are not expected explicitly in IBC 2013 are developing and using models, and the use of mathematics and computational thinking in the inquiry processes. On the other hand, both documents do have similar practices on their scientific inquiry stages.

Table 4.5: Scientific approach steps in the IBC 2013

Scientific Approach	Activity Description	Learning Expectation
Observing	Observing with senses (reading, listening, observing, watching, etc.) with/without tools.	Attention during observing objects/ reading article or passage/ listening to explanation; notes during observing, patience, the duration during observing
Questioning	Proposing questions, answering questions, discussing topics that are not understood yet or additional topics to be known; or clarifying.	Types, qualities, and number proposed questions by pupils (factual, conceptual, or procedural questions)
Experimenting	Exploring, trying and discussing, demonstrating, imitating shapes/motions, conducting experiments, reading resources other than textbooks; gathering data from interviewees through questionnaires; interviewing, modifying/adding/developing.	Quantity and quality of sources used in the study, comprehensiveness of information, the validity of gathered information, and instruments/tools used for gathering data

Table 4.5. (Cont.)

Scientific Approach	Activity Description	Learning Expectation
Associating	Analyzing gathered information by categorizing, associating or relating the phenomena/information to determine patterns and draw a conclusion.	Developing interpretation, argumentation, and conclusion from the relation of information generated from two facts/concepts/theories Synthesizing and proposing argumentations, developing interpretation and conclusion from information generated from two facts/concepts/theories/ argumentations that are related or unrelated from various sources.
Communicating	Composing reports in the forms of charts, diagrams, or graphics; preparing written reports and orally presenting reports covering process, results, and conclusion	Presenting results of the study (from observing to associating) in written, graphics, electronic media, multimedia, etc.

Table 4.6: A summary of scientific inquiry found in the NGSS Life Science Standards

Science Engineering Practices	Science Practices Description	Performance Expectation Grade 9-12 (NGSS Appendix F, 2013 draft)
Asking questions (for science) and defining problems (engineering)	Formulate solvable questions empirically about phenomena, establish known information and determine an unsatisfying solution	"Asking questions and defining problems in 9 –12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations" (p.4).
Developing and using models	Models and simulations are built and developed to support explanations and predictions as well as create and visualize natural phenomena;	"Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds" (p.6) .
Planning and carrying out an investigation	Perform to test the hypothesis by proposing experimental design comprising determinations of dependent and independent variables, data collection, and recording	"Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models" (p.7).
Analyzing and interpreting data	The generated data are analyzed using descriptive and/or inferential statistics to	"Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets

Table 4.6. (Cont.)

Science Engineering Practices	Science Practices Description	Performance Expectation Grade 9-12 (NGSS Appendix F, 2013 draft)
	reveal the significance of patterns in data	for consistency, and the use of models to generate and analyze data" (p.9).
Using mathematics and computational thinking	Use to represent and predict physical variables and their relationship	"Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions…to analyze, represent, and model data" (p.10)
Constructing explanations	Construct by combining the scientific understanding or model aligned with the available evidence to generate a theory	"Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories" (p.11).
Engaging in argument from evidence	The proposed explanations are formulated, defended, communicated, and collaborated with peers to generate the best explanations	"Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s)…current scientific or historical episodes in science" (p.13).
Obtaining, analyzing, and communicating information	The results of investigations are disseminated to others in scientific meetings to discuss and evaluate the validity of the results	"Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs" (p.15).

On the other hand, the Indonesia senior secondary biology curriculum 2013 is not integrated as science curriculum that is used as in elementary school and junior secondary school, yet in general, Indonesia science curriculum for elementary and lower secondary share similar NOS matrix to the ones in the NGSS standards. Thus, there is no exact Nature of Science (NOS) reference written in the IBC 2013. However, as a part of science knowledge, biology

might have the same NOS categories as mentioned in science curriculum for elementary school provided by Sardinah & Tursinawati (2012) including science as product (knowledge is based on empirical facts and evidence, science is objective, science products include law, theory, facts, concepts, and principle, science has an important role in technology, scientific knowledge is temporary, etc.); science as process (scientific knowledge is temporary, science must be testable, scientific knowledge based on observation, etc.); and science as attitude (Scientists must be open to new ideas, scientists are honest, scientists are never satisfied with science knowledge and keep working on it, etc.). While in the NGSS, NOS is categorized as follow (p. 4 of the NGSS appendix H):

- Scientific investigations use a variety of methods
- Scientific knowledge is based on empirical evidence
- Scientific Knowledge is open to revision in light of new evidence
- Scientific Models, Laws, Mechanisms, and Theories explain natural phenomena
- Scientific knowledge assumes order and consistency in natural systems
- Science is a way of knowing
- Science is a human endeavor
- Science addresses questions about the natural and material world

Moreover, the comparison of curriculum elements discussed is related to life processes and content focused on living things. The correlation elements found within the NGSS life science document and the 2013 biology are shown in Table 4.7 as follow (none means the element does not possess by the other). As shown in Table 4.7, both documents cover majority similar core ideas of biology/life science discipline. Even though there are some different emphasis of detail sub-topics covered for each core ideas stated in the documents, there are core

ideas that are not covered by each other such as biotechnology (does not include obviously in the NGSS yet stated precisely in IBC 2013), the different explanation of biodiversity (especially tropical biodiversity of Indonesia), and Mendel and Hardy-Weinberg's Laws in heredity. In contrast, the IBC 2013 does not have the core ideas about social interactions and group behavior in genetics, feedback mechanism maintenance and evidence of common ancestry and diversity.

Table 4.7: The correlation of NGSS core ideas and IBC 2013 content corresponding to life process and living things

Disciplinary Core Ideas of Life Science—US Standard (NGSS)	**Core materials—Indonesia 2013 biology curriculum**
LS1.A Structure and Function	XI-1 (Cell); XII-3 (Genetics materials)
• specialized cells perform the essential functions of life. • All cells contain genetic information in the form of DNA molecules • Multicellular organisms have a hierarchical structural organization. • Feedback mechanisms (positive and negative feedback) maintain a living system's internal conditions within certain limits and mediate behaviors.	• Chemical component of cell structure. • Structure and function of cell components • Cell activity as a structural and functional unit of living things: • Transport through the membrane • Proteins synthesis to develop morphological and physiological properties of cells • Reproduction of cells as an activity to form the body's morphology and multiply the body • Gen, DNA, Chromosome • Protein synthesis and character traits
LS1.B: Growth and Development of Organisms	XI-2 (structure and function of plant and animal tissues); XI-3 to XI-10 (structure and function of human tissue); XII-1 (the concept of growth and development); XII-4 (Cell Division)
Mitosis in multicellular organism.	• Mitosis • Meiosis • Types of plant tissues • Properties of tissues replication and tissue culture • Structure, function and position of animal tissue • Tissue structure and function in movement system: movement mechanism, types, abnormalities in movement system and technology to solve the problems • Tissue structure and function in circulation system • Tissue structure and function in digestive system • Tissue structure and function in respiration system

Disciplinary Core Ideas of Life Science—US Standard (NGSS)	Core materials—Indonesia 2013 biology curriculum
	• Tissue structure and function in excretion system • Tissue structure and function in nerve system, coordination, and psychotropics • Tissue structure and function in reproduction system • Tissue structure and function in immune system • Internal and external factors that influence growth and development of living organism
LS1.C: Organization for Matter and Energy Flow in Organisms	X-9: Ecology (ecosystem, energy flow, interaction, biogeochemist cycles); XII-2: Enzyme and cell metabolism
• The process of photosynthesis. • The sugar molecules formation into larger molecules. • Energy flow in living systems. • Cellular respiration and chemical reactions	• energy flow and material cycles • biogeochemist cycles • Enzyme components and mechanism • Carbohydrate catabolism (aerobic respiration and fermentation) • Anabolism (Photosynthesis)
LS2.A: Interdependent Relationships in Ecosystems	X-9: Ecology (ecosystem, energy flow, interaction, biogeochemist cycles)
Ecosystems: carrying capacities	• interactions in ecosystem
LS2.B: Cycles of Matter and Energy Transfer in Ecosystems	X-9: Ecology (ecosystem, energy flow, interaction, biogeochemist cycles)
• Photosynthesis and cellular respiration • Food web. matter and energy transfer and conserve. • the carbon cycles.	• Ecosystem components, • energy flow and material cycles • biogeochemist cycles • interactions in ecosystem
LS2.C: Ecosystem Dynamics, Functioning, and Resilience	X-10: Environmental change and recycle
• A complex set of interactions within an ecosystem • Anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change	• Ecosystem equilibrium (environmental damage, pollution and preservation) • Recycle (type and recycling processes)
LS2.D: Social Interactions and Group Behavior	Not Mentioned
Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives	
LS3.A: Inheritance of Traits	XII-6: Pattern of heredity link and crossover
DNA and its regulations	• The heredity patterns: linkage, crossing-over, separation failure, and lethal gen • Heredity in human blood type, gender, and hereditary disease
LS3.B: Variation of Traits	XII-5 (Pattern of traits and Mendel Law); XII-6 (The pattern of heredity linkage and crossing-over); XII-7 (Heredity in human); XII-8 (mutation: cause and effect)

Disciplinary Core Ideas of Life Science—US Standard (NGSS)	Core materials—Indonesia 2013 biology curriculum
• Mutation as source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited • Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population.	• Concepts of allele, gamete, genotype and phenotype • Mendel's law and apparent aberration of Mendel's Law: Interaction issues, cryptomeria, epistasis / hypostatic, complementary, polymeric • The heredity patterns: linkage, crossing-over, separation failure, and lethal gen • Heredity in human blood type, gender, and hereditary disease • Simulation of mutations • Simulation of Aberration
LS4.A: Evidence of Common Ancestry and Diversity	Not Mentioned
Genetic information. DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence.	
LS4.B: Natural Selection	XII-9 (Evolution)
• Natural selection • The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population.	
LS4.C: Adaptation	XII-9 (Evolution)
• Evolution • Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. • Adaptation also means that the distribution of traits in a population can change when conditions change. • Changes in the physical environment. • Species become extinct because they can no longer survive and reproduce in their altered environment.	• Darwin's theory of evolution: study Darwin's phenomenon of evolution through the phenomena of giraffes, finches and Butlerian butterflies, linked to the present reality • The comparison of Darwin's theory and theory of intelligent design • The mechanism of evolution • Geographic isolation • Adaptive Radiation • Hardy-Weinberg's Law
LS4.D: Biodiversity and Humans	X-1 to X-7
• Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). Humans activity impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change.	• The scope of biology, scientific methods and safety, job carrier in biology • Indonesian (tropical) biodiversity concept, benefit, taxonomy classification and its conservation. • role and characteristics fungi, virus, archaebacteria, eubacteria, and Protista. • the morphology, metagenesis and benefit of seedless and seed plants. • the characteristic and classification of animal kingdom: invertebrate and vertebrata
Not Mentioned	XII-10 (biotechnology)
	• The basic concept of Biotechnology • Type of Biotechnology • Conventional Biotechnology (Fermentation) • Modern Biotechnology (Genetic Engineering) and Conventional Biotechnology Products

Table 4.7. (Cont.)

Disciplinary Core Ideas of Life Science—US Standard (NGSS)	Core materials—Indonesia 2013 biology curriculum
	• Modern Biotechnology Products • The impact of utilization of biotechnology products in the community

*HS-LS: High School-Life Science
X-XII: class level

Discussing the breadth and potential difficulty of the biology content found in NGSS and IBC 2013 in a comparison of curriculum corresponding the scientific inquiry, I assumed that the biology curriculum 2013 is similar in difficulty to the NGSS life science, yet the NGSS life science applies mathematical and computational much broader than required one in the biology curriculum 2013. Thus, relating to the areas of life processes and living things, both documents are quite similar in difficulty. The NGSS life science is broader in the interdependent relationship in the ecosystem, yet 2013 biology curriculum is broader in the area of applied biology (enzyme and biotechnology). Overall, the NGSS life science is similar in content to the IBC 2013, yet there is a different way in content organization and the addition of nature of science in their science practices.

Furthermore, in the comparison of teaching order, the IBC 2013 has arranged specific competencies for each grade (X, XI, XII) and the topics taught are systematically designed in the syllabus. On the other hand, the NGSS life science presents the topics for high school (9-12) in general without clearly dividing the topics to each grade. Therefore, there is no order of topic taught corresponding to the NGSS life science or biology framework of a state. While regarding the integration of subjects, it is clearly seen in the NGSS life science by looking to the ***connection to box*** that stated information about the connections to other DCIs in this grade-band, articulation of DCIs across grade-bands, and Common Core State Standards and ELA/literacy Connections. Yet, there is almost none of the integration across other core ideas of

discipline into biology topics in the IBC 2013, except mathematical calculation and few science contents. Thus, in the IBC 2013, biology as one of the *interest subjects* has allocated 3 hours meeting for grade X, 4 hours meeting for grade XI and XII per week. Each hour meeting is 45 minutes. On the other hand, there is no specific amount of time written for the NGSS life science instruction or time allocation per week. Yet, the teaching allocation time is decided by individual school districts. Lastly, correlating to the compulsion of teaching methods and guidance, the NGSS life science applies the wide range of instructional practices as the same as the IBC 2013.

In conclusion, the comparison between the U.S. Next Generation Science Standards Life Science (NGSS-LS) and 2013 Indonesian biology curriculum (IBC 2013) for senior secondary school was analyzed by some comparison elements. These elements consist of standard/curriculum structure, content-related to scientific inquiry and life processes and living things, the breadth and difficulty of biology materials, order of teaching materials, integration of other disciplines, teaching subject allocation time, and the strategy of the classroom instruction. Both NGSS-LS standards and the IBC 2013 structure were organized by performance expectations. Yet, the performance expectation in NGSS-LS is connected to three dimensions of framework and other ideas within disciplines. In general, NGSS-LS standards and the IBC 2013 have similar elements of comparison, except the difficulty of core ideas materials and the crosscutting concept which are considered less difficult.

Research Question 2: What Opinions do Indonesian teachers in Aceh Province hold with respect to the required biology content?

The abundant amount of biology content required to be taught has encouraged me to gather information on how biology teachers value those content or their perspectives of the importance of each topic mandated to be taught in the classroom. Based on frequency distribution result on Table 4.8, more than 40 percent of GSSS biology teachers agreed that

biology topics contained in the curriculum are significant to be taught (except for the specialized cells of a multicellular organism and their functions: circulation topic which was viewed as a more important topic to be learned). Yet, only a few teachers had a conflicting opinion on these topics (1.0 to 3.0 percent). To support this finding, descriptions and analysis of six teachers' opinions to the question—What do you consider an ideal biology curriculum in terms of representative biology content?−are presented into three perspectives as shown below.

Table 4.8: Frequency (percentage) of GSSS teachers' perceptions of the importance of biology topics taught in the curriculum

No.	Topics	NI (1)	LI (2)	N (3)	I (4)	VI (5)	No response	TOTAL
1	Genetic materials and structures (DNA-protein)	2 (0.7)	1 (0.3)	17 (5.9)	129 (45.1)	115 (40.2)	22 (7.7)	286 (100)
2	Hierarchical structure of multicellular organism: cell structure and function	2 (0.7)	0 (0.0)	17 (5.9)	139 (48.6)	113 (39.5)	15 (5.2)	286 (100)
3	Structure and function of plant tissues	1 (0.3)	0 (0.0)	14 (4.9)	141 (49.3)	115 (40.2)	15 (5.2)	286 (100)
4	Structure and function of animal tissues	1 (0.3)	0 (0.0)	11 (3.8)	139 (48.6)	113 (39.5)	22 (7.7)	286 (100)
5	Specialized cells of multicellular organism and their functions: digestion	1 (0.3)	1 (0.3)	9 (3.1)	123 (43.0)	133 (46.5)	19 (6.6)	286 (100)
6	Specialized cells of multicellular organism and their functions: circulation	2 (0.7)	2 (0.7)	7 (2.4)	110 (38.5)	144 (50.3)	21 (7.3)	286 (100)
7	Specialized cells of multicellular organism and their functions: respiration	2 (0.7)	1 (0.3)	13 (4.5)	125 (43.7)	128 (44.8)	17 (5.9)	286 (100)
8	Specialized cells of multicellular organism and their functions: muscle	2 (0.7)	1 (0.3)	10 (3.5)	144 (50.3)	112 (39.2)	17 (5.9)	286 (100)
9	Specialized cells of multicellular organism and their functions: excretion	2 (0.7)	1 (0.3)	14 (4.9)	132 (46.2)	120 (42.0)	17 (5.9)	286 (100)
10	Specialized cells of multicellular organism and their functions: reproduction	2 (0.7)	1 (0.3)	10 (3.5)	121 (42.3)	132 (46.2)	20 (7.0)	286 (100)
11	Specialized cells of multicellular organism and their functions: nerve system	2 (0.7)	1 (0.3)	13 (4.5)	125 (43.7)	121 (42.3)	24 (8.4)	286 (100)
12	Growth and development of living things: basic concept	2 (0.7)	1 (0.3)	14 (4.9)	126 (44.1)	117 (40.9)	26 (9.1)	286 (100)
13	Metabolism: Photosynthesis (process of energy transformation)	2 (0.7)	0 (0.0)	16 (5.6)	134 (46.9)	105 (36.7)	29 (10.1)	286 (100)

Table 4.8. (Cont.)

No.	Topics	NI (1)	LI (2)	N (3)	I (4)	VI (5)	No response	TOTAL
14	Metabolism: cellular respiration (aerobic-anaerobic)	2 (0.7)	1 (0.3)	13 (4.5)	131 (45.8)	107 (37.4)	32 (11.2)	286 (100)
15	Metabolism: Enzymes	3 (1.0)	1 (0.3)	18 (6.3)	138 (48.3)	87 (30.4)	39 (13.6)	286 (100)
16	Ecosystem: biodiversity	2 (0.7)	1 (0.3)	22 (7.7)	138 (48.3)	81 (28.3)	42 (14.7)	286 (100)
17	Ecosystem: matter cycles and energy flows	2 (0.7)	1 (0.3)	15 (5.2)	142 (49.7)	91 (31.8)	35 (12.2)	286 (100)
18	Ecosystem: component and interaction	2 (0.7)	1 (0.3)	18 (6.3)	141 (49.3)	92 (32.2)	32 (11.2)	286 (100)
19	Ecosystem: changes of physical environment and waste recycle	2 (0.7)	1 (0.3)	11 (3.8)	141(49.3)	100 (35.0)	31 (10.8)	286 (100)
20	Morphology of plants and its function	2 (0.7)	0 (0.0)	21 (7.3)	143 (50.0)	91 (31.8)	29 (10.1)	286 (100)
21	Cellular Division: mitosis and meiosis	0 (0.0)	3 (1.0)	15 (5.2)	135 (47.2)	105 (36.7)	28 (9.8)	286 (100)
22	Mendel law	0 (0.0)	5 (1.7)	18 (6.3)	126 (44.1)	90 (31.5)	47 (16.4)	286 (100)
23	Variation of traits: pattern of heredity, mutation, and heredity in human	1 (0.3)	1 (0.3)	15 (5.2)	120 (42.0)	117 (40.9)	32 (11.2)	286 (100)
24	Natural selection and adaptation	0 (0.0)	0 (0.0)	33 (11.5)	142 (49.7)	77 (26.9)	34 (11.9)	286 (100)
25	Darwin's theory of evolution	1 (0.3)	14 (4.9)	37 (12.9)	137 (47.9)	55 (19.2)	42 (14.7)	286 (100)
26	Feedback mechanism inside the living system: homeostasis	0 (0.0)	7 (2.4)	24 (8.4)	136 (47.6)	61 (21.3)	58 (20.3)	286 (100)
27	Mendel Pattern and inheritance	1 (0.3)	1 (0.3)	21 (7.3)	132 (46.2)	97 (33.9)	34 (11.9)	286 (100)
28	Basic concept of Biotechnology	0 (0.0)	3 (1.0)	17 (5.9)	120 (42.0)	109 (38.1)	37 (12.9)	286 (100)
29	Immune system: mechanism	0 (0.0)	2 (0.7)	11 (3.8)	138 (48.3)	99 (34.6)	36 (12.6)	286 (100)
30	Role and characteristics of Invertebrate and vertebrate	0 (0.0)	2 (0.7)	16 (5.6)	151 (52.8)	88 (30.8)	29 (10.1)	286 (100)
31	Role and characteristics of Fungi	0 (0.0)	2 (0.7)	20 (7.0)	145 (50.7)	91 (31.8)	28 (9.8)	286 (100)
32	Role and characteristics of Protista	0 (0.0)	2 (0.7)	23 (8.0)	145 (50.7)	88 (30.8)	28 (9.8)	286 (100)
33	Role and characteristics of Bacteria	0 (0.0)	1 (0.3)	16 (5.6)	143 (50.0)	97 (33.9)	29 (10.1)	286 (100)
34	Role and characteristics of virus	0 (0.0)	1 (0.3)	16 (5.6)	141 (49.3)	100 (35.0)	28 (9.8)	286 (100)

The first response from respondents was that "an ideal curriculum should accommodate local content knowledge and skills' application (entrepreneurship)." Teacher 1 (TR1), an experienced teacher from a suburban school close to a beach area, believes that an ideal

curriculum should cover a wide scope of biology topics related to the local conditions of a particular area, such as the landscape, the main commodities for economic source, etc. which could support students' skills after graduation. For instance, Aceh is a coastal province surrounded by Indian ocean. So, in its implementation, a biology curriculum should emphasize ocean biota or seashore's flora and fauna or marine ecosystem. Therefore, this local content knowledge might be able to support students' skills in their daily life especially their entrepreneurship skills. He knew that the biology content taught in senior secondary schools is already complicated, yet it needs to switch its learning focus from mastery of the content into content application. Also, content related to the local conditions should be taught in more detail than any other core ideas of biology content. This quote makes that case

> What I always dream about is a local feature-based curriculum as a secondary curriculum in addition to the national curriculum..., a curriculum needs to integrate entrepreneurship. . . students are not only taught to understand the materials but also to have entrepreneurial skills so that they can apply their knowledge. (TR1)

The second thought was that a biology curriculum should be designed by biology experts with fewer amounts of core materials taught in the curriculum. The TR6 believed that educators or policymakers should reduce the scope of biology materials or simplify the basic competencies (standards). This thought came out with respect to his religious beliefs as stated in the Holy Quran about simplification to face living. Besides, this idea is also complimented by TR5 stating that teachers would not be able to finish teaching all the required materials in a semester.

> The ideal curriculum for biology needs to cover more simplified materials. The basic competence for flora and fauna should be simplified, not too bias. We should teach simpler flora and fauna first. Sometimes, the syllabus is fine, until (. . . minute 7:50) third grade. The materials are perfectly organized, but there is room for simplicity. (TR6)

> Actually, there are a lot of materials to teach, such as in grade XI. There are many sub-topics related to "system" in the second semester so that I do not have time

> left for other materials. I sometimes gave students assignment to cover those materials, because there are many sub-topics to teach. (TR5)

According to TR5, the *system* content ideas, primarily related to digestive system, cover excessively detailed materials similar to those at the college level. Thus, given that other core materials thar need to be learned, the material ideas on human and animal body system should be reduced because students will get more profound knowledge at the university level. Otherwise, those students, whom will not continue to the university level, are assumed to have adequate materials coverage (such as the introduction or brief information) of the body system. However, TR5 could not deprive of the fact that the government has designed a greater curriculum with stronger assessment element.

> Curriculum 2013 is an excellent curriculum, the materials are more organized, the syllabus has been provided by the government, teachers only need to develop it, teaching tools can be supported by teaching method. The assessment is also very good. There is an assessment for affective, cognitive, and psychomotor skills. . . (TR 5)

Meanwhile, TR3 believes that the *Hierarchical Organization of Organisms* is not a relevant topic to be covered by high school student (since it has been taught in middle school), yet the *classification* may be important and could be taught as independent core ideas in biology teaching (to avoid redundant materials to be taught). TR3 statement was also supported by an idea from TR4, who explicitly expressed that a materials scope should be chosen thoroughly by the curriculum designer based on students' acquisition of biology knowledge construction.

> Hierarchical Organisation has been discussed in the first grade of junior secondary school. . . I think Hierarchical Organisation does not need to be taught in high school. (TR3)

> I think Curriculum 2013 is an excellent curriculum, but it can be improved because there are some materials which are very brief yet very important. (TR4)

Having similar thought—the idea that a biology expert should have been involved in the 2013 curriculum design—TR2 argued that the involvement of experts in designing a biology

curriculum is essential. The biology experts are assumed to not only understand the abstract concepts but more importantly also the practical work in biology teaching and learning processes. In this case, teachers know that the implementation of inquiry methods in teaching is required, yet they need more information on the steps of inquiry methods for each topic content.

> In my opinion, an ideal curriculum, especially for a biology course, is one designed by experts in biology, with more lab work or observation. . . If possible, it is the biology teachers who should design the curriculum, so more lab work can be included. . . Teachers have a guideline on implementing inquiry, but they do not have detail instruction for every topic. . . (TR2)

Lastly, another important thought offered was the idea of adequate facilities and infrastructures to support content teaching process. TR1 and TR3 agreed that the IBC 2013 is excellent enough in terms of designed and organization and covers adequate biology topics. Yet, teachers suggested for more infrastructure and facility supports to make the IBC 2013 an ideal curriculum.

> I hope that the government provides more training and competency tests for teachers so that we do not mislead our students. We do not have a reading culture, unlike others. Training and competency tests can motivate us to improve our knowledge, especially about biology. (TR1)

> The materials in the syllabus are very good for the students to study both concrete to abstract concepts. For me, they are great, but the only problem is the implementation because of limited lab facilities. (TR3)

Research Questions 3: What aspects and with what frequency do Indonesian-Acehnese teachers teach the various aspects of the Biology Curriculum 2013?

The result of this question was found by calculating the number of responses to whether the teachers should or should not teach the core materials mandated in the IBC 2013 curriculum. Indeed, teachers' opinion and experiences of the challenges and opportunities in implementing the IBC 2013 were the basic information needed to figure out the teaching aspects that might influence curriculum implementation.

Table 4.9 shows that almost all GSSS teachers reported having taught all the biology topics listed in the curriculum. Approximately 95.5 percent GSSS biology teachers teach the hierarchical structure of multicellular organisms, especially cell structures and functions. Yet, there was a range of 4.5 to 26.6 percent of GSSS teachers who did not teach some topics. Based on my field note, those topics were not taught because either they did not have enough time or they were not assigned by the school to teach them. Only a few teachers personally decided to provide a short overview of some specific topics as they consider them insignificant. In addition, it is such a compulsory for Indonesian GSSS teachers to implement the curriculum precisely.

Table 4.9: Frequency (percentage) of GSSS teachers' perceptions of biology topics taught in the curriculum

No.	Topics	Taught	Not Taught	No response	TOTAL
1	Genetic materials and structures (DNA-protein)	261 (91.3)	24 (8.4)	1 (0.3)	286 (100)
2	Hierarchical structure of multicellular organism: cell structure and function	273 (95.5)	13 (4.5)	0 (0.0)	286 (100)
3	Structure and function of plant tissues	270 (94.4)	16 (5.6)	0 (0.0)	286 (100)
4	Structure and function of animal tissues	261 (91.3)	25 (8.7)	0 (0.0)	286 (100)
5	Specialized cells of multicellular organism and their functions: digestion	262 (91.6)	24 (8.4)	0 (0.0)	286 (100)
6	Specialized cells of multicellular organism and their functions: circulation	259 (90.6)	27 (9.4)	0 (0.0)	286 (100)
7	Specialized cells of multicellular organism and their functions: respiration	262 (91.6)	24 (8.4)	0 (0.0)	286 (100)
8	Specialized cells of multicellular organism and their functions: muscle	260 (90.9)	26 (9.1)	0 (0.0)	286 (100)
9	Specialized cells of multicellular organism and their functions: excretion	259 (90.6)	27 (9.4)	0 (0.0)	286 (100)
10	Specialized cells of multicellular organism and their functions: reproduction	253 (88.5)	33 (11.5)	0 (0.0)	286 (100)
11	Specialized cells of multicellular organism and their functions: nerve system	254 (88.8)	32 (11.2)	0 (0.0)	286 (100)
12	Growth and development of living things: basic concept	256 (89.5)	30 (10.5)	0 (0.0)	286 (100)
13	Metabolism: Photosynthesis (process of energy transformation)	248 (86.7)	38 (13.3)	0 (0.0)	286 (100)
14	Metabolism: cellular respiration (aerobic-anaerobic)	245 (85.7)	41 (14.3)	0 (0.0)	286 (100)
15	Metabolism: Enzymes	244 (85.3)	42 (14.7)	0 (0.0)	286 (100)
16	Ecosystem: biodiversity	236 (82.5)	50 (17.5)	0 (0.0)	286 (100)

Table 4.9. (Cont.)

No.	Topics	Taught	Not Taught	No response	TOTAL
17	Ecosystem: matter cycles and energy flows	245 (85.7)	40 (14.)	1 (0.3)	286 (100)
18	Ecosystem: component and interaction	250 (87.4)	36 (12.6)	0 (0.0)	286 (100)
19	Ecosystem: changes of physical environment and waste recycle	254 (88.8)	32 (11.2)	0 (0.0)	286 (100)
20	Morphology of plants and its function	253 (88.5)	33 (11.5)	0 (0.0)	286 (100)
21	Cellular Division: mitosis and meiosis	249 (87.1)	37 (12.9)	0 (0.0)	286 (100)
22	Mendel law	235 (82.2)	51 (17.8)	0 (0.0)	286 (100)
23	Variation of traits: pattern of heredity. mutation and heredity in human	245 (85.7)	41 (14.3)	0 (0.0)	286 (100)
24	Natural selection and adaptation	238 (83.2)	48 (16.8)	0 (0.0)	286 (100)
25	Darwin's theory of evolution	234 (81.8)	52 (18.2)	0 (0.0)	286 (100)
26	Feedback mechanism inside the living system: homeostasis	209 (73.1)	76 (26.6)	1 (0.3)	286 (100)
27	Mendel Pattern and inheritance	240 (83.9)	46 (16.1)	0 (0.0)	286 (100)
28	Basic concept of Biotechnology	239 (83.6)	47 (16.4)	0 (0.0)	286 (100)
29	Immune system: mechanism	244 (85.3)	41 (14.3)	1 (0.3)	286 (100)
30	Role and characteristics of Invertebrate and vertebrate	253 (88.5)	33 (11.5)	0 (0.0)	286 (100)
31	Role and characteristics of Fungi	255 (89.2)	30 (10.5)	1 (0.3)	286 (100)
32	Role and characteristics of Protista	251 (87.8)	35 (12.2)	0 (0.0)	286 (100)
33	Role and characteristics of Bacteria	259 (90.6)	27 (9.4)	0 (0.0)	286 (100)
34	Role and characteristics of virus	259 (90.6)	27 (9.4)	0 (0.0)	286 (100)

Furthermore, to gather more in-depth information of GSSS teachers' perspectives in teaching the topics listed in the curriculum, I constructed the interview question: "What are the challenges/problems and opportunities that you face in teaching any of the curriculum topics?" and asked a few selected respondents. Based on the thematic analysis, there are several aspects teachers considered as challenges in teaching. They are listed below.

The first aspect that might influence GSSS biology teachers was related to the instructional process, especially the assessment. Even though the Ministry of Education has revised the assessment required, there were still pros and cons among those teachers. A teacher said since there were various assessments need to be done, some teachers were still confused

about how to use them correctly. Moreover, teachers need to conduct various teaching models to stimulate a discussion or to encourage student-centered learning process in the classroom. Employing varied teaching strategies is essential to evade monotony in learning activities. Furthermore, the teachers gave their thoughts on their struggle in achieving the learning goals because of their lack of time to complete all the tasks required. Some expressions are as follows:

> The challenge is the complicated assessment. Very few teachers are able to use the evaluation correctly because the items are abundant and complex. (TR2)
>
> . . . another challenge is related to assessment, i.e. student grade report, which keeps changing every semester, leaving the teachers confused. (TR5)
>
> Teachers should be creative in using various techniques to avoid boredom. (TR3)
>
> . . . the objectives are difficult to achieve because in this curriculum the students are encouraged to study in groups. . ., however, the time is not enough to achieve all purposes. (TR6)

The second aspect concerned the facilities that support the instruction, such as the lack of training (in the technical implementation of the 2013 curriculum) or the lack of no equal chance to participate in training due to a limited number of professional developments held. Furthermore, the schools located in rural area have reduced access to adequate learning facilities, such as Internet access, or other sources of information.

> Another weakness lies in teacher training because not all teachers are given an opportunity to participate in training. (TR1)
>
> The challenge is that I have not fully understood the curriculum because the lack of training, and the training given to teachers are not comprehensive, . . . not all teachers have given a chance to attend the training. (TR4)
>
> . . . when teachers assign the students group work to find materials from the internet, students do not have internet access because internet café or Wi-Fi is not available in the area. (TR5)

On the other hand, GSSS biology teachers also gave their views about the ability of the curriculum implementation to support teaching and learning process, such as to motivate

students' knowledge construction, to improve students' character, and to improve the assessment system. Those views are illustrated below:

> The evaluation system offered by Curriculum 2013 is very detailed. Concerning knowledge, there is a written test, spoken test, and assignment with assessment criteria. . . The same principle also applies to attitude, and there are many aspects to access. (TR1)
>
> Actually, this curriculum is very good, to improve their character. (TR5)
>
> It is more responsive because it utilizes teaching aid which helps students retain information better. . . (TR6)

Research Questions 4: What instructional methods are used by these Indonesian-Acehnese biology teachers to support students in understanding biology?

Descriptively shown in Table 4.10, we see that most teachers used all three instructional methods as their teaching strategies to teach the listed biology topics. The GSSS biology teachers believed that inquiry teaching strategy should be combined with the direct instruction as shown by the same number of teachers choosing both strategies for each topic listed. On the other hand, not all GSSS teachers had extra hours to teach strategies out of the school time as indicated by the percentage of choices no higher than 26.2 percent (as the highest number of teachers' perception). This number pointed to the "*changes of physical environment and waste recycle*" topic, which might be shown in fieldwork or project homework assigned to students.

Moreover, the GSSS biology teachers were also asked to give additional information about other instructional strategies that might be conducted to teach those topics listed. Table 4.11 shows the categories of the ideas that came up from the teachers and the examples of their responses. From the table, many responses stated that teachers did not use other instructional methods except those three mentioned in the survey question. Yet, some teachers mentioned precise examples of inquiry-discovery models. Additionally, most of the teachers used cooperative learning (sociocultural models) in their teaching strategies, which consisted of

various kinds of collaboration and cooperation learning models, such as role play, STAD, think-pair-share, jigsaw, sequence chains, gallery walks, etc. Additionally, constructivist models (conceptual change) and direct interactive have also been used.

Table 4.10: Frequency (percentage) of the instructional methods reportedly used by GSSS teachers in teaching the topics

No.	Topics	Direct Instruction	Inquiry	Extra Hour
1	Genetic materials and structures (DNA-protein)	232 (81.1)	232 (81.1)	33 (11.5)
2	Hierarchical structure of multicellular organism: cell structure and function	220 (76.9)	220 (76.9)	44 (15.4)
3	Structure and function of plant tissues	223 (78.0)	223 (78.0)	35 (12.2)
4	Structure and function of animal tissues	211 (73.8)	211 (73.8)	37 (12.9)
5	Specialized cells of multicellular organism and their functions: digestion	221 (77.3)	221 (77.3)	38 (13.3)
6	Specialized cells of multicellular organism and their functions: circulation	225 (78.7)	225 (78.7)	43 (15.0)
7	Specialized cells of multicellular organism and their functions: respiration	212 (74.1)	212 (74.1)	39 (13.6)
8	Specialized cells of multicellular organism and their functions: muscle	208 (72.7)	208 (72.7)	41 (14.3)
9	Specialized cells of multicellular organism and their functions: excretion	208 (72.7)	208 (72.7)	36 (12.6)
10	Specialized cells of multicellular organism and their functions: reproduction	207 (72.4)	207 (72.4)	33 (11.5)
11	Specialized cells of multicellular organism and their functions: nerve system	201 (70.3)	201 (70.3)	40 (14.0)
12	Growth and development of living things: basic concept	198 (69.2)	198 (69.2)	74 (25.9)
13	Metabolism: Photosynthesis (process of energy transformation)	197 (68.9)	197 (68.9)	56 (19.6)
14	Metabolism: cellular respiration (aerobic-anaerobic)	195 (68.2)	195 (68.2)	44 (15.4)
15	Metabolism: Enzymes	188 (65.7)	188 (65.7)	33 (11.5)
16	Ecosystem: biodiversity	187 (65.4)	187 (65.4)	44 (15.4)
17	Ecosystem: matter cycles and energy flows	190 (66.4)	190 (66.4)	47 (16.4)
18	Ecosystem: component and interaction	200 (69.9)	200 (69.9)	53 (18.5)
19	Ecosystem: changes of physical environment and waste recycle	189 (66.1)	189 (66.1)	75 (26.2)
20	Morphology of plants and its function	196 (68.5)	196 (68.5)	55 (19.2)
21	Cellular Division: mitosis and meiosis	191 (66.8)	191 (66.8)	39 (13.6)
22	Mendel law	169 (59.1)	169 (59.1)	30 (10.5)
23	Variation of traits: pattern of heredity. mutation. heredity in human	190 (66.4)	190 (66.4)	47 (16.4)
24	Natural selection and adaptation	185 (64.7)	185 (64.7)	45 (15.7)

Table 4.10. (Cont.)

No.	Topics	Direct Instruction	Inquiry	Extra Hour
25	Darwin's theory of evolution	181 (63.3)	181 (63.3)	32 (11.2)
26	Feedback mechanism inside the living system: homeostasis	161 (56.3)	161 (56.3)	23 (8.0)
27	Mendel Pattern and inheritance	184 (64.3)	184 (64.3)	43 (15.0)
28	Basic concept of Biotechnology	181 (63.3)	181 (63.3)	55 (19.2)
29	Immune system: mechanism	183 (64.0)	183 (64.0)	26 (9.1)
30	Role and characteristics of invertebrate and vertebrate	192 (67.1)	192 (67.1)	44 (15.4)
31	Role and characteristics of Fungi	191 (66.8)	191 (66.8)	58 (20.3)
32	Role and characteristics of Protista	182 (63.6)	182 (63.6)	53 (18.5)
33	Role and characteristics of Bacteria	189 (66.1)	189 (66.1)	49 (17.1)
34	Role and characteristics of virus	191 (66.8)	191 (66.8)	42 (14.7)

Table 4.11: GSSS teachers' explanation and other teaching strategies (models of science teaching) used to teach the biology curriculum topics

Theme	Sub-Theme	Example of Responses
Constructivist models of Instruction	Conceptual change	"I use contextual teaching and learning approach. . ."; "by giving student personal assignment to explore and arrange the information in the form of report. . ." "I ask students to use concept mapping model in reading" "Students are asked to create the miniature copy of plant and animal cell" "applying integrative teaching strategy that correlates a biology topic with other subjects to make students have deeper understanding of that topic"
Sociocultural models of Instruction	Peer collaboration & Cooperative learning	"In general, I am using those strategies mentioned (in the questionnaire), but I use other strategies such as role playing, student teams achievement division, and broken circle" "I use several cooperative learning-based models" ". . . blended learning and social media"

Table 4.11. (Cont.)

Theme	Sub-Theme	Example of Responses
		"I do not vary teaching models that much, I ask students to give presentation"
Inquiry models	Discovery Learning	"I use other teaching strategies because it will affect the achievement, for instance, library exploration strategy that activate students' creativity and dependence"
		"Students are asked to find the information from the internet and make a laboratory report"
Teacher-Centered models	Direct-Interactive Teaching	"I also use technology-based information to help"
		"yes, direct learning using environment-based strategy"
		"I use questioning strategy with electronic media system"
		"Hospital visiting to directly learn the symptom of several illness and their treatment"
Not use another teaching strategy beside as mentioned as in the questionnaire	Lecture, Inquiry, Extra time (outside formal class meeting)	"I don't use any other strategy because what those teaching models mentioned (in the questionnaire) has proven to achieve the learning goal"
		"I don't use other strategies, but I just mix one to the others"
		"I don't use other strategies because the lack of biology hours"
		"yes, the teaching strategy used is adjusted to the basic competency and the learning goal (the indicator of learning)"
		"the teaching strategy used is adjusted to the students' learning condition"
		The teaching models are not always used because of the lack of facilities at school"

Furthermore, to gain more profound thought on instructional strategy, I asked selected teachers “What essential elements do you think should be present in your instruction or teaching practice (including assessment) to facilitate students’ knowledge construction?” As their responses to this question, two ideas that have been extracted include (1) the acquisition of teachers’ knowledge competencies, which is expected to broaden teachers’ biology content/knowledge so as to support students in constructing theirs; and (2) the conditions of learning, which is described as learning tools in the process of knowledge acquisition. The learning tools or instructional aids include media, laboratory equipment, and other sources. Some of the teachers’ statement about these views were:

> . . . the very important elements for instruction are facilities and teachers’ competence. We should create balance or strategies between personal and materials as well as the method implemented. (TR1)
>
> I think it is the process, as long as it is a good process, such as when proper media are involved. In Curriculum 2013, a good process also includes assessment. (TR2)
>
> The most important element for knowledge construction is the first indicator for each material we teach so that it leads teachers to achieve the objective of teaching. . . more attentions should be paid to material review for teachers because the materials that the teachers need to teach are completely different to what we learned in college. . . (TR3)
>
> If we have a laboratory with complete equipment, most likely about 80% of the teaching and learning process has been covered. . . (TR4)
>
> The most important element is learning resource, teaching methodology, and teaching media. For learning resource, teachers may explain the material to the students but if they do not have learning resource, they will rely on teachers who become the primary resource. . . (TR5)
>
> They are media and teaching aid. . . (TR6)

Research Questions 5: What general perceptions are reported by these Indonesian-Acehnese teachers regarding the required biology assessment in the Indonesian curriculum 2013 document?

The percentage calculation of the technique used in assessing students' attitude (Table 4.12) shows that: (1) observations were used ≥ 50 percent in teaching the topics "genetic materials and structures (DNA-protein) and specialized cells of multicellular organism and their functions (circulation)" with 50.0% and 52.1% respectively; (2) Self-assessment was used ≥ 50 percent in teaching the topics "genetic materials and structure (DNA-protein), hierarchical structure of multicellular organism (cell structure and function), and specialized cells of multicellular organism and their functions (digestion, circulation, respiration, muscle)"; and (3) Peer observations were used ≤ 50 percent in teaching all the topics listed.

Thus, regarding the students' knowledge measurement (Table 4.13), more than 60 percent of teachers agreed to use paper tests for the assessment technique, except for the topics "Mendel's Law and Feedback mechanism inside the living system: homeostasis," being selected 58% and 57% respectively. Next, assigning homework was the second vast assessment technique choices for teachers in measuring students' knowledge ranging from 40% to 62%. On the other hand, oral test and portfolios assessment techniques were rarely used by the GSSS teachers, being chosen less than 45% and 26% respectively.

Moreover, to measure students' skills (Table 4.14), the GSSS biology teachers preferred to apply performance-based assessment techniques to both portfolios and projects. The highest percentage of assessment technique used by teachers for performance, portfolio and projects was on the topic structure and function of plant tissues and specialized cells of multicellular organism and their functions (circulation) (55.2%), basic concepts of biotechnology (30.4%), and ecosystem (changes in physical environment and waste recycle) (25.2%).

Table 4.12: Frequency (percentage) of assessment items used by the GSSS teachers to measure the student's attitudes in particular topics

No.	Topics	Observations	Self-assessment	Peer Observations
1	Genetic materials and structures (DNA-protein)	143 (50.0)	162 (56.6)	87 (30.4)
2	Hierarchical structure of multicellular organism: cell structure and function	134 (46.9)	155 (54.2)	97 (33.9)
3	Structure and function of plant tissues	135 (47.2)	152 (53.1)	88 (30.8)
4	Structure and function of animal tissues	131 (45.8)	142 (49.7)	99 (34.6)
5	Specialized cells of multicellular organism and their functions: digestion	133 (46.5)	146 (51.0)	94 (32.9)
6	Specialized cells of multicellular organism and their functions: circulation	149 (52.1)	152 (53.1)	90 (31.5)
7	Specialized cells of multicellular organism and their functions: respiration	134 (46.9)	144 (50.3)	88 (30.8)
8	Specialized cells of multicellular organism and their functions: muscle	138 (48.3)	146 (51.0)	91 (31.8)
9	Specialized cells of multicellular organism and their functions: excretion	127 (44.4)	142 (49.7)	88 (30.8)
10	Specialized cells of multicellular organism and their functions: reproduction	135 (47.2)	142 (49.7)	91 (31.8)
11	Specialized cells of multicellular organism and their functions: nerve system	123 (43.0)	135 (47.2)	85 (29.7)
12	Growth and development of living things: basic concept	130 (45.5)	136 (47.6)	81 (28.3)
13	Metabolism: Photosynthesis (process of energy transformation)	124 (43.4)	127 (44.4)	81 (28.3)
14	Metabolism: cellular respiration (aerobic-anaerobic)	113 (39.5)	134 (46.9)	83 (29.0)
15	Metabolism: Enzymes	114 (39.9)	132 (46.2)	77 (26.9)
16	Ecosystem: biodiversity	111 (38.8)	126 (44.1)	76 (26.6)
17	Ecosystem: matter cycles and energy flows	113 (39.5)	132 (46.2)	86 (30.1)
18	Ecosystem: component and interaction	114 (39.9)	139 (48.6)	82 (28.7)
19	Ecosystem: changes of physical environment and waste recycle	118 (41.3)	142 (49.7)	88 (30.8)
20	Morphology of plants and its function	119 (41.6)	136 (47.6)	81 (28.3)
21	Cellular Division: mitosis and meiosis	107 (37.4)	132 (46.2)	71 (24.8)
22	Mendel law	91 (31.8)	11 (40.6)	60 (21.0)
23	Variation of traits: pattern of heredity, mutation, and heredity in human	108 (37.8)	129 (45.1)	74 (25.9)
24	Natural selection and adaptation	104 (36.4)	128 (44.8)	77 (26.9)
25	Darwin's theory of evolution	99 (34.6)	124 (43.4)	72 (25.2)
26	Feedback mechanism inside the living system: homeostasis	85 (29.7)	109 (38.1)	58 (20.3)
27	Mendel Pattern and inheritance	94 (32.9)	129 (45.1)	81 (28.3)
28	Basic concept of Biotechnology	102 (35.7)	135 (47.2)	75 (26.2)

Table 4.12. (Cont.)

No.	Topics	Observations	Self-assessment	Peer Observations
29	Immune system: mechanism	97 (33.9)	128 (44.8)	70 (24.5)
30	Role and characteristics of Invertebrate and vertebrate	106 (37.1)	134 (46.9)	84 (29.4)
31	Role and characteristics of Fungi	109 (38.1)	135 (47.2)	89 (31.1)
32	Role and characteristics of Protista	110 (38.5)	135 (47.2)	84 (29.4)
33	Role and characteristics of Bacteria	117 (40.9)	125 (43.7)	82 (28.7)
34	Role and characteristics of virus	110 (38.5)	132 (46.2)	87 (30.4)

Table 4.13: Frequency (percentage) of the assessment used by the GSSS teachers' perceptions in teaching the topics to measure the student's knowledge

No.	Topics	Paper test	Oral Test	Homework	Portfolio
1	Genetic materials and structures (DNA-protein)	237 (82.9)	123 (43.0)	176 (61.5)	72 (25.2)
2	Hierarchical structure of multicellular organism: cell structure and function	227 (79.4)	124 (43.4)	160 (55.9)	72 (25.2)
3	Structure and function of plant tissues	225 (78.7)	121 (42.3)	154 (53.8)	70 (24.5)
4	Structure and function of animal tissues	221 (77.3)	115 (40.2)	152 (53.1)	65 (22.7)
5	Specialized cells of multicellular organism and their functions: digestion	225 (78.7)	126 (44.1)	158 (55.2)	72 (25.2)
6	Specialized cells of multicellular organism and their functions: circulation	227 (79.4)	126 (44.1)	157 (54.9)	68 (23.8)
7	Specialized cells of multicellular organism and their functions: respiration	210 (73.4)	114 (39.9)	153 (53.5)	77 (26.9)
8	Specialized cells of multicellular organism and their functions: muscle	210 (73.4)	118 (41.3)	147 (51.4)	64 (22.4)
9	Specialized cells of multicellular organism and their functions: excretion	207 (72.4)	116 (40.6)	145 (50.7)	66 (23.1)
10	Specialized cells of multicellular organism and their functions: reproduction	208 (72.7)	112 (39.2)	142 (49.7)	54 (18.9)
11	Specialized cells of multicellular organism and their functions: nerve system	204 (71.3)	106 (37.1)	144 (50.3)	64 (22.4)
12	Growth and development of living things: basic concept	198 (69.2)	118 (41.3)	140 (49.0)	69 (24.1)
13	Metabolism: Photosynthesis (process of energy transformation)	197 (68.9)	102 (35.7)	141 (49.3)	61 (21.3)
14	Metabolism: cellular respiration (aerobic-anaerobic)	190 (66.4)	104 (36.4)	134 (46.9)	60 (21.0)
15	Metabolism: Enzymes	181 (63.3)	110 (38.5)	135 (47.2)	52 (18.2)
16	Ecosystem: biodiversity	180 (62.9)	107 (37.4)	131 (45.8)	51 (17.8)
17	Ecosystem: matter cycles and energy flows	197 (68.9)	101 (35.3)	141 (49.3)	62 (21.7)

Table 4.13. (Cont.)

No.	Topics	Paper test	Oral Test	Homework	Portfolio
18	Ecosystem: component and interaction	193 (67.5)	109 (38.1)	128 (44.8)	61 (21.3)
19	Ecosystem: changes of physical environment and waste recycle	194 (67.8)	106 (37.1)	150 (52.4)	67 (23.4)
20	Morphology of plants and its function	195 (68.2)	114 (39.9)	147 (51.4)	62 (21.7)
21	Cellular Division: mitosis and meiosis	188 (65.7)	104 (36.4)	133 (46.5)	62 (21.7)
22	Mendel law	166 (58.0)	89 (31.1)	119 (41.6)	49 (17.1)
23	Variation of traits: pattern of heredity, mutation, heredity in human	189 (66.1)	102 (35.7)	141 (49.3)	64 (22.4)
24	Natural selection and adaptation	189 (66.1)	100 (35.0)	123 (43.0)	57 (19.9)
25	Darwin theory of evolution	181 (63.3)	91 (31.8)	123 (43.0)	56 (19.6)
26	Feedback mechanism inside the living system: homeostasis	163 (57.0)	84 (29.4)	119 (41.6)	40 (14.0)
27	Mendel Pattern and inheritance	187 (65.4)	98 (34.3)	135 (47.2)	62 (21.7)
28	Basic concept of Biotechnology	181 (63.3)	97 (33.9)	138 (48.3)	66 (23.1)
29	Immune system: mechanism	176 (61.5)	98 (34.3)	117 (40.9)	50 (17.5)
30	Role and characteristics of Invertebrate and vertebrate	197 (68.9)	111 (38.8)	143 (50.0)	51 (17.8)
31	Role and characteristics of Fungi	198 (69.2)	103 (36.0)	140 (49.0)	57 (19.9)
32	Role and characteristics of Protista	199 (69.6)	102 (35.7)	138 (48.3)	55 (19.2)
33	Role and characteristics of Bacteria	200 (69.9)	99 (34.6)	144 (50.3)	62 (21.7)
34	Role and characteristics of virus	202 (70.6)	106 (37.1)	147 (51.4)	63 (22.0)

Table 4.14: Frequency (percentage) of the assessment used by the GSSS teachers' perceptions in teaching the topics to measure the student's skills

No.	Topics	Performance	Portfolio	Projects
1	Genetic materials and structures (DNA-protein)	144 (50.3)	98 (34.3)	39 (13.6)
2	Hierarchical structure of multicellular organism: cell structure and function	155 (54.2)	86 (30.1)	49 (17.1)
3	Structure and function of plant tissues	158 (55.2)	82 (28.7)	39 (13.6)
4	Structure and function of animal tissues	146 (51.0)	78 (27.3)	35 (12.2)
5	Specialized cells of multicellular organism and their functions: digestion	149 (52.1)	85 (29.7)	43 (15.0)
6	Specialized cells of multicellular organism and their functions: circulation	158 (55.2)	94 (32.9)	43 (15.0)
7	Specialized cells of multicellular organism and their functions: respiration	156 (54.5)	79 (27.6)	44 (15.4)
8	Specialized cells of multicellular organism and their functions: muscle	133 (46.5)	80 (28.0)	41 (14.3)
9	Specialized cells of multicellular organism and their functions: excretion	147 (51.4)	76 (26.6)	37 (12.9)

Table 4.14. (Cont.)

No.	Topics	Performance	Portfolio	Projects
10	Specialized cells of multicellular organism and their functions: reproduction	136 (47.6)	65 (22.7)	32 (11.2)
11	Specialized cells of multicellular organism and their functions: nerve system	142 (49.7)	76 (26.6)	32 (11.2)
12	Growth and development of living things: basic concept	140 (49.0)	79 (27.6)	70 (24.5)
13	Metabolism: Photosynthesis (process of energy transformation)	140 (49.0)	67 (23.4)	47 (16.4)
14	Metabolism: cellular respiration (aerobic-anaerobic)	129 (45.1)	73 (25.5)	46 (16.1)
15	Metabolism: Enzymes	127 (44.4)	78 (27.3)	37 (12.9)
16	Ecosystem: biodiversity	118 (41.3)	64 (22.4)	38 (13.3)
17	Ecosystem: matter cycles and energy flows	123 (43.0)	76 (26.6)	42 (14.7)
18	Ecosystem: component and interaction	119 (41.6)	75 (26.2)	44 (15.4)
19	Ecosystem: changes of physical environment and waste recycle	137 (47.9)	83 (29.0)	72 (25.2)
20	Morphology of plants and its function	140 (49.0)	85 (29.7)	49 (17.1)
21	Cellular Division: mitosis and meiosis	122 (42.7)	77 (26.9)	36 (12.6)
22	Mendel law	104 (36.4)	64 (22.4)	22 (7.7)
23	Variation of traits: pattern of heredity, mutation, heredity in human	123 (43.0)	78 (27.3)	41 (14.3)
24	Natural selection and adaptation	120 (42.0)	65 (22.7)	35 (12.2)
25	Darwin theory of evolution	112 (39.2)	62 (21.7)	26 (9.1)
26	Feedback mechanism inside the living system: homeostasis	104 (36.4)	50 (17.5)	21 (7.3)
27	Mendel Pattern and inheritance	125 (43.7)	69 (24.1)	29 (10.1)
28	Basic concept of Biotechnology	121 (42.3)	87 (30.4)	70 (24.5)
29	Immune system: mechanism	103 (36.0)	68 (23.8)	24 (8.4)
30	Role and characteristics of Invertebrate and vertebrate	137 (47.9)	77 (26.9)	44 (15.4)
31	Role and characteristics of Fungi	139 (48.6)	78 (27.3)	51 (17.8)
32	Role and characteristics of Protista	137 (47.9)	76 (26.6)	39 (13.6)
33	Role and characteristics of Bacteria	146 (51.0)	68 (23.8)	46 (16.1)
34	Role and characteristics of virus	135 (47.2)	76 (26.6)	42 (14.7)

Furthermore, teachers' perceptions regarding the assessment required in the 2013 curriculum are categorized into nine categories as shown in Table 4.15, including the examples of responses and the number of responses which appeared as the same responses. The most response to the implementation of the assessment system was "comprehensive," which is a

relatively positive response because the system has a precise technique in doing a fair evaluation. However, many teachers said that the required assessment is very complex and complicated, thus shifting teachers' focus on teaching to understand and filling up the assessment rubrics. Besides, a teacher applied the assessment due to the government policy.

Table 4.15: The GSSS teachers' opinion of the assessment required in the biology Curriculum 2013

Themes	Example of Response in the Theme	Number of responses appeared
Comprehensive (Detail, specific, clear, objective, systematic, and complete); measure 3 aspects of competencies: attitude, knowledge, and skill	"the assessment includes all required characters to be assessed which reflect on student's attitude, and two other aspects (knowledge and skill)"	128
	"In curriculum 2013, the assessment requirement is very detailed because it assesses each basic competency"	
	"it helps teachers to have fair evaluation of the teaching and learning process, especially with those who prepare all the assessment in the beginning of semester"	
	"very precise, because by our measuring the attitude, learners appreciate their friends and teachers"	
	"it is more specific and detailed than previous curriculum assessment. . . "	
	"Assessment is the most crucial part of the curriculum 2013 that requires teacher to evaluate students in detail for each competency aspects"	
Complicated/ Need to be simplified	"it is very complicated to do the various assessments making teacher less focused on teaching process"	70
	"it is very complex because some teachers still do not understand and accustomed to it"	
	"the assessment system is very difficult . . . especially for school conditioned in the rural areas. . ."	
	"there are too many rubrics that need to fill up. . ."	
Time consuming	"teacher needs extra times to finish the class assessment, so it is ineffective"	17

Table 4.15. (Cont.)

Themes	Example of Response in the Theme	Number of responses appeared
	"teacher cannot assess students' attitude in every meeting because of the lack of time"	
	"there are too many aspects that need to be assessed, so we need bunch of time to do the process"	
Assessment system is less suitable for students with lower competency (or with the wide range of competency's gap)	". . . the assessment is too detailed so it is less suitable for students with medium-low competencies of basic knowledge"	3
Interactive/ authentic	". . ., students become more active, creative, confident, and improve their skills"	19
	"the assessment creates interactive responses between teacher and students to be more cooperative and open. . ."	
Giving accessibility to evaluate the problem in the curriculum implementation	"The assessment is good to figure out the achievement level of completed class activities, therefore, we might be able to evaluate the curriculum and its elements"	1
Lack of socialization of the assessment system/ professionalism training	"it is good, yet needs to be socialized"	21
	"it is confusing because of our lack of training in converting grades using alphabet value…"	
	"some teachers are not ready or confident to use this assessment system because of their lack of training"	
	"there are some teachers who do not get any professional training to use the curriculum 2013, especially the assessment system"	
Not using the assessment yet	"This assessment system does not apply yet in my school"	10
Subjective peer assessment	". . ., also, for the peer assessments among students, sometimes it is not so objective"	1
Less applicable because of the lack of supporting facilities	". . . the knowledge aspect of student-centered teaching strategy is hard to assess since there is a lack of internet access to find information, especially for boarding school"	6
	"the assessment will be easier to be implemented with enough facilities"	
A government policy	"Teachers need to conduct the curriculum policy. . ."	1

Research Question 6: How do Indonesian-Acehnese biology teachers integrate the required aspects of character education into biology instruction?

Table 4.16 shows the result categories of the GSSS biology teachers' responses regarding the way they integrated character education into the teaching and learning process. There are several aspects of character education that have been applied including religiosity, honesty, tolerance, discipline, hard-work, creativity, curiosity, friendliness, sociability and awareness of environment, and responsibility. Yet, I could not find any responses related to independence, democracy, nationality, patriotism, appreciation for achievement, and a love of reading.

The table also shows that those characters education have been integrated at different steps of instructional methods, which consist of engaging, exploring, explaining, elaborating, and evaluating. Thus, teachers also integrated the character's education on their co-curricular activities. At the "engagement" stage (Table 4.16), integrating religious character was the most frequent opinion shared by teachers on the survey, such as praying before the class begins, connecting the topic discussed to real phenomena and God's rules, and etc. In addition, assimilating the social and environmental awareness into the "engagement" stage was the other character education that teachers selected.

At the "exploration" step (Table 4.16), teachers inserted the characters of honesty, tolerance, creativity, curiosity, communicative, love of peace, and responsibility, especially into instructional activities related to laboratory or field work (e.g., during the observation). Thus, the GSSS biology teachers also integrated several character educations during the explanation stage including religiosity, discipline, and responsibility. The integration of character education during this stage was usually conducted by connecting knowledge and religious teachings, or as encouragement to follow the teaching process with discipline and responsibility.

While at the "elaboration" stage (Table 4.6), teachers promoted students' interest with their work, creativity, and responsibility as a form of character integration, such as recording the experiment activities/results and being responsible for it. Then at the "evaluation" stage, teachers were able to integrate more characters into their instructional methods including religiosity (e.g. by associating teaching materials with verses of Quran), honesty (e.g. by not cheating during tests or in doing homework), discipline (e.g. by submitting homework on time), creativity (e.g. by self-assessment in project presentation), environmental awareness (e.g. by encouraging students to be concerned about and wise on the environmental problem), and responsibility (e.g. by assessing students' responsibility for their works in and out class).

Table 4.16: The GSSS teachers' perceptions of character education integration in different steps of instructional

Value Aspect of Character Education	**Steps of Instructional that is Inserted to the Character Value**	**Examples of the Integration Action Applied**
Religiosity	Engagement	Connecting God's rule in the universe to the overview of the balancing between biotic and abiotic
		Praying before the class instruction started.
		Associating the topics with daily life situation/phenomena;
		Framing the topic of genetic engineering to God as the creator to motivate student's confidence;
	Explanation	Encouraging students to praise God during the concept explanation
	Evaluation	Giving homework that may content religious aspect related to the topic; Asking question that may relate new knowledge to certain phenomena and religious concepts.
Honesty	Exploration	Reporting what they have found and see during the microscope observation.
	Evaluation	Being honest in doing their homework; Instruction not to cheat on tests
Tolerance	Exploration	Guiding students to appreciate others' opinion during group discussion; Appreciating differences in opinions during class/lab activities.

Table 4.16. (Cont.)

Value Aspect of Character Education	Steps of Instructional that is Inserted to the Character Value	Examples of the Integration Action Applied
Discipline	Explanation	Students' following the explanation orderly and obediently
	Evaluation	Submitting homework/exercise punctually.
	Co-Curricular	Being able to commit to school programs regarding the cleanliness
Hard Working	Exploration	Getting more information to additional works/practices
Creativity	Exploration	Being creative in doing such field work as making herbariums.
	Elaboration	Being creative in applying new learning; Creative and innovative in creating presentation.
	Evaluation	Project evaluation
Independence	Not mention	Not mention
Democratic	Not mention	Not mention
Curiosity (active)	Exploration	Exploring information; Questioning, lab activities; being active in discussion.
	Elaboration	Visiting national agency of food and drug control to encourage students to be perceptive and to use the information to select food consumptions.
Nationality	Not mention	Not mention
Patriotism	Not mention	Not mention
Appreciation of achievement	Not mention	Not mention
Communicative/friendly	Exploration	Being cooperative in lab experiment.
Peacefulness	Exploration	Become a good listener and give responses in good manner.
Love reading	Not mention	Not mention
Social Awareness	Engagement	Encouraging students to be more sensitive and care about their friends.
Environmental Awareness	Engagement	Framing environmental awareness indicators in biodiversity topic.
	Evaluation	Encouraging students to be concerned about and wise on the environmental problem; Encouraging students to keep the environment clean, e.g. by pointing out what they need to do with the garbage; Visiting coastal areas and forests to apply their knowledge in wildlife conservation and environmental cleanliness; Students' applying their knowledge about plant tissues to generate medicine from the plants at school.
	Co-curricular	Giving demonstration and participating in school gardening as the implementation of class learning process.

Table 4.16. (Cont.)

Value Aspect of Character Education	Steps of Instructional that is Inserted to the Character Value	Examples of the Integration Action Applied
Responsible	Explanation	Participating in learning process; questions and giving responses; group discussion.
	Elaboration	Recording the experiment activities/results; Making a project and being responsible for it.
	Evaluation	Assessing students' responsibility for their works in and out of class; Being responsible for providing evidence to the work experiment.

*co-curricular explains as informal activities outside the class instruction

In addition, some tecahers have also stated that they integrated the character education in non-formal way. Teachers have expanded their strategies of inserting moral or education values, such as discipline and environmental awareness in the gardening program. Based on the Table 4.16, the most frequent examples given were to the value of "religiosity" and "environmental awareness", which may indicate to the value that are most related or applicable to the biology teaching process. Thus, based on the analysis, the integration of education value at school has been applied either in formal way (through the instruction steps) or in non-formal way (through some co-curricular activities).

CHAPTER 5
CONCLUSION, DISCUSSION, AND IMPLICATIONS

Introduction

The education system in Indonesia defines "curriculum" as a set of plans and arrangements regarding the objectives, contents, teaching materials, as well as guidelines for the organization of learning activities to achieve specific educational goals (Badan Nasional Standar Pendidikan/BSNP, 2006). An idea to produce and implement what might be called an "ideal" or at least an "intended" model curriculum has influenced the continuous development and changes of the curriculum in Indonesia. The 2013 Indonesian curriculum (referred to throughout this study as Curriculum 2013) is the latest iteration of a series of documents that has evolved from the previous documents which were primarily related to competency-based standards. According to the Indonesian government, the 2013 curriculum is the answer (or innovation) developed to improve the ability of Indonesia's human resources to face the ever-changing world. The implementation of the Curriculum 2013, of course, involves numerous factors including all of those associated in education and the supporting factors necessary to achieve reform in education (Sugiyono et al., 2014). The 2013 document and its implementation with a special examination of instruction within secondary school biology are the focus of the study concluded in this chapter.

In Indonesian secondary schools, biology is a section of science focusing on living things and life processes. Science learning should be accompanied by appropriate teaching methods to achieve the expected performances or the competency goals (Nuh, 2013). Thus, the Indonesian Education Ministry required science teaching reformation through an inquiry mode to foster students' ability to think, practice, behave, and communicate which are important life skills

(Syarif, 2015). Therefore, the inclusion of biology in schools (including high schools, Islamic schools and vocational schools) is expected to provide a direct learning experience through the use and development of process skills and a proper scientific attitude.

Overview of the Study

In addition to a comparison of the intended biology curricular of the U.S. (NGSS) and Indonesia (Curriculum 2013), this study was designed to uncover the perceptions held by general secondary senior high school biology teachers about the application of Curriculum 2013. Their further opinions of biology topics and the instructional practices in the classroom are offered to support the conclusions of this study. As data sources, I involved general senior secondary school (GSSS) biology teachers from 22 districts in the Aceh province who were randomly selected for participation in the study. This group consisted of teachers from public schools (n=254) and from private ones (n=32). Also, six of the 286 subjects were selected as a sample of convenience to have a one-on-one phone interview. A partially mixed concurrent equal status design of mixed method typology was used to collect the data. The GSSS biology teachers were surveyed from August-November 2016. The collected data were analyzed descriptively (resulting in the establishment of frequency and percents) and thematically to address the research questions.

In this discussion and conclusion chapter, I present the discussion of result findings for each research question based on the survey analysis from Chapter 4. The summary of interview results with the detailed transcriptions of six subjects can be found in Appendix E1 (English version) and E2 (Bahasa version). Additionally, my final thoughts of this study and my identification of implications for further studies and practices are also presented in this chapter for each research questions.

Discussion of Findings

The initial idea of conducting this study was prompted by the interest and thoughtful discussion about the relatively low rank held by Indonesian students on science achievement in the Program for International Student Assessment (PISA). Thus, this seemed an appropriate time to examine the nature of the biology curriculum and to compare the science standards of the United States (Next Generation Science Standards) and Indonesian Biology Curriculum (IBC) 2013 in. Furthermore, this investigation was expanded to obtain more information related to the implementation of the IBC 2013 from biology teachers, especially Acehnese high school teachers, who are the most immediate interest to me professionally as the crucial factor that affects a curriculum implementation.

Research Question 1: How does the Indonesian biology Curriculum 2013 content compare to the related aspects of the U.S. Next Generation Science Standards (NGSS)?

Although there is a different definition of the curriculum between the U.S. and Indonesian contexts, this first research questions addressed the similarities and differences of several aspects found in the intended standards (NGSS-LS) and intended curriculum (IBC 2013). To address this question, I considered the basic structure, the science practices, and several elements to study (see Table 4.1. in Chapter 4 as reference to the summary of elements comparison). The NGSS-LS standards document is provided in the next generation science standards website, while the documents related to the Indonesian Curriculum 2013 biology documents can be requested from the Ministry of National Education and Culture of Indonesia, which unfortunately does not provide an English version. This added considerable time in making the comparison. It is useful to state that the comparison between the NGSS-LS and IBC 2013 was about the intended standards and the intended curriculum. There was no plan to compare the enacted curriculum from both countries, although I did discover some of this

information for the Aceh/Indonesian context in addressing other research questions. In general, the intended standards (NGSS-LS) website provides information about the standards (read the standards, appendices, understanding the standards, and developing the standards), instruction and assessments (evaluating instructional materials, instruction and assessment supports) and planning and communication (state and district implementation, communicating about the standards, video hub, and resource library). While in the intended curriculum (IBC 2013), the curriculum module guideline document provides information about the concepts of curriculum 2013 (rationale, objectives, standards, the regulation laws, introduction of learning approach and assessment), guideline of teachers and students textbooks, the design of learning and assessment, learning formats, and assessment rubrics. I also use the competencies (core and basic) and syllabus documents that are provided separately.

The comparison in the study has been based on the similar content information that can be compared between the intended standards (NGSS-LS) and the intended curriculum (IBC 2013). It is worthy noting that the parts from both documents may have different names yet provide similar context and content information. Therefore, I emphasized the comparison analysis to the similar information provided and ignoring the terms used.

Comparison of the Basic Structure

The NGSS-LS standards and IBC 2013 are two different documents each having its own structures. Basic structure is defined as how a standard or a curriculum is built/organized. In general, high school curriculum structure in Indonesia is the application of content organization in the learning system (Sunendar, 2014). Since I am using the IBC 2013's syllabus (which are provided by the Ministry of Education) as the structure to be compared to the NGSS standards, the structure of the IBC 2013 is defined as the organization of learning contents and processes

arranged by the basic competencies according to graduation competency standards and content standards. On the other hand, the NGSS-LS standards are organized by basic competencies (Bybee, 2012). Based on the analysis result, it might be said that the IBC 2013 contains those aspects that are included in the NGSS-LS standards, except for the connection to core ideas of other disciplines (see Figures 5.1 and 5.2 component that are provided with the detailed information as the example).

Figures 5.1 and 5.2 describe how the elements of the IBC 2013 and the three dimensions of the standards are arranged. The similarities to the NGSS structure include: (1) performance expectations that are similar to core competency and basic competency in the IBC 2013; (2) science and engineering practices that are similar to the skills learning process in the IBC 2013; (3) disciplinary core ideas that are similar to material subtopics in the IBC 2013;

Education Unit : Senior Secondary School Biology
Class : XI (age of 17)
Core Competency 1: Immersing and practicing their religious principle believed
Core Competency 2: Realizing and practicing honest, disciplined, responsible, caring (polite, cooperative, tolerant, peaceful) responsive and proactive behaviors, and showing attitude as part of the solution to problems in interacting effectively with the social and natural environment; also, in placing his or herself as a reflection of the nation in the association of the world
Core Competency 3: Understand, apply, analyze factual, conceptual, procedural knowledge based on his or her knowledge of science, technology, arts, culture and humanities with humanitarian, national, state, and civilization insights on phenomena and events, and apply procedural knowledge to specific areas of study according to his talents and interests to solve problems
Core Competency 4: Processing, reasoning and presenting in the concrete and abstract domains related to the development of knowledge and skills learned at schools independently, and using methods according to scientific rules

Basic Competency	Material	Learning Process	Assessment	Time Allocation	Media, Apparatus, Sources
Core Ideas: Cell as the smallest unit of living things and the bioprocess in a cell					
1.1. Admire the regularity and complexity of God's creation of the structure and function of the cells, tissues, organ of the systems and bioprocesses that occur in living things	• Chemical components of cell structure. • Structure and function of each cell parts • Cell activity as a structural and functional unit of living things. • Membrane Transport • Synthesis of proteins to develop morphological and physiological properties of cells • Reproduction of cells	**Observing** • Read the literature on the chemical components of the cell structure • Read the literature or various sources about the cell structure **Asking** • What kind of processes occur inside a cell? **Data Collection (Experiments / Exploration)** • Review the literature • Observe the process of diffusion and osmosis	**Homework** • cell and tissue models (2D or 3D prototype) **Observation** • Scientific methods and safety work **Portfolio** • Observation reports **Test** • The concept of cell, tissues, and cell bioprocess (intercellular transport, protein synthesis and cell reproduction).	5 weeks x 4 meeting hours OR 4x45 minutes in a week for 5 weeks length	Students book, Textbook (such as Campbell), and laboratory equipment and substances for observation or experimentation (such as microscope, chemical substances, apparatus)
1.2. Realize and admire the scientific mindset in the ability to observe bioprocess.					
1.3. see the IBC 2013 document					
2.1. see the IBC 2013 document					
2.2. see the IBC 2013 document					
3.3. see the IBC 2013 document					
3.4. see the IBC 2013 document					
4.3. see the IBC 2013 document		• Observe the mitotic process **Associating** • Discuss in groups to compare the observation results and summarize the results **Communicating** • Compile reports in the form of: pictures, lab worker tables.			
4.4. see the IBC 2013 document					

Figure 5.1: The structure of syllabus for IBC 2013 (translated) of the cell structure and function.

HS.Structure and Function

HS.Structure and Function

Students who demonstrate understanding can:

HS-LS1-1. **Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells.** [Assessment Boundary: Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis.]

HS-LS1-2. **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.** [Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] [Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.]

HS-LS1-3. **Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.** [Clarification Statement: Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, and root development in response to water levels.] [Assessment Boundary: Assessment does not include the cellular processes involved in the feedback mechanism.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models

Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world.

- Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-2)

Planning and Carrying Out Investigations

Planning and carrying out in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-LS1-3)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-LS1-1)

Connections to Nature of Science

Scientific Investigations Use a Variety of Methods

- Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings. (HS-LS1-3)

Disciplinary Core Ideas

LS1.A: Structure and Function

- Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1)
- All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS1-1) *(Note: This Disciplinary Core Idea is also addressed by HS-LS3-1.)*
- Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. (HS-LS1-2)
- Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS-LS1-3)

Crosscutting Concepts

Systems and System Models

- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. (HS-LS1-2)

Structure and Function

- Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. (HS-LS1-1)

Stability and Change

- Feedback (negative or positive) can stabilize or destabilize a system. (HS-LS1-3)

Connections to other DCIs in this grade-band: **HS.LS3.A** (HS-LS1-1)

Articulation across grade-bands: **MS.LS1.A** (HS-LS1-1),(HS-LS1-2),(HS-LS1-3); **MS.LS3.A** (HS-LS1-1); **MS.LS3.B** (HS-LS1-1)

Common Core State Standards Connections:

ELA/Literacy –

RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS1-1)
WHST.9-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-LS1-1)
WHST.9-12.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS1-3)
WHST.11-12.8	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. *(HS-LS1-3)*
WHST.9-12.9	Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS1-1)
SL.11-12.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. *(HS-LS1-2)*

Figure 5.2: The example of NGSS-LS system architecture for HS-LS1A: Structure and Function

Comparison of the Content – Corresponding to the core ideas (teaching materials)

Based on the data, it seems that the most noticeable difference in the structure of the the intended standards NGSS-LS and the intended curriculum IBC 2013 is the arrangement of the specific core ideas, which are shown in the *blocked topics* (group of core ideas that have been included in the syllabus, see Table 4.2) of grade levels for IBC 2013 and specific core ideas found in the NGSS-LS standards. In the IBC 2013, the material topics have been arranged based on core competencies (capabilities to be attained after learning process) and basic competencies (skills built during the learning process) that have been set by the government through the Ministry of Education and Culture (MoEC). The arrangement of essential topics in the IBC 2013, progressing from concrete and easy to abstract and difficult concepts was based on content standard criteria set by the Badan Nasional Standar Profesi (National Professional Certification Authority) for high school students, such as students' cognitive and mental development stages, qualifications of Indonesian competence, and graduation competence level. In the NGSS-LS structure, the arrangement of core ideas is based on specific criteria stated by NRC (2012) for K-12, including: (1) a core idea that should be the main principle of single discipline or have wide-ranging significance across multiple science/engineering disciplines; (2) a core idea that should offer a key tool to understand or explore more complex ideas; (3) a core idea that should concern on students' life interest and social experiences and relate their interest to scientific/technological knowledge; (4) a core idea that should be able to be taught and learned by over several grade levels.

Generally, although biology concepts taught in the United States and Indonesia are similar, they are different in the depth of content and difficulty. For instance, the NGSS-LS core ideas of LS4 (biological evolution) cover empirical evidence at different scales and provide

evidence for causality in explanations of common ancestry and biological evolution, such as the discussion of the evolution process through the relationship between phenotypic variation and survivorship by analyzing beak size among the Galapagos Island finches, modeling industrial melanism among peppered moths, and observation of adaptations in chimpanzees' use of twigs to capture termites or sea otters' use of rocks to open shellfish. On the other hand, in the IBC 2013, the scope of evolution is only focused on Darwin's evolution theory using images of giraffes, finches, and peppered butterflies, along with the evolution process through geographic isolation. The content assortment for one core idea in the NGSS-LS is decided in accordance with the focus of the NRC's concept in discovering more profound and meaningful important concepts. The number of core ideas included in the NGSS standards was purposely set to avoid the scope of topics that cannot be connected to other disciplines or subjects, mainly those in the common core standards (Bybee, 2012; NRC, 2012; NGSS Lead States, 2013; Pruitt, 2014). Moreover, the set of core ideas in Grades 9-12 is the content progression (students' sophistication thinking) from K-2, 3-5, and 6-8, as opposed to Indonesian science curriculum, which has yet to notice the essence of a learning continuum (according to the age of learners and directed to the maximal achievement of every competency in each stage) in material possessions as found in the digestive system concept (Situmorang, 2016). I assumed that the similarity found in biology core ideas taught was a result from the efforts of both the United States and the Republic of Indonesia to develop science instruction that would fit their national and international scopes. Stacey et al., (2018) found that the intended science topics in curricula are becoming similar across countries due to the influence of the international examination outcomes of PISA for science education reformation (Çil & Çepni, 2014).

Based on Table 4.7, several materials that are different in both the standard and the curriculum are: (1) in the NGSS-LS, there is a feedback mechanism (positive or negative) inside the living system, such as heart rate response to exercise, stomate response to moisture and temperature, and root development in response to water levels; whereas in biology Curriculum 2013 only a brief explanation of homeostasis mechanism on urine production (specialized cells of multicellular organism and their functions: excretion) is found; (2) in the NGSS-LS, the assessment does not include the biochemistry of protein synthesis, while in the IBC 2013 the discussion on protein synthesis includes the explanation of biochemistry level; (3) in the NGSS-LS, there is a core idea related to the use of mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales, while in the IBC 2013 it is non-existent; (3) there is a discussion of how to design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity in the NGSS-LS but not in biology curriculum 2013; (4) in the NGSS-LS, social interaction and group behavior put more focus on the survival of genetic inheritance, while in the biology curriculum 2013 different types of interactions (intraspecific and interspecific) and their examples are provided; (5) there is a discussion about Evidence of Common Ancestry and Diversity in the NGSS-LS, yet it is not present in the IBC 2013; (6) there is discussion on the basic conventional and modern biotechnologies and their application and products in the IBC 2013, but none in the NGSS-LS.

The core ideas differences found between both intended standards NGSS-LS and intended curriculum IBC 2013 are considered to the nature of the documents. In the NGSS-LS standards outlined, the basic knowledge that every student graduating from high school should know. Some of advanced topics would be covered in other biology courses offered by schools

that go beyond the basics. Also, some of these topics could be assumed to be embedded within performance expectations, even though they are not specifically stated. Whereas, in the IBC curriculum outline, advanced core ideas could be offered in the textbook or through teachers‘ lesson plan design or teaching materials.

Comparison of the Content – Corresponding to the scientific inquiry

In terms of scientific inquiry, both documents have described similar practices in their scientific inquiry stages. This analysis result is supported by what has been found by Haridza and Irving (2017) who signified that the science curriculum design and decision making in Indonesia and the U.S. are influenced by similar thoughts of the process of science learning, emphasizing concepts of discovery from students’ experiences through inquiry and problem-solving strategies. The scientific approach used in IBC 2013 includes observing, questioning, experimenting, associating, and communicating. By contrast, the NGSS scientific approach consists of asking questions, developing and using models, planning and carrying out investigations, analyzing and interpreting data, using mathematics and computational thinking, constructing explanations, engaging in argument from evidence, as well as obtaining, evaluating, and communicating information (NRC, 2012; Ford, 2015). Although the intended standards NGSS-LS and the intended curriculum IBC 2013 stated different numbers of inquiry steps, their scientific practices express the same aspects; the use of observing and questioning (in IBC 2013), which is described as “asking a question that arises from careful observation of phenomena” in the NGSS (the NGSS Lead States, 2013, Appendix F, p.4). Yet, the IBC 2013 curriculum does not apply a sophisticated range of mathematics and computational thinking, such as the trigonometric functions, exponentials and logarithms, as well as computational tool in the NGSS practices. Besides, there is no engineering practices written in the IBC 2013.

Furthermore, as the central intersection of the three dimensions (the scientific and engineering practices, disciplinary core ideas, and crosscutting concepts) of the NGSS standards, the matrix of nature of science ("Scientific investigations use a variety of methods; Scientific knowledge is based on empirical evidence; Scientific knowledge is open to revision in light of new evidence; Scientific models, laws, mechanisms, and theories explain natural phenomena; Science is a way of knowing; Scientific knowledge assumes an order and consistency in natural systems; Science is a human endeavor; and Science addresses questions about the natural and material world", NGSS Lead Sates, 2013, Appendix H, p.4) has been associated with the practice and crosscutting concept. At this point, students have to reflect (what they have done and why) to understand the whole picture of scientific knowledge from their science practices. In contrast, there is no detailed information regarding the nature of science in the IBC 2013, although it can be found in the junior secondary science curriculum of the NGSS.

Comparison of Other Components

In terms of teaching order, biology teachers in Indonesia are required teach topics that have been systematically designed in the curriculum to reach the required basic competency expectation. Yet, they need to design their own indicators (measurable markers) when designing a lesson plan and must follow the order of the topics within the topic group assigned in the syllabus (see Table 4.2 for the group of biology topics assigned for each grade level). On the other hand, since the NGSS life science is a standard, it presents the core ideas for high school (9-12) without clear topic division across grades since it is specifically unlinked to the curriculum or instruction plan. Therefore, there is no order to teach topics according to the NGSS life science or biology framework of a state, as written in the NGSS Lead States (2013):

> "The Next Generation Science Standards are student outcomes and are explicitly NOT curriculum. Even though within each NGSS performance expectation

> Scientific and Engineering Practices (SEP) are partnered with a particular Disciplinary Core Idea (DCI) and Crosscutting Concept (CC), these intersections do not predetermine how the three are linked in the curriculum, units, lessons, or instruction; they simply clarify the expectations of what students will know and be able to do by the end of the grade or grade band. Though considering where Performance Expectations (PEs) will be addressed within courses is an important step in curriculum development, additional work will be needed to create coherent instructional programs that help students achieve these standards" (p. 5).

Regarding the integration of subjects, the NGSS provided clear information in the connection box since it is important to build coherent connections between science as a quantitative discipline to students' learning in mathematics (Common Core State Standards connections) (the NGSS Lead States, 2013). The mathematics concepts such as statistics and probability, algebra technique, ratios, unit conversions, etc., are applied in the NGSS-LS. Besides, the connection to the ELA/literacy standards is important in developing knowledge in science by providing connections between literacy key points and specific content in the NGSS outline (the NGSS Lead States, 2013). On the other hand, the integration of mathematical and other science content is not arranged in a specific table yet can be found in the learning process stated in the syllabus. For instance, in the heritance pattern of the Mendellian law material, students will determine the genotype and phenotype ratios of F1 and F2 using chessboard or fork systems; whereas in literacy, students are required to communicate what they have learned in the classroom.

In accordance with the comparison element of "teaching time allocation and the compulsion of teaching methods and guidance", the intended curriculum IBC 2013 has provided this information detail inside the syllabus, while the intended standards NGSS-LS does not prescribe this information.

Conclusion Thought for the Comparison

The literature study presented here sought to address what might be connected between the intended standards NGSS-LS and the intended curriculum IBC 2013 that have been designed and written with great effort to improve science education reformation in both countries, the United States and the Republic of Indonesia. Coincidentally, both documents were designed in 2013, and were triggered by the students' low achievement rank in science and math in PISA and TIMSS reports (OECD, 2014). In addition, the Indonesia Ministry of Education and Culture (2014) stated that the low achievement was caused by the mismatch between what has been tested internationally and what has been taught to Indonesian students. The international test results, which may reflect how pupils are taught and learned in both countries, also indirectly reflected the achievement of the national curriculum/standard from these countries. Since the elements of comparison used are adapted from a study conducted by Ruddock & Sainsbury (2008), the comparison between the NGSS-LS and the IBC 2013 looked into components that are similar in both countries, components that might be presented in the NGSS-LS standard but not in the IBC 2013 or vice-versa, as well as components that might be judged "narrower," "broader," "easier," or "harder".

The main challenges found in the study include the difficulty in assessing each element for comparison. For instance, when an element was marked "similar," it does not necessarily mean that it provided identical points of comparison. In addition, some elements were not presented clearly and difficult to find. Thus, the adjustment to another possible information gathered in the documents was necessary to answer the research question. For instance, in comparing the basic structures, it was almost impossible to find similarities between two different types of documents (a curriculum and a standard) since both countries have their own

terms for curriculum. Yet, by understanding the documents and reading intensely, I have found that the NGSS-LS contain the same elements as the IBC 2013. This conclusion is consistent with Stacey et al. (2018) who signified that all countries included in the study had changed their intended curricula especially by adding science topics in response to the TIMSS curriculum questionnaire. Furthermore, the NGSS-LS provides more explicit and detailed information, such as the instruction and assessment support (samples of classroom tasks) for their teachers to develop a science curriculum at their school states. In brief, I have addressed the answer to the research question based on detailed information analyzed and presented in Chapter 4.

Practical Recommendations

The comparison between the intended standards NGSS-LS and the intended curriculum IBC 2013 has shown that those standards and curriculum have been contextually designed in each country. Technically, there are no significant parts of the IBC 2013 curriculum that need to be changed or developed. However, there are some suggestions that can be considered by the Indonesian government, particularly, the Ministry of National Education to idealize the IBC 2013 curriculum as follows:

- In syllabus composition, as an educator, I would like to suggest two concept separations on each topic, namely basic concepts and applied concepts. In the current curriculum both concepts are combined, and in some topics, they lack the applied concepts. To exemplify, in the syllabus for topic of viruses, for the basic concepts, students are introduced to the structure and morphological features of viruses completed with core concepts, lesson plan, assessment, time allocation, and references. The same topic is then developed for its applied concept. In this case, students are required to learn about viral replications, viral

infections, diseases caused by viral infections, the treatment for viral infections and other applied scientific inquiries or approaches.

- It is important to integrate appropriate nature of science in the biology curriculum that is separately designed from Science subjects.

Areas for Further Study

To seek significant differences of both curricula (the NGSS-LS and IBC 2013), lesson plan analysis can be performed to examine particularly the similar core ideas or teaching material in terms of scientific practices (i.e. types of applied inquiries), applied scientific approaches, and to seek the strengths and weaknesses of the scientific methods implemented in the learning process. Besides, the connection between the implementation of both intended and enacted curricula can be also further analyzed.

Research Question 2: What Opinions do Indonesian teachers in Aceh Province hold with respect to the required biology content?

The core ideas of biology content selected to be taught in senior secondary high schools are based on the content standards written as Permendikbud (the Act of National Education and Culture Ministry No. 21, Year 2016) (Badan Nasional Standar Pendidikan, 2018). Thus, Indonesian biology teachers are required to teach the aforementioned essential topics (i.e., the intended content) and most of them believed that all the core ideas are important (refer to Table 4.8).

Yet, interestingly, I found valuable thoughts (while doing data collection process) from few senior teachers (who have been teaching biology for more than 15 years) who stated that some biology topics do not need to be taught in depth for high school students due to several reasons:

- Students must work hard to learn many topics in the span of three years of school time, and they will learn them again in an advanced science program at the university level.
- Other option is to give students the opportunity to learn basic knowledge in junior high schools without repeating the content in senior high schools, thus reducing the subtopics that high school students must learn.
- Some biology topics (see Tables 4.2 and 4.7), such as the observation of the tissue structure in movement (the observation of the effect of physiological salts to muscles in femurs and heart of frogs) and excretion system (the observation of nephron structure), require advanced laboratory work and seem impossible to be conducted in most school laboratory facilities in Aceh province. Teachers believed that students should not learn science facts abstractly, but rather through hands-on experiences. In addition, advanced laboratory work will require certain skill level from teachers themselves, the equipment, the use of technology and time, which most schools and teachers in Aceh province cannot afford.

If we refer to the Table 4.8, many biology topics (more than 40% of the subjects) are related to specialized cells of a multicellular organism and their functions in human organ systems. Due to this fact, I have several perspectives that might drive teachers decisions to value each biology topic: (1) teachers who consider these topics very important will teach those topics longer than allocation portion required; (2) based on the syllabus, these topics have more basic competencies to achieve (9-10 basic competencies) than other topics (approximately 7 basic competencies); (3) the human organ systems are the topics that are closely related to human body functions, which are considered to be interesting and useful to learn; (4) its abundant teaching

materials and its arguably abstract content (Fajar, 2016) have positioned the organ systems as difficult topics to learn.

Furthermore, the subjects in the study were teachers whom had at least five years of teaching experiences and were willing to be interviewed. The first response from them was that "an ideal curriculum should accommodate local content knowledge and skills' application (entrepreneurship)." The utilization of local sites in learning biology has been shown by Situmorang (2018) and Mumpuni (2013), who stated that the availability of learning objects in the forms of local potentials is expected to invite learners to be exposed to many phenomena and facts unique to their regions through understanding the concept of teaching materials. Although their studies did not directly point to the idea of an ideal curriculum, the findings have shown the possibility of similar ideas that Indonesian biology teachers might have about biology curriculum content. The second thought was the idea that a biology curriculum should be designed by not only biology experts but also practitioners who understand the real conditions of the teaching process. Lastly, a critical thought was the idea of adequate facilities and infrastructures to support the teaching content process.

In conclusion, there are several factors that might affect teachers' valuing the required biology core ideas required to teach. For instance, the amount of teaching experiences has given advantages for teachers to know the relative necessity of such knowledge to support contextual learning in understanding phenomena and the characteristics of knowledge and skills possibly tested in the national examination.

Practical Recommendations

Based on Table 4.8 the ranks of very important biology topics are: (1) specialized cells of multicellular organism and their functions: circulation, (2) specialized cells of multicellular

organism and their functions: reproduction, (3) specialized cells of multicellular organism and their functions: respiration, (4) specialized cells of multicellular organism and their functions: excretion, and (5) specialized cells of multicellular organism and their functions: nerve system. The five very important topics selected were about human physiology and function, which are such "abstract" concepts that are difficult concepts to be explained. Therefore, I suggest to the Indonesia Ministry or Aceh province National Education Bureau to provide continuing knowledge training towards those concepts and conducted thoroughly (using efficient and low-cost budget strategy) to all teachers in 23 districts in Aceh Province. To support professional development (PD) of the human physiology and function concepts materials, a specific scientific-based workshop can be designed to enrich biology teachers' skills in doing laboratory works at schools. The workshop designed can be collaborated with the scientific experts of this knowledge area or specialist doctors who are the expert in human anatomy and physiology.

To accommodate Indonesia-Acehnese biology teachers' ideas to teach biology classroom with local contents, the National Education agency of Aceh province can design learning media in the form of students' worksheets or textbooks that can be distributed to all schools in Aceh province. Those students' worksheets or textbooks could be designed by and for teachers from 23 districts of Aceh or designed by biology educators from schools or universities in Aceh province. In addition, to avoid redundant learning content and laboratory activities, for instance, the laboratory work of proofing photosynthesis process on plants, the National Education agency can mandate teachers to write different indicators for that topic for middle school and high school classroom activities. The government can conduct a workshop to help teachers in designing various laboratory practices and share the information with all teachers in the Aceh districts.

Areas for Further Study

Conducting further survey research through a phone call by asking the detail reason of their perspective on the importance of the biology topics taught can enrich the finding of this research question. Also, further data analysis using non-parametric *Kruskal–Wallis test* to determine significant differences of the perceptions related to the length of teaching experiences, the gender, or school locations, or the latest school levels graduated can also conduct to expand the result findings. For example, do more experienced teachers teach a certain topic more than novice teachers, etc.

Research Questions 3: What aspects of the Biology Curriculum 2013 do Indonesian-Acehnese teachers teach and to what extent do they teach them?

More than 80% of the total teachers in this study said that they had taught all the 34 topics asked in the survey form or required by the IBC 2013 (presented in Table 4.9). Yet, there is not much information to support the discussion of this finding. However, by analyzing the curriculum documents, it was found that there are two significant reasons as to why the biology teachers decided to teach the mandatory biology topics; (1) as educators, they are responsible for reporting the learning outcomes to school, parents, and national education agency (in the forms of outcome competency report/LCK), and (2) to get their professional incentives, their performance will be assessed (through teacher performance evaluation or PKG).

LCK is an illustration of learners' competence achievement in every semester, which consists of the assessment of knowledge, skills, and attitude (Syarif, 2015). The procedure and important criteria to fill out this LCK are explained in the curriculum document. On the other hand, PKG is defined as the assessment of all main tasks of a teacher used primarily to foster their career, rank, and position as stated in the Regulation of the State Minister of Administrative

Reform and Bureaucracy Reform No. 16 Year 2009 and the Regulation of the Minister of National Education No. 16 Year 2007 regarding Academic Qualification Standards and Teacher Competencies (Suadinmath, 2014; MoEC, 2012a). Thus, the aspects that are assessed from teachers include their pedagogy, personality, as well as their social and professional development. In pedagogy competency, the elements that are graded include the quality of the teaching-learning process and the suitability of teaching materials to the curriculum requirement.

Based on the interview analysis, there are several challenges faced in teaching biology topics, including the various assessments that need to be done, the need to conduct various teaching models to engage the students in learning activities, and the lack of facilities to support instruction due to the geographical limitation. The aspects related to assessment and teaching models will be discussed in the following research questions. One study has found similar challenges in the implementation of 2013 Curriculum, such as the lack of understanding of scientific learning approach, the need of accompaniment of a mentor during the instruction, the need of professional development in the application of attractive and innovative teaching strategies and assessment, and the need of teachers' and local government's mindset change to give full support to the curriculum implementation (Kastawi et al., 2017).

In brief, as has been discussed, teachers have stated that they have taught all the topics required in the curriculum 2013 due to their obligation to provide students' learning evaluation as a part of schooling and the education system and to match their work to what is required in the curriculum as mandated in pedagogical competency. School headmasters or a person in charge of National Education Bureau perform teachers' performance evaluation. In addition, I also believe that some teachers must have taught those biology topics as a moral obligation to provide adequate knowledge to their students.

Practical Recommendations

Considering the interview result of challenges and opportunities teachers faced, the National Education Bureau of Aceh province can provide long days workshop (3-5 days) for representative groups of teachers from 23 districts to design appropriate assessment for 2-3 instructional models for all topics required in the IBC 2013. Thus, the result can be shared in the teachers meeting forum in each district. Thus, the problems analyzed from the interview result including assessment, instructional methods, and PD can be solved.

Areas for Further Study

Collecting teachers sets of lesson plans from the subjects of this study, which include teachers' yearly and semester timeline plan, teaching plans, assessment documents (rubric, the paper test, etc) can be used to validate their survey opinion related to evidence of topics taught. Thus, those documents can also be used to identify the possible challenges faced by teachers during the instructional process.

Research Questions 4: What instructional methods are used by these Indonesian-Acehnese biology teachers to support students in understanding biology?

The majority of GSSS biology teachers believed that they had used a number of teaching models in their instructional strategies (refer to Table 4.10 and Table 4.11), especially those suggested in the Curriculum 2013 (discovery learning, project-based learning, problem-based learning, and inquiry learning). The GSSS biology teachers preferred to use student-centered teaching models such as discussion and active learning (role-playing, concept mapping, student teams' achievement division, think-pair-share, blended learning, etc.). Their choices in selecting teaching models have reflected the principles of biology learning process in the IBC 2013, which emphasize that learners figure out the knowledge rather than being informed; that a teacher is not

the only source of learning; and a shift from textual approach of learning into a process approach to support the use of scientific methods (Syarif, 2015).

Other factors leading to teachers' selection of "direct instruction" as the instruction strategy, according to Zahriani (2014) and National Research Council (2011), are: (1) although it is not a one way knowledge transfer, the teacher is the main sources of information; (2) direct instruction adopts systematic and straightforward instruction steps; (3) direct instruction is an effective way to develop students' skills in taking notes and summarizing; (4) as direct instruction is teacher-centered, teachers are not only a great model of the learning process, but also capable of giving reinforcement and feedback to students. For science learning, direct instruction can be used to demonstrate the skills or conceptual and procedural knowledge when addressing demanding teaching materials (Zahriani, 2014).

Furthermore, Indonesian-Acehnese biology teachers have also employed "inquiry" as their teaching strategy. This selection is in line with the teaching strategy required in the curriculum that emphasizes the use of scientific and process skill approaches in teaching strategy. Students can benefit from the use of the scientific approach to science teaching since it stimulates their critical thinking, encourages observation, pushes for analysis and requires communication (Syarif, 2015). Therefore, the scientific inquiry in science teaching strategy consists of basic process skills (observing, measuring, concluding, predicting, classifying, and communicating) and integrated process skills (controlling variables, interpreting data, formulating a hypothesis, defining operational variables, and designing an experiment).

Regarding important elements in facilitating students' knowledge construction, the subjects explained how the teachers' competency played an important role in constructing students' knowledge. The MoEC (2012a) listed four components of teachers' competency (see

Table 5.1). Therefore, one way to assess teachers' competency is by viewing their skills in developing learning indicators to achieve learning objectives. According to Syarif (2015), learning indicators function as a guideline for teachers in developing teaching materials, designing learning activities, developing learning sources (such as textbooks, student worksheets, and media), and designing and conducting an assessment in the classroom. Thus, it was clear from the interview results that beside educational facilities, teacher's competence in students' ability to construct their own knowledge is also essential to consider. He/she also added that the balancing strategies of the biology materials and the choice of teaching method would also serve this purpose. In addition, a study by Sudarisman (2015) has found that some strategies to support the acquisition of teachers' competencies through the educational institution may include reinforcing pre-service biology teacher's knowledge in the nature and characteristics of biology learning and developing academic situations for prospective biology teachers in biology knowledge and skills as well the role of biology education in the future. At this point, teachers' knowledge development is needed to assist students in gaining information.

Table 5.1: Components of teachers' competencies

No	Subjects Teachers' Competencies
1	**Pedagogy**
	Knowing the students' characteristics
	Mastering the learning theories and learning principles and concepts
	Developing curriculum
	Developing students' potentials
	Maintaining good communication with students
	Assessing and evaluating
2	**Personalities**
	Behaving in accordance with religious, legal, social and cultural norms
	Modeling mature and exemplary personalities
	Possessing work ethics, responsibility, and pride as a teacher
3	**Social**
	Being inclusive, objective, and indiscriminative
	Maintaining excellent communication with colleagues, staff, students' parents, and communities
4	**Professionalism**
	Mastering the teaching materials, structures, concepts, and scientific mindset to support teaching
	Developing professionalism through reflective actions

Another essential factor that can be extracted from the interview results to help students in constructing their knowledge is “the condition of learning.” Learning condition is one of the curriculum elements that emphasizes learning tools or facilities to support the learning process. Teachers need learning tools to support learning activities even though it is not the only factor that supports effective teaching. Learning facilities can also reduce students’ difficulty in understanding abstract concepts in biology learning. The need for adequate facilities was highlighted in the interview by a teacher who pointed to students’ overreliance to the teachers as the sole learning resource when supports from learning media, laboratory equipment, and other sources are absent. This teacher’s thought is in harmony with the study finding in Atilla (2012) who discovered that the main reason as to why the students had difficulties in learning biology included teachers’ lack of teaching skill, the vast concept/information to learn, as well as the lack of time and resources (lesson time, laboratory work, and teaching equipment/material).

Another result of the data analysis was the list of teaching methods written by teachers through the open-ended response to the questionnaire (Table 4.11). From the result, I have grouped the teaching strategies listed into categories. There is no evidence to guarantee that teachers have applied those instructional strategies in their classrooms. Yet, one indication that I can observe was their enthusiasm to find information on the latest instructional methods to teach biology, especially those that require students to have learning experiences without the requirement of the laboratory during the data collection process. Teachers requested me to share my teaching experiences and possible non-laboratory inquiry-based biology learning activities. I was also invited to give a talk in teachers’ forum discussion on teaching methods required in the IBC 2013.

In brief, the Indonesian-Acehnese teachers preferred to use direct instruction methods and inquiry learning to teach biology content while still considering their pedagogy and professional competencies as well as the support of conducive learning conditions (especially learning tools or facilities) in teaching biology.

Practical Recommendations

The data of Table 4.10, all the teachers reported that they had used both teaching strategies in equal frequencies (direct instruction and inquiry) to teach all biology topics. From this study, I learned that all teachers have enough knowledge related the various teaching models that are including in direct instruction and inquiry approaches (as consequences of PD-related contextual instruction strategies given by the national education agency of Aceh province). Also, the reflection retrieved from the interview result, the real challenge was not about implementing various teaching instructions, but more to the content knowledge that teachers have and the learning conditions. Thus, the practical recommendation that I can suggest are:

- Although there were content/knowledge sharings in teachers meeting forum or from some professional development given by the National Education Bureau of Aceh province, each National Education Agency in each district has to regularly update content/teaching materials before a new semester started to make sure all biology teachers have the same competency of biology content.
- There is a need for each national education agency in each district to evaluate teachers' knowledge of the biology content mastery. Thus, the result will be effectively used as the source of information to upgrade their biology knowledge acquisition.
- The National Education Agency of Aceh province must provide adequate biology-supported teaching process for each school and should mandate all schools' manager/headmaster to hire a

professional laboratory assistant to manage the laboratory facilities and equipment. Besides, adequate skills in using and treating some teaching-supported equipment through professional development. The national agency should check that all teacher gets the same probability to involve in this PD because from the field note I have got, the school headmaster gets used to send the same person to participate in similar PD.

- Because there is circulation in headmaster position at a school for certain time, the National Education agency must confirm that all headmaster has similar policies and managing skills of the use of schools' facilities. Therefore, unnecessary prohibition to use teaching learning supported-facilities at schools could be avoided.

Areas for Further Study

To validate teachers' opinion towards the implementation of various instructional strategies, sets of lesson plan of several biology topics from Indonesia-Acehnese high school teachers from 23 districts can be collected and analyzed. Teacher's workbooks (called book 1 and book 2), that consist of administration documents (book 1) and instructional documents (book 2, which consist of the lesson plan, assessment, etc.) can also be assessed to get information about the teaching and learning process conducted in a classroom. Additionally, in-depth interviews about their struggles in conducting teaching and learning of biology content, especially the process stages in designing their lesson plan from indicators elaboration to the assessment process, will enrich the evidence for the future research.

Research Questions 5: What general perceptions are reported by these Indonesian-Acehnese teachers regarding the required biology assessment in the Indonesian curriculum 2013 document?

To review, the scope of assessment in IBC 2013 implementation consists of measuring learning outcomes in terms of attitude (social and spiritual skills), cognition (knowledge), and

affective/psychomotor (skills) domains in authentic ways. Syarif (2015) stated that each focus of assessment has its own assessment goals.

The assessment of attitude domains consists of the stages of acceptance, response, appreciation, awareness, and practical value. The instrument used to assess students attitudes includes checklists or rating scales with rubrics, which are calculated in the modus score, as well as the anecdotal record using teachers' journal. The result of the analysis of attitude domain assessment (see Table 4.12) showed that the biology teachers preferred to use self-assessment technique (using self-assessment sheet) for almost all biology materials (except the Mendel law topic) rather than observations and peer-observations. As stated in the IBC 2013, the observation assessment technique is usually used for experiment and discussion type of instructional methods, which, in my opinion, is suitable for learning the Mendel law.

On the other hand, self-assessment can be used as reinforcement in measuring their own learning progress. A self-assessment is usually conducted after students have learned a particular basic competency or finished a task. Also, to eliminate learners' bias and subjectivity in assessing themselves, self-assessment is conducted based on clear and objective criteria. The teachers' tendency of using this attitude type of assessment could be affected by the complex assessment required in the curriculum or by a shift in teaching trend that centered on students.

The results here were contrary to those of previous studies done by Natsir et al. (2018) and Retnawati et al. (2016). They maintained that that observation and the use of a journal gave a more straightforward and effective assessment in measuring students' attitude than other assessment techniques. Retnawati et al. (2016) also added that the observation technique is low-cost (less paper) and time-saving (less effort to design the instrument) technique.

Meanwhile, the objectives of assessment in the cognitive domain are to assess the ability to think and remember, understand, apply and analyze, and evaluate and create factual, conceptual, procedural, and metacognitive information. To assess students' knowledge (see Table 4.13), biology teachers preferred to use paper-based tests (57%-83%) and homework (42%-62%, which were created either by teachers themselves or from questions found in the textbooks) rather than oral test or portfolio. I assume that the tests and homework are simple and easy assessments to assess what students have learned from the abundant core materials required.

In accordance with the affective domain, the assessment objectives include measuring abstract skills (in the forms of learning abilities of observing, questioning, gathering information / attempting, reasoning / associating, communicating), and assessing the concrete skills (perceptual skills, readiness, mimic/guided response, mechanism, complex or overt response) from a natural movement (adaptation) into an original action. Besides, assessing students' skills through performance was preferred by most of the teachers to portfolio or projects assignment (Table 4.14). Although assessing students' skills through performance assessment is considered to be more appropriate, preparing the assessment rubric and determining the indicators can be challenging (Retnawati et al., 2016).

Furthermore, based on the open-ended response analysis (see Table 4.15), many teachers (approximately 128 responses came up on the survey instrument) also said that the required assessment is very complex and complicated, shifting their focus to teaching to understanding and to filling up the paper. At this point, I firmly agree with the teachers' opinions. There are vast quantities of assessment rubrics provided and required in the curriculum. However, nowadays, the National Education Bureau has reduced the assessment techniques required in the

curriculum as part of the evaluation progresses. Thus, each assessment rubric provided in the curriculum is followed by clear instruction and criteria in conducting the assessment.

The complexity of the assessment required was also supported in the studies conducted by Natsir et al. (2018) and Retnawati et al. (2016). In addition, Lumadi (2013) stated that the major challenges affecting teachers' classroom assessment included understanding the required policy, providing the assessment plan, implementing the assessment, using the various assessment methods, and allocating time for doing the assessment. Suyanto (2017) also found that because of teachers' unpreparedness to assess students in four aspects (knowledge, skill, social, and spiritual), 43.5% of the total number of teachers in this study still faced difficulties in understanding and implementing authentic assessment in their classrooms. Although there is no exact number to be reported concerning the unpreparedness of Acehnese teachers in applying the required assessment, the interview responses from them in this study reported having difficulties in understanding and using such complex assessment correctly as well as in customizing students' card report that keeps changing several times.

Practical Recommendations

Reflecting to the result Table 4.12, Table 4.13, and Table 4.14, the lowest selection of teachers' choices to assess students' attitude, knowledge, and skills are peer observation, portfolio, and giving projects respectively. The recommendation that I can suggest to the Aceh National Education Agency is to consider my qualitative analysis results in Table 4.15, especially to the most frequent response given by teachers related their view towards their problems in applying assessment required in the IBC 2013. Then, the Bureau can generate polices based on assessment requirement according to the students' conditions in the Aceh province. A workshop and professional development of creating instruments for assesment

should be conducted to design appropriate rubrics that are aligned with the competency standards and indicators of each topic taught. Professional development in test questions construction will also help teachers to apply proper assessment to the curriculum instead of their efforts on using assessment tools and test downloaded from the internet or taken from any biology textbooks.

Area for Further Study

Qualitative analysis of assessment documents created by teachers is allowed to gather extended information of the alignment on assessment designed to what is expected to be measured in the intended curriculum. Also, the use of non-parametric tests such as the *Mann–Whitney U* test or *Kruskal-Wallis* to examine the significant relationships between length of teaching experience and length of teaching experience using the IBC 2013 on the selection of assessment used to assess attitude, knowledge, and performance.

Research Question 6: How do Indonesian-Acehnese biology teachers integrate the required aspects of character education into biology instruction?

The implementation of character education at schools is not in the form of the specific subject but is inserted in the classroom and informal activities of a learning process at schools (Julaiha, 2014; Judiani, 2010). According to Badan Penelitian dan Pengembangan Pusat Kurikulum dan Pembukuan (Puskurbuk) (2011), the development of character education is influenced by two factors: nurture (environment) and nature (congenital/default). Thus, the aspects of character education include: (1) emotional and spiritual development, (2) intellectual development, (3) physical and kinesthetic development, and (4) affective and creativity development. In addition, the implementation process of character education in senior secondary school is conducted in three ways by the integration into subjects (instructional steps), integration through self-development activities (extracurricular activities), and integration

through local content or specific occasions. Teachers may also use other strategies to integrate character education at schools such as in routine habits, spontaneous habit, and modeling habit (Badan Penelitian dan Pengembangan Pusat Kurikulum dan Pembukuan, 2011).

Based on the result analysis (see Table 4.16), most of the character education required to be integrated into biology teaching and learning process has been assimilated by Acehnese teachers even though some characters, such as independence, democracy, nationalism, patriotism, appreciation of achievement and love of reading, were not mentioned. I believe that those unmentioned educational characters (moral values) have been explicitly implemented by students during their learning processes. To organize the types of integration of character education into lessons, I adopted the instructional steps of the 5Es model. At this point, my reasons for using these instructional steps include: (1) they consist of proper steps of instruction from opening to closing sessions, which help me arrange my information finding efficiently; (2) biology teachers in Aceh are familiar with 5E instructional model and frequently adopted it in their teaching because its application has produced significant impacts in science process skills (Karsli & Ayas, 2014; Purwanto, 2014; Nugraheni, 2012;), significant achievement on science academic results (Ajaja & Eravwoke, 2012; Açışlı et al., 2011; Cardak et al., 2008), substantial impact on science education, and good understanding of the nature of science (BSCS, 2016).

Julaiha (2014) has reported the following similar situation in the integration of character education into instructional stages: (1) at the opening activity, the character values were embedded. For instance, teachers coming to the class on time as a reflection of discipline, and praying before initiating the lessons as the value of religious; (2) during the main activities (exploration, elaboration, confirmation) the character values are integrated; for instance, teachers involve learners in looking for extensive and in-depth information on the topic studied as the

reflection of independence, logical thinking, creativity and cooperation (exploration); teachers familiarize students with reading, writing, and discussing tasks as the reflection of love of science, creativity, logical thinking, critical thinking, and mutual respect (elaboration); and teachers give positive feedback and reinforcement as the reflection of mutual respect, confidence, politeness, critical thinking, and logical thinking (confirmation); (3) at the closing activity, teachers and students collaboratively create conclusions as the reflection of independence, cooperation, as well as critical and logical thinking.

Furthermore, Yudianto (2011) explained the value of character education through biology science models for human learning, including togetherness and cooperation values through the analogy model of plant transportation system, and nationality value through the model of fruit development. Matchin (2014) also added that character integration in biology learning provides a meaningful experience for students because they understand, internalize and actualize the values through learning process. He also found that the application of a scientific approach and character integration have positively affected the cognitive, affective and psychomotor learning outcomes of more than 85% of all students who were involved in the instruction.

In brief, the Indonesian-Acehnese biology teachers have integrated character education not only through dividing teaching activities into several stages of instructional steps (inserted in core competency and basic competency) but also in the extracurricular activities at school. As an autonomous province characterized with Islamic Sharia, character education and moral values have been integrated indirectly long before they were required and mandated in the new curriculum.

Practical Recommendations

As the semi-autonomous and sharia-law province, the educator and policy makers (including the National Education agency and Experts from the Universities) should have considered to the integration of religious characters formally into schools. The National Education agency of Aceh province should collaborate with the Islamic Educational Affairs of Aceh province in providing contextual workshop of biology lesson plans design to be implemented in classroom.

Areas for Further Study

Asking teachers to provide descriptions (such as in an essay writing form) on how they have integrated educational values (for certain biology topics) in their instructional process will expand the qualitative analysis result in answering this research questions. In addition, a comparison study of the character education integration in biology subjects between two semi-autonomous provinces in Indonesia (Aceh province and Yogyakarta province) will expand the information on the probability of other aspects that may influence the character education integration process, such as cultural factor, specific customs, policy or the environment conditions.

Conclusion for Further Study Suggestions

The suggestion for future research related to the data analysis (perhaps for more than one research question) would be to use non-parametric tests, such as the Mann–Whitney U test or Kruskal-Wallis to examine the significance of the relationships between participant demographics and various outcomes. For example, more experienced teachers teach a certain topic more than novice teachers, etc.

Through direct observation of the real classroom, the more in-depth answer to the research questions could be provided. The classroom observation might provide a connection between teachers' perspective given in the questionnaire and their real classroom actions so possible synchronization of both (perception and action) could be highlighted. In addition, by interviewing peer teachers and school headmasters, I also could evaluate teachers' performance to enrich the triangulation methods in this research.

This research can also be expanded by interviewing people in charge from both national education bureau of Aceh province and the regional Education Quality Insurance Board as additional sources to obtain the whole pictures of curriculum implementation process in Aceh. In addition, analyzing teaching documents provided by teachers such as lesson plans will give detailed information on teachers' efforts in supporting the curriculum implementation. I also could see how teachers make significant changes to their teaching skills by looking into the previous lesson plan from the previous curriculum requirement.

Talking to students or knowing their perceptions about the teaching and learning process conducted by their biology teachers would provide suitable instructional methods that can be uniquely applied in Aceh, rather than in other provinces in Indonesia.

In the comparison of the intended curriculum on biology content, involving more countries in this study will enrich the information about an ideal curriculum for biology teaching. Also, it might be interesting to extend this research by observing the classroom application of the inquiry learning between science classroom in the United States and Aceh province.

Final Thoughts

This study acknowledges me on how to compare the similarities and differences between two different types of documents that run in the education system in developed (The United

States) and developing (Republic of Indonesia) countries. As an educator, from this study, I learned that both documents have provided satisfactory intended standards and intended curriculum content to support science teaching and learning process. Gathering information on biology teachers' perspectives about the implementation of the IBC 2013 as specific case findings for Aceh's province provide information to conduct another similar study across provinces in Indonesia.

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Appendix A1

Survey of Biology Content and Action of Biology Curriculum

Please complete this questionnaire below. All information in this questionnaire will be used for research and analysis purposes only as a part of Doctoral dissertation. No individual results will be provided to anyone but the researcher

Part I: Subject Background

Instruction: answer each question below by giving check mark (√) in appropriate column

Personal details

1. Age :

2. Gender : □ Male □ Female

3. Type of Senior Secondary School : □ Public □ Private

4. School Location: □ Rural □ Sub-Urban □ Urban

Educational background

1. What is the highest level of latest education you have completed?

□ Diploma (D3) □ Doctor (S3)

□ Bachelor (S1) □ Others, ……..

□ Master (S2)

2. Year of graduation from your highest level of education:

Biology teaching experience

1. Length of teaching experience:

□ < 1 year
□ 1- 5 years
□ 6 - 10 years
□ 11-15 years
□ > 15 years

2. Teaching experience with curriculum 2013:

□ < 1 month
□ 1- 5 months
□ 6-10 months
□ > 12 months

3. Teaching experience with the character integration aspect of the new curriculum:

□ < 1 month
□ 1- 5 months
□ 6-10 months
□ > 12 months

Part II: Biology Content

Instruction: Please use this scale below in order to answer the questions by giving check mark (√) in appropriate column according to you.

Topic covered is either the content is taught Y=Yes, N=No

Level of importance is how extent your belief to the topic to be taught to understand biology course NI=Not Importance, LI=Less Importance, N=Neutral, I=Importance, SI=Strongly Importance

No	Biology Topic	(A) Topic Covered		(B) Level of Importance					(C) Teaching Strategy (Tick all that are relevant)			(D) Assessment Strategies									
		Y	N	NI	LI	N	I	SI	Direct Instruction (lecturer)	Inquiry or Discovery (practical work)	After school experiences	Attitude			Knowledge				Skill		
												Observation sheets/ journal	Self assesment	Peer assesment	Written tewt	Oral test	homework	Potofolio	perfoemance	Portofolio	project
1.	Genetics materials and structure (DNA, protein)																				
2.	Hierarchical structure of multicellular organism: cell structure and function																				
3.	Structure and function of plant tissues																				
4.	Structure and function of animal tissues																				
5.	Specialized cells of multicellular organism and their functions: digestion																				
6.	Specialized cells of multicellular organism and their functions: circulation																				
7.	Specialized cells of multicellular organism and their functions: respiration																				

No	Biology Topic	(A) Topic Covered		(B) Level of Importance					(C) Teaching Strategy (Tick all that are relevant)			(D) Assessment Strategies									
		Y	N	NI	LI	N	I	SI	Direct Instruction (lecturer)	Inquiry or Discovery (practical work)	After school experiences	Attitude			Knowledge				Skill		
												Observation sheets/ journal	Self assesment	Peer assesment	Written tewt	Oral test	homework	Potofolio	perfoemance	Portofolio	project
8.	Specialized cells of multicellular organism and their functions: muscle																				
9.	Specialized cells of multicellular organism and their functions: excretion																				
10.	Specialized cells of multicellular organism and their functions: reproduction																				
11.	Specialized cells of multicellular organism and their functions: nerve system																				
12.	Growth and development of living things: basic concept																				
13.	Metabolism: Photosynthesis (process of energy transformation)																				

No	Biology Topic	(A) Topic Covered		(B) Level of Importance					(C) Teaching Strategy (Tick all that are relevant)			(D) Assessment Strategies									
		Y	N	NI	LI	N	I	SI	Direct Instruction (lecturer)	Inquiry or Discovery (practical work)	After school experiences	Attitude			Knowledge				Skill		
												Observation sheets/ journal	Self assesment	Peer assesment	Written tewt	Oral test	homework	Potofolio	perfoemance	Portofolio	project
14.	Metabolism: cellular respiration (aerobic-anaerobic)																				
15.	Metabolism: Enzymes																				
16.	Ecosystem: biodiversity																				
17.	Ecosystem: matter cycles and energy flows																				
18.	Ecosystem: component and interaction																				
19.	Ecosystem: changes of physical environment and waste recycle																				
20.	Morphology of plants and its function																				
21.	Cellular Division: mitosis and meiosis																				
22.	Mendel law																				
23.	Variation of traits: pattern of heredity, mutation, heredity in human																				

No	Biology Topic	(A) Topic Covered		(B) Level of Importance					(C) Teaching Strategy (Tick all that are relevant)			(D) Assessment Strategies									
		Y	N	NI	LI	N	I	SI	Direct Instruction (lecturer)	Inquiry or Discovery (practical work)	After school experiences	Attitude			Knowledge				Skill		
												Observation sheets/ journal	Self assesment	Peer assesment	Written tewt	Oral test	homework	Potofolio	perfoemance	Portofolio	project
24.	Natural selection and adaptation																				
25.	Darwin theory of evolution																				
26.	Feedback mechanism inside the living system: homeostasis																				
27.	Mendel Pattern and inheritance																				
28.	Basic concept of Biotechnology																				
29.	Immune system: mechanism																				
30.	Role and characteristics of Invertebrate and vertebrate																				
31.	Role and characteristics of Fungi																				
32.	Role and characteristics of Protista																				

No	Biology Topic	(A) Topic Covered		(B) Level of Importance					(C) Teaching Strategy (Tick all that are relevant)			(D) Assessment Strategies									
		Y	N	NI	LI	N	I	SI	Direct Instruction (lecturer)	Inquiry or Discovery (practical work)	After school experiences	Attitude			Knowledge				Skill		
												Observation sheets/ journal	Self assesment	Peer assesment	Written tewt	Oral test	homework	Potofolio	perfoemance	Portofolio	project
33.	Role and characteristics of Bacteria																				
34.	Role and characteristics of virus																				

Part III: Short Answer Questions

1. Do you use any different strategies (not mentioned above) to teach any biology topics? Please explain.

_____

_____

_____

_____

_____

2. How do you integrate the character education value in your teaching? Provide examples.

_____

_____

_____

_____

_____

_____

3. What do you think of the assessment that is required in the biology curriculum? Please explain your response.

_____

_____

_____

_____

_____

_____

THANK YOU FOR YOUR PARTICIPATION AND RESPONSES

Interview Questions

1. What essential element do you think should be present in your instruction or teaching practice (including assessment) to facilitate students' knowledge construction?
2. Do you use the 2006 KTSP biology curriculum or 2013 biology curriculum? What are the challenge/problem and opportunities that you face in the implementation of any of those curriculums?
3. What do you consider an ideal biology curriculum in terms of representative biology content?

Appendix A2

Angket Kurikulum 2013 Sekolah Menengah Atas dan Proses Belajar Mengajar Biologi

Lengkapi kuesioner di bawah ini. Semua informasi dalam kuesioner ini akan digunakan untuk tujuan penelitian dan dianalisis sebagai bagian dari disertasi. Infomasi perorangan dijamin kerahasiaanya dan hanya diketahui peneliti.

Bagian A: Latar Belakang Peserta

Instruksi: Isilah setiap pertanyaan di bawah dan beri tanda (√) dalam kolom yang sesuai.

Data Pribadi

1. Umur :
2. Jenis Kelamin : □ Laki-laki □ Perempuan
3. Jenis Sekolah : □ Negeri □ Swasta
4. Lokasi Sekolah : □ Desa □ Pinggiran Kota □ Kawasan Perkotaan

Data Pendidikan

1. Pendidikan terakhir

□ Sarjana (S1) □ Doktor (S3)

□ Magister (S2) □ Lainnya, ……

2. Tahun tamat pendidikan terakhir:

Pengalaman Mengajar

1. Sudah berapa lamakah anda membelajarkan mata pelajaran biologi?

□ < 1 tahun □ 11-15 tahun

□ 1- 5 tahun □ > 15 tahun

□ 6 - 10 tahun

2. Pengalaman membelajarkan siswa dengan kurikulum 2013:

□ Tidak pernah □ 6-10 bulan

□ < 1 bulan □ > 12 bulan

□ 1-5 bulan

3. Pengalaman membelajarkan siswa dengan meintegrasikan nilai karakter sesuai persyaratan dalam kurikulum:

□ Tidak pernah □ 6-10 bulan

□ < 1 bulan □ > 12 bulan

□ 1-5 bulan

Bagian II: Materi Pokok Biologi

Instruksi : Gunakan skala berikut ini untuk menjawab pertanyaan kolom A, B, C dan D dan beri tanda centang (√) untuk jawaban yang sesuai menurut anda.

(A) Apakah topik biologi ini diajarkan? Y=Ya, T=Tidak

(B) Tingkat kepentingan adalah sejauh mana anda yakin bahwa topik biologi tersebut penting diajarkan untuk memahami ilmu biologi: STP=Sangat Tidak Penting, TP=Tidak Penting, N=Netral, P=Penting, SP=Sangat Penting

No	Topik Biologi	(A) Topik Diajarkan		(B) Tingkat Kepentingan					(C) Strategi Belajar Mengajar (*Jawaban boleh lebih dari satu)			(D) Teknik Penilaian (*Jawaban boleh lebih dari satu)									
		Y	T	STP	TP	N	P	SP	Intruksi Langsung (ceramah)	Pembelajaran melalui penyelidikan/ proyek	Jam tambahan diluar kelas	Sikap			Pengetahuan				Keterampilan		
												Lembar observasi/Jurnal	Penilaian diri	Peniaian antar teman	Tes tertulis	Tes lisan	penugasan	portofolio	kinerja	portofolio	proyek
1.	Struktur dan materi genetik (DNA, protein)																				
2.	Struktur hirarkis organisme multiseluler: Struktur sel dan fungsi																				
3.	Struktur dan fungsi jaringan tumbuhan																				
4.	Struktur dan fungsi jaringan hewan																				
5.	Sel-sel khusus organisme multisel dan fungsinya: Sistem pencernaan																				
6.	Sel-sel khusus organisme multisel dan fungsinya: Sistem peredaran darah																				
7.	Sel-sel khusus organisme multisel dan fungsinya: sistem pernafasan																				
8.	Sel-sel khusus organisme multisel dan fungsinya: sistem gerak																				
9.	Sel-sel khusus organisme multisel dan fungsinya: sistem ekskresi																				
10.	Sel-sel khusus organisme multisel dan fungsinya: sistem reproduksi																				

No	Topik Biologi	(A) Topik Diajarkan		(B) Tingkat Kepentingan					(C) Strategi Belajar Mengajar (*Jawaban boleh lebih dari satu)			(D) Teknik Penilaian (*Jawaban boleh lebih dari satu)									
		Y	T	STP	TP	N	P	SP	Intruksi Langsung (ceramah)	Pembelajaran melalui penyelidikan/ proyek	Jam tambahan diluar kelas	Sikap			Pengetahuan				Keterampilan		
												Lembar observasi/Jurnal	Penilaian diri	Peniaian antar teman	Tes tertulis	Tes lisan	penugasan	portofolio	kinerja	portofolio	proyek
11.	Sel-sel khusus organisme multisel dan fungsinya: sistem syaraf																				
12.	Pertumbuhan dan perkembangan makhluk hidup: Konsep dasar																				
13.	Metabolisme: Fotosintesis (proses perubahan energi)																				
14.	Metabolisme: respirasi sel (aerob dan anaerob)																				
15.	Metabolisme: Enzim																				
16.	Ekosistem: Biodiversitas																				
17.	Ekosistem: Siklus materi dan aliran energi																				
18.	Ekosistem: komponen dan interaksi																				
19.	Ekosistem: Perubahan iklim/lingungan dan daur ulang limbah																				
20.	Tumbuhan: ciri-ciri morfologis dan peranannya																				
21.	Pembelahan sel: Mitosis and meiosis																				
22.	Hukum Mendel																				

No	Topik Biologi	(A) Topik Diajarkan		(B) Tingkat Kepentingan					(C) Strategi Belajar Mengajar (*Jawaban boleh lebih dari satu)			(D) Teknik Penilaian (*Jawaban boleh lebih dari satu)									
		Y	T	STP	TP	N	P	SP	Intruksi Langsung (ceramah)	Pembelajaran melalui penyelidikan/ proyek	Jam tambahan diluar kelas	Sikap			Pengetahuan				Keterampilan		
												Lembar observasi/Jurnal	Penilaian diri	Peniaian antar teman	Tes tertulis	Tes lisan	penugasan	portofolio	kinerja	portofolio	proyek
23.	Variasi pewarisan sifat: pola-pola hereditas, mutasi, hereditas pada manusia																				
24.	Adaptasi dan seleksi alami																				
25.	Teori evolusi Darwin																				
26.	Homeostasis																				
27.	Pola Mendel dan pewarisan sifat																				
28.	Konsep dasar bioteknologi																				
29.	Sistem pertahanan tubuh																				
30.	Ciri dan karakteristik serta peranan avertebrata dan vertebrata																				
31.	Ciri dan karakteristik serta peranan jamur																				
32.	Ciri dan karakteristik serta peranan Protista																				
33.	Ciri dan karakteristik serta peranan bakteri																				
34.	Ciri dan karakteristik serta peranan virus																				

Bagian III: Jawaban Singkat

1. Apakah anda menggunakan strategi pembelajaran lainnya (selain yang disebutkan diatas) dalam proses kegiatan pembelajaran mata pelajaran biologi? Jelaskan.

2. Bagaimana anda menintegrasikan nilai nilai karakter dalam proses belajar mengajar mata pelajaran biologi? Berikan contoh.

3. Bagaimana pendapat anda tentang sistem penilaian dalam pembelajaran mata pelajaran biologi seperti yang disyaratkan dalam kurikulum 2013? Jelaskan pendapat anda.

Terima Kasih Atas Partisipasi dan Jawaban Anda

Kerjasama Anda Sangat Kami Hargai

Appendix B

Official Letters from Local Education Agency of Aceh

PEMERINTAH ACEH
DINAS PENDIDIKAN
Jalan Tgk. H. Mohd Daud Beureueh Nomor 22 Banda Aceh Kode Pos 23121
Telepon (0651) 22620, Faks (0651) 32386
Website : disdik.acehprov.go.id, Email : disdik@acehprov.go.id

Banda Aceh, 05 Agustus 2016

Nomor : 071 /D.1/ 1993 /2016
Sifat : Biasa
Lampiran : -
Hal : Rekomendasi / Izin Penelitian

Yang Terhormat,
Wakil Dekan I
Fakultas Keguruan dan
Ilmu Pendidikan, Unsyiah
di-
Tempat

Sehubungan dengan surat Wakil Dekan I Fakultas Keguruan dan Ilmu Pendidikan Universitas Syiah Kuala tanggal 17 Mei 2016 hal Mohon Bantuan dan Izin Melakukan Observasi/Penelitian berjudul *"Teacher' Opinions And Teaching Practices On The 2013 Biology Curriculum"* atas nama Saudari Wiwit Artika, S.Si, M.Ed (NIP. 19820610 200912 2 006), maka untuk maksud tersebut kami sampaikan beberapa hal berikut :

1. Kami memberikan izin penelitian untuk mengumpulkan data pada beberapa sekolah di Provinsi Aceh.
2. Mengingat kegiatan ini akan melibatkan para guru, diharapkan agar dalam pelaksanaannya tidak mengganggu proses belajar mengajar.
3. Demi kelancaran kegiatan tersebut, hendaknya berkoordinasi terlebih dahulu dengan Kepala Dinas Pendidikan Kabupaten/Kota dan Kepala Sekolah yang bersangkutan.

Demikian kami sampaikan, atas kerjasamanya kami haturkan terimakasih.

Banda Aceh, 05 Agustus 2016
KEPALA DINAS PENDIDIKAN,

PEMERINTAH ACEH DINAS PENDIDIKAN

Drs. NASRUN, MM
PEMBINA TK. I
NIP. 19670801 199303 1 003

ND Nomor: 800/A.2/1880/2016 tanggal 01 Agustus 2016

Appendix C

Approval IRB Protocol

UNIVERSITY OF ARKANSAS

Office of Research Compliance
Institutional Review Board

June 21, 2016

MEMORANDUM

TO:	Wiwit Artika William McComas
FROM:	Ro Windwalker IRB Coordinator
RE:	New Protocol Approval
IRB Protocol #:	16-06-791
Protocol Title:	*Secondary Biology Instruction in the General Senior Secondary Schools of Aceh Province of Indonesia: Analysis of Teachers' Opinions and Teaching Practices Related to the 2013 Biology Curriculum*
Review Type:	☒ EXEMPT ☐ EXPEDITED ☐ FULL IRB
Approved Project Period:	Start Date: 06/21/2016 Expiration Date: 06/20/2017

Your protocol has been approved by the IRB. Protocols are approved for a maximum period of one year. If you wish to continue the project past the approved project period (see above), you must submit a request, using the form *Continuing Review for IRB Approved Projects*, prior to the expiration date. This form is available from the IRB Coordinator or on the Research Compliance website (https://vpred.uark.edu/units/rscp/index.php). As a courtesy, you will be sent a reminder two months in advance of that date. However, failure to receive a reminder does not negate your obligation to make the request in sufficient time for review and approval. Federal regulations prohibit retroactive approval of continuation. Failure to receive approval to continue the project prior to the expiration date will result in Termination of the protocol approval. The IRB Coordinator can give you guidance on submission times.

This protocol has been approved for 300 participants. If you wish to make *any* modifications in the approved protocol, including enrolling more than this number, you must seek approval *prior to* implementing those changes. All modifications should be requested in writing (email is acceptable) and must provide sufficient detail to assess the impact of the change.

If you have questions or need any assistance from the IRB, please contact me at 109 MLKG Building, 5-2208, or irb@uark.edu.

Appendix D1
Informed Consent Survey

Secondary Biology Instruction in the General Senior Secondary Schools of Aceh Province Indonesia: Analysis of Teachers' Opinions and Teaching Practices Related to the 2013 Biology Curriculum

Dear Biology Teacher,

You are invited to participate in a study entitled "Secondary Biology Instruction in the General Senior Secondary Schools of Aceh Province Indonesia: Analysis of Teachers' Opinions and Teaching Practices Related to the 2013 Biology Curriculum". The goals of the research are to better understand (1) Indonesian teachers' general perceptions of the importance of the required biology topics; (2) teaching strategies that teachers use to teach the biology topics and integrate character education in their teaching; and (3) teachers' general opinion of the biology assessment required in the curriculum; and (1) the differences and similarities between Indonesia biology curriculum 2013 and the corresponding life science framework of NGSS. You were selected as a possible participant in this study because this study will involve 278 of 1,154 biology teachers from 436 high school (public and private) in 23 Aceh districts that are selected randomly.

If you decide to participate, please complete the enclosed questionnaire. Your return of this survey is implied consent. It will take about 20 minutes to complete the questionnaire. No benefits accrue to you for answering the questionnaire, but your responses will be used to assist the curriculum implementation unit of Aceh Province (the National Education Bureau and the Education Quality Insurance Institute) in monitoring the 2013 curriculum implementation with a particular focus on the Biology curriculum. Any discomfort or inconvenience to you derives only from the amount of time taken to complete the questionnaire. In addition to the survey, you might be also selected and asked to complete an interview.

Your decision whether or not to participate will not prejudice your future relationships with College of Education and Health Professions at the University of Arkansas. If you decide to participate, you are free to discontinue participation at any time without prejudice.

Any information that is obtained in connection with this study and that can be identified with you will be kept confidential to the extent allowed by law and University policy and maintained for three years past the completion of the study.

If you have questions or concerns about this study, you may contact William F. McComas, PhD at (479) 575-7525 or by e-mail at mccomas@uark.edu. For questions or concerns about your rights as a research participant, please contact Ro Windwalker, the University's IRB Coordinator, at (479) 575-2208 or by e-mail at irb@uark.edu.

Thank you for your willingness to participate in this study.

IRB #16-06-791
Approved: 06/21/2016
Expires: 06/20/2017

Appendix D2

Informed Consent Interview

Secondary Biology Instruction in the General Senior Secondary Schools of Aceh Province Indonesia: Analysis of Teachers' Opinions and Teaching Practices Related to the 2013 Biology Curriculum

Dear Biology Teacher,

You are invited to participate in a study entitled "Secondary Biology Instruction in the General Senior Secondary Schools of Aceh Province Indonesia: Analysis of Teachers' Opinions and Teaching Practices Related to the 2013 Biology Curriculum". The goals of the research are to better understand (1) Indonesian teachers' general perceptions of the importance of the required biology topics; (2) teaching strategies that teachers use to teach the biology topics and integrate character education in their teaching; and (3) teachers' general opinion of the biology assessment required in the curriculum; and (1) the differences and similarities between Indonesia biology curriculum 2013 and the corresponding life science framework of NGSS. You were selected as a possible participant in this study because this study will involve 10 of 278 biology teachers from 436 high school (public and private) in 23 Aceh districts that are selected randomly.

If you decide to participate, during the interview, you will be asked three questions and it will be audio-taped. Your willing to answer the questions is implied consent of interview. It will take about 45 to 60 minutes to complete the interview. No benefits accrue to you for answering the questions in the interview, but your responses will be used to assist the curriculum implementation unit of Aceh Province (the National Education Bureau and the Education Quality Insurance Institute) in monitoring the 2013 curriculum implementation with a particular focus on the Biology curriculum. Any discomfort or inconvenience to you derives only from the amount of time taken to answer the questions of interview.

Your decision whether or not to participate will not prejudice your future relationships with College of Education and Health Professions at the University of Arkansas. If you decide to participate, you are free to discontinue participation at any time without prejudice.

Any information that is obtained in connection with this study and that can be identified with you will be kept confidential to the extent allowed by law and University policy and maintained for three years past the completion of the study.

If you have questions or concerns about this study, you may contact William F. McComas, PhD at (479) 575-7525 or by e-mail at mccomas@uark.edu. For questions or concerns about your rights as a research participant, please contact Ro Windwalker, the University's IRB Coordinator, at (479) 575-2208 or by e-mail at irb@uark.edu.

Thank you for your willingness to participate in this study.

Appendix E1

English Transcripts of Interview

Transcription code: Transcript 001

Notes: Q: Interviewer; A: Responder

1 Q: What are the most important elements which should have been included in the teaching and learning process where it can enable students to construct their knowledge?

A: I think skill is critical because students will understand better when they do and observe, not when they only listen.

Q: In biology course curriculum, the elements are teaching and learning process, assessment, teaching material, content, learning condition, competitions and their rules. So, in your opinion, are there any other elements essential for constructivism?

A: The very important elements for instruction are facilities and teachers' competence. We should create balance or strategies between personal and materials as well as the method implemented. In short, the elements of man and facilities/infrastructure should be present.

Q: So, they are strategies used by teachers, how teachers utilize facilities and their competence in teaching, then.

A: Yes. Information is also essential.

2 Q: At the school where you work, has the Curriculum 2013 been implemented? What are the challenges or opportunities faced by the school?

A: Actually, there are many weaknesses, strengths, challenges, and opportunities at the school. The first weakness in a private school is a financial problem, but it can be

covered by operational cost. Another weakness lies in teacher training because not all teachers are given an opportunity to participate in training. However, teachers who took part in training can share with other teachers by hosting a local training at the school. The challenge for teachers is that they have to implement education program established by the government through the implementation of Curriculum 2013.

Q: What about the opportunities?

A: Actually, there is a chance given by Curriculum 2013, such as authentic assessment which represents cognitive aspect, affective and skill aspects. The evaluation system offered by Curriculum 2013 very details. Regarding knowledge, there is a written test, spoken test, clear assignment with assessment criteria. The instrument and rubrics to be used, description and how to calculate grades can be written on the assessment sheet, so that the assessment is objective and precise. The same principle also applies to attitude, and there are many aspects to access. The students are not only graded by their teachers but also by their classmates, although this creates some bias. For example, when asking students whether they have prayed, and they answered, "Not yet," we can grade students as honest because they admit that they have not prayed.

Q: Do the teachers have problems in implementing the curriculum regardless of clear guidelines?

A: The workload has indeed piled up, but professional teachers will use the assessment elements as best as they could during the teaching and learning process until they realize that they do not have enough time to complete the task. So, of course, less competent teachers will be loaded. However, with technology, the work can be

simplified. Therefore, teachers have to be familiarized with the use of a computer, which is a new challenge for them. Some certification pay can be used to improve their competence, such as for computer training for those who are computer illiterate, or for other competence and skill improvement. Actually, the program is excellent.

3 Q: My last question is what criteria does an ideal curriculum need to have for biology course? Every teacher should have an expectation regarding the curriculum considered an ideal curriculum. What do you consider in deciding if a curriculum for biology course is ideal?

A: In my opinion, concerning economy, the curriculum needs to integrate entrepreneurship. This means that the students are not only taught to understand the materials but also to have entrepreneurial skills so that they can apply their knowledge.

Q: For biology course, how do we select materials which are related to entrepreneurship?

A: At least students can use biological knowledge in their life through business. What I always dream about is a local feature-based curriculum as a secondary curriculum in addition to the national curriculum. For example, for schools in coastal areas, they have the curriculum related to marine so that the students have required knowledge and not less-informed. The local curriculum is adjusted to the environment condition where the school is located, with local custom integration so that the local custom is well-maintained.

Q: So, you mean that secondary biology curriculum is related to local tradition where the students are learning, and the topic is made more detail. For example, in coastal areas, materials related to marine biota are given more focus. It's interesting!

A: Yes, that’s right. So, the local custom is taught in detail. It is local content curriculum which is based on the local feature. The national curriculum should also accommodate the local curriculum.

Q: Is there anything else you would like to add regarding our curriculum, especially for biology course?

A: For biology, the materials are already very complex. The problem now is that we need to change our focus to the application. Furthermore, I hope that the government provides more training and competency test for teachers so that we do not mislead our students. We do not have reading culture, unlike other people, training and competence test can motivate us to improve our knowledge, especially about biology.

Transcription code: Transcript_2

Notes: Q: Interviewer; A: Responder

1 Q: There are some elements in the curriculum. I found in the literature that those elements are assessment, students, learning condition, content, learning objective, material, topic, and teaching and learning process. In your opinion, what essential elements should have been included in the teaching and learning process to facilitate constructivism? I mean... what factors support knowledge construction?

A: I think it is the process, if it is a good process, such as when proper media are involved. In Curriculum 2013, a good process also includes assessment. If the evaluation is not suitable, a material is not well-delivered either.

Q: So, if the process meets the requirement and the assessment is suitable, student knowledge will be well-constructed. What I mean by *to construct* is to develop knowledge.

A: Yes. Indeed.

2 Q: In implementing Curriculum 2013, what do you think the challenges and opportunities are?

A: The challenge is the complicated assessment. Not all teachers are able to use the evaluation correctly because the items are abundant and complex.

Q: I heard that some components of assessment in Curriculum 2013 have been reduced?

A: After the revision, some items in assessment have been taken away such as peer assessment, self-assessment, and indicators for core competence 1 and 2 for all subjects except religion and civic education, and this makes the assessment easier.

Q: What opportunities does Curriculum 2013 offer for students compared to previous curricula?

A: Curriculum 2013 are clearer targets compared to previous ones.

Q: Does this opportunity only apply to students, or both teachers and students?

A: For teachers as well. Teachers are given clear guidelines so that the students can learn better when taught.

Q: That brings us to the last question, because I only have three questions.

A: (laugh)

3 Q: In your opinion, how should an ideal biology curriculum look like? What should be considered in deciding that a biology curriculum is an ideal one, especially regarding core topics because there are many topics in biology?

A: For Curriculum 2013, right?

Q: No. It is in more general sense. Every teacher has her own criteria of an ideal curriculum. Can you consider the curriculum designed by the government as an ideal curriculum? Or what is an ideal curriculum for you?

A: In my opinion, an ideal curriculum, especially for a biology course, is the curriculum designed by experts in biology, with more lab work or observation. Students should be given many labs works in a biology course. If possible, it is the biology teachers who should design the curriculum, so more lab work can be included.

Q: I heard that the Minister has not established a biology department, but biology is in the science department. I personally do not know the department sections it has. Maybe it is science in general, perhaps it is a combination of physics, chemistry, etc. There is, of course, no separate department for biology. In curriculum 2013, one of

the steps is inquiry. I think lab work is one of the activities in inquiry. So, lab work is not a problem but…

A: Yes, but we need more of it.

Q: Yes, not enough or its implementation has not been supported by...

A: I mean like simple media, meaning that each material for science class presented to the students should be learned through inquiry.

Q: That suggests that we need to be supported by facilities and infrastructure. Teachers have a guideline on implementing inquiry, but it does not have detail instruction for every topic. The guideline only addresses the definition of inquiry, like, with some examples.

A: Yes, it is still very general too.

Transcription code: Transcript_3

Notes: Q: Interviewer; A: Responder

1 Q: Based on the literature that I read, also from the curriculum, there are some elements in the curriculum, that is students, assessment, competence, learning condition, and context. In our curriculum, there are objective of a biology course, materials/topics and contents, also assessment. In your opinion, what element is essential in teaching and learning process for students to be able to construct their knowledge in biology?

A: The most important element for knowledge construction is the first indicator for each material we teach so that it leads teachers to achieve the objective of teaching. Second, because the government asks teachers to meet the goals of teaching with suggested teaching models, they should have provided examples of the models so that teachers are not confused in implementing the models. The revised version of the curriculum has permitted teachers to apply any models they think fit, maybe because it was found that the models suggested are confusing for teachers. Teachers are now being provided with information regarding the revision in Curriculum 2013. I hope that the teachers are also provided with an example of teaching models so that teachers can apply recommended teaching models. Also, more attention should be paid to material review for teachers because the materials the teachers need to teach are completely different to what we learned in college, as a result of development in science. Unfortunately, teachers have not fully learned new materials, maybe because of lack of training.

Q: In short, the government should have improved teachers' competence, which covers material and examples of teaching models. Indeed, the writers sometimes think that

all teachers know how to apply teaching models without studying the real phenomena at schools.

A: Yes, that's true.

2 Q: You are currently using Curriculum 2013, aren't you? What do you think are the challenges in implementing Curriculum 2013, or what are the problems?

A: Actually, Curriculum 2013 makes it easier for teachers to implement teaching and learning process where teachers are no longer the center of the process. In my opinion, students should be motivated to discuss materials so that they can work together. This will make them learn more. Teachers should be creative in using various techniques to avoid boredom. In any subjects, the students are expected to discuss, to construct knowledge. Therefore, teachers need to know many teaching models so that the discussions are not boring for the students. So, the model should not be over-repeated.

Q: Yes, indeed.

A: So, the challenge I face is that I have to learn more teaching models to be implemented in the classroom.

Q: What's about opportunities provided by the curriculum in teaching biology? For example, the chances for students to understand the material taught according to Curriculum 2013 compared to previous curricula.

A: Actually, the opportunity offered for students by Curriculum 2013 is greater because it encourages students to acquire knowledge by active participation. However, we as teachers should have been given more training on teaching methodology.

Q: Such as how to make the class active? Although it is student-centered, teachers should still be given training.

A: Yes. The teaching and learning process is student-centered, but still, teachers are trained teaching models which are applicable to teaching so that the process can make students more active. Actually, curriculum 2013 support biology course because we use the laboratory for inquiry, where students can construct their knowledge. However, not all required lab equipment is available. It is a challenge for teachers who want to facilitate students to conduct an experiment, but the equipment is not available.

Q: Yes. Actually, I was asked by my professor about the condition of school laboratories in Indonesia and about the support from the government. I told **him** that when I was in high school, I used lab only once or twice. Curriculum 2013 implement inquiry approach. Adequate lab facilities will support this approach, to make students motivated. I do not know the real condition of the laboratory at schools. Some teachers also reported that the laboratory in their schools are accessible because they are locked by the school principal.

A: Maybe because the school does not have any laboratory assistant, or maybe the equipment is not adequate so that we cannot conduct any experiment. Actually, Curriculum 2013 is very suitable for biology course because we can motivate students to acquire the knowledge themselves.

3 Q: What do you consider as an ideal biology curriculum for teaching materials in biology?

A: Are they the topics for biology subject which have been set by the government, or what do you mean?

Q: The topics which are already in the curriculum.

A: The materials in the syllabus are very good for the students to study them from concrete to abstract concepts. For me, they are great, but the only problem is the implementation because of limited lab facilities.

Q: So, you believe that biology curriculum is already ideal. In the US, teachers are allowed to choose whether a material is to be taught or skipped for some reasons. I do not know for sure though. If they consider a material is not worth teaching, they leave it out. Are there any such materials in our curriculum?

A: Maybe *Hierarchical Organisation* in Grade X.

Q: I don't know to be honest. Will it be taught to all students? If it is an introduction, students will understand it easier.

A: *Hierarchical Organisation* has been discussed in the first grade of secondary school. Maybe because there are a lot of topics in biology, when they are asked about the material, they do not remember it. I think *Hierarchical Organisation* does not need to be taught in high school.

Q: Yes. You are right.

A: On the other hand, *Classification* is very brief in the syllabus. It is even included in the *Hierarchical Organisation*. In my opinion, *Classification* should be taught separately because this topic is very important. This topic is very limited in Curriculum 2013.

Q: Yes. I have ever conducted research to find out why students score for Classification was very low, and I discovered that the material requires students to remember many things.

A: Yes, *Hierarchical Organisation* is not very relevant. However, sometimes teachers who graduated from Teacher Training and Education Faculty at Syiah Kuala University did not learn enough about Classification, so they did not teach students thoroughly.

Transcription code: Transcript_4

Notes: Q: Interviewer; A: Responder

1 Q: You previously completed my questionnaire. May I ask you three more questions?

A: Certainly.

Q: First of all, do you know what elements are in a curriculum?

A: Syllabus, right?

Q: Based on the literature, the elements in a curriculum covers teaching and learning process, assessment, and learning condition, learning objectives, teaching material, context, classroom condition, etc. In your opinion, what elements are essential so that students can construct their knowledge?

A: Facilities and infrastructure.

Q: Why are they important?

A: In a rural area, facilities and infrastructure are very limited, such as laboratory, which not all schools here have although it is very important.

Q: How important is a laboratory for teaching and learning process in a biology class.

A: If we have a laboratory with complete equipment, most likely about 80% of the teaching and learning process has been covered. Most schools here have a laboratory, but it is an integrated laboratory for science subjects, with limited equipment.

Q: Have you ever taught a class outside the classroom without using a laboratory?

A: I have had an outdoor class, but not all materials can be taught as such. Some materials can be taught without a laboratory equipment, but others cannot.

2 Q: My second question is, do you teach based on Curriculum 2013 or 2006 at the school?

A: I use both. The school where I teach uses Curriculum 2013 by initiative. Some other schools have been instructed to use Curriculum 2013.

Q: Are they target schools?

A: Yes. There are three target schools in Bener Meriah district, others are not. At the school I teach, Curriculum 2013 is used for first grade, and Curriculum 2006 is used for the second and third grade.

Q: I see. That's fine because my research is about biology. My professor asked me to choose one curriculum, the newest one, with a consideration that all schools implement it, or will implement it. What is the challenge you faced in implementing Curriculum 2013 and 2006?

A: The challenge is that I have not fully understood the curriculum because the lack of training, and the training given to teachers are not comprehensive. Selection for training at the provincial level is made by a team in the province, while teams in district level select subjects in district level. However, the same teachers are always selected, so not all teachers have given a chance to attend the training.

Q: I see. It maybe will be more well-distributed if the Department of Education selected the subjects. What is the challenge of using Curriculum 2013 in the classroom?

A: It's not hard actually, but easier instead. It is just not well-understood. Evaluation is quite complicated.

Q: But affective category in assessment has been simplified, revised right?

A: I believe so, but we have not received any training about the revised curriculum.

Q: So you still use previous assessment system?

A: Yes.

Q: Is there any opportunity for the school to perform better with Curriculum 2013?

A: If it is well-implemented, Curriculum 2013 is better than the school-based curriculum. In terms of material, there have not been many changes between the school-based curriculum and Curriculum 2013 except Curriculum 2013 has more a systematic system. So, if it is implemented, the teaching and learning process is better, but a better understanding of the curriculum is required.

Q: So, we can conclude that there is a lack of teaching professional development.

A: Yes. Teachers desperately need training.

3 Q: In your opinion, don't worry, I do not record your identity. In your opinion, what is an ideal curriculum for biology, especially in terms of teaching material? Do you think our curriculum is ideal, with all material to be taught? Is there any material we should leave, or what do you think?

A: I think Curriculum 2013 is an excellent curriculum, but it can be improved because there are some materials which are very brief but very important at the same time. But students at public senior high schools will complain if the materials are taught extensively.

Q: That’s true because the curriculum for public senior high schools, Islamic senior high schools, and vocational schools is similar. I will compare the curriculum in the US and that in Indonesia because the US curriculum covers materials in detail but not too many materials are taught. Do you think our students are capable of learning all materials in biology subject?

A: That's what I told you. At the senior high school level, what materials we should teach and which ones are important need more attention.

Q: So, you believe that Curriculum 2013 can be considered an ideal curriculum? I mean, will the students learn enough material in Biology?

A: Yes. I think the materials in syllabus have covered what our students need to learn.

Transcription code: Transcript_5

Notes: Q: Interviewer; A: Responder

1 Q: Previously, you have completed my questionnaire. You answered the question about the topics which you considered important and those you considered not necessary. I mentioned about assessment, teaching and learning strategies, and topics in biology. In your opinion, which important element do we need to have in teaching and learning process in order to facilitate knowledge construction? Is it assessment, material, or learning resource?

A: The most important element is learning resource, teaching methodology, and teaching media. For learning resource, teachers may explain the material to the students but if they do not have learning resource, they will rely on teachers who become the primary resource. If they have books as their learning resource, they will learn from the books in addition to teaching staff. After that, visual aids such as torso is important for me.

Q: I see. It is like supporting media, right?

A: Yes, as supporting media and they are crucial. The school where I teach is located between Lhokseumawe City and North Aceh, so most students are from this area. Most of them come from middle to lower-class families, so we cannot expect them to have their own course book. The school provides about 25 books but they cannot be checked out, so they do not read the book to prepare themselves for the class, but they only read it during the class.

Q: Is that because the books are not enough for all students, so they have to share with peers?

A: Yes, they cannot take the books home, so materials from teachers, learning resources, and media are vital.

2 Q: Have you implemented Curriculum 2006 or Curriculum 2013 so far?

A: We have been using Curriculum 2013 for three years.

Q: What are challenges in implementing Curriculum 2013?

A: The challenge is that the students some from less fortunate families, so it is challenging to implement Curriculum 2013. Curriculum 2013 motivates students to obtain knowledge themselves, but teachers are still the source of knowledge because students do not have books to read. For example, when teachers assign group work and find materials from the internet, students do not have internet access because internet café or wifi are not available in the area. Only one or two students have access to the internet.

Q: Are internet access not available in coffee shops either?

A: No. Only one or two students have a notebook computer which belongs to their sister, with wifi, and that's it. So, it is very difficult for teachers to upgrade students critical thinking.

Q: Yes. Books for biology based on Curriculum 2013 can be downloaded, but maybe they can't effort to print the book?

A: That's what happen. There is no internet café around. It is only accessible in the city, but it is too far from their area. Another challenge is related to assessment, i.e. students grade report, which keeps changing every semester, making teacher confused.

Q: Is the report presented in a piece of paper or in a book?

A: Student's scores are inserted into a software, which produces final scores for the report, which can later be printed. But, the format keeps changing.

Q: So that is the challenge, making teacher's job pile up. What is the positive effect of using Curriculum 2013?

A: There are many positive effects of Curriculum 2013 but because the implementation in our school is limited, it is not perfect.

Q: So, there are many challenges, although it is a good curriculum.

A: Yes. Actually, this curriculum is very good, to improve their character.

Q: What character have you been integrating at the school?

A: What I have implemented was praying at the beginning of the lesson, which develops students' religious character, submitting assignments on time to develop discipline, and making students listen and respect opinions of others in a discussion.

Q: What's about when you are teaching a certain topic. Have you integrated a character into a lesson?

A: Yes. I do it for all lessons.

Q: Do you mean that Curriculum 2013 develops characters as a whole? Is it not only the characters related to this knowledge?

A: Not. It develops character as a whole. For examples, students attend the class on time or submit an assignment. These develop the students' character.

3 Q: Yes, yes. The third question is how should an ideal curriculum look like? Maybe you have an expectation about an ideal curriculum for biology.

A: Curriculum 2013 is an excellent curriculum, the materials are more organized, the syllabus has been provided by the government, teachers only need to develop it,

teaching tools can be supported by teaching method. The assessment is also very good. There is an assessment for affective, cognitive, and psychomotor. Generally, everything is great. Fortunately, the assessment in Curriculum 2013 has been revised, where assessment for the affective domain has been simplified. Previously we had to make an assessment for individual students, which took too much time.

Q: Yes, that's right.

A: But now the assessment for the affective domain is more intensive, intended to specified target students. Only students who have problems with the affective domain are assessed.

Q: What's about biology materials in the syllabus? Do you think there are too many materials to teach?

A: Actually, there are a lot of materials to teach, such as in grade XI. There are many sub-topics in "System" in the second semester so that I do not have time left for other materials. I sometimes gave students assignment to cover those materials, because there are many sub-topics to teach.

Q: So, is it like when we were at the university?

A: Yes. It is like material in college. In the grade XII, we can still cover all the materials although there are also many materials to teach, but those in the grade XI are just too extensive, such as materials about the digestive system. There are too many materials, let alone for students who do not have their own course book. We have to teach the step by step, little by little until they understand them because they do not have reading materials at home and thus rely much on teachers.

Q: So, it is a bit challenging, isn't it? We cannot use the time wisely.

A: Yes, we cannot use the time efficiently.

Q: After reading my questionnaire, do you have any suggestion?

A: I hope your research will be successful.

Transcription code: Transcript_6

Notes: Q: Interviewer; A: Responder

1 Q: My first question is, what are important elements which can help construct students' knowledge?

A: They are media and teaching aid. Previously, there was a confusion about which curriculum to use, whether it was School-Based Curriculum or Curriculum 2013. Because our school is a small school, we decided to use School-based Curriculum, but we refer to Curriculum 2013 for teaching method. For biology, it needs media and teaching aid. Fortunately, the school has been provided with teaching aid by Education Department. However, the laboratory does not meet the standard requirement. Many microscopes provided by Education Department did not work when we tested them. In short, curriculum, media, and visual aid are very important.

2 Q: Then, you still use Curriculum 2006 but you refer to Curriculum 2013 for teaching method. In your opinion, what are challenges and opportunities you experienced when you used these curricula?

A: The problem in teaching and learning by using Curriculum 2013 for biology is that the objectives are difficult to achieve because in this curriculum the students are encouraged to study in groups. They are facilitated to study independently to discuss, complete exercises, write papers, and summarize the materials. However, the time is not enough to achieve all purposes.

Q: In terms of its bright side of Curriculum 2013, what is the prospect of Curriculum 2013?

A: It is more responsive because it utilizes teaching aid which helps students retain information better. In addition, the teaching methods it offers are dissimilar to student Active Student Learning Method, where the teachers write the materials on the backboard. Students cannot easily understand the material by using this method, but they can if methods offered by Curriculum 2013 is implemented. For example, a teacher draws an example of an animal cell and plant cell with their organelles. The teacher does not provide labels for each organelle, but the students know that the pictures are cells. So, the students can respond faster to the material if the teacher refers to Curriculum 2013 in teaching a material. The only problem is inadequate time, which has to be very well-organized to complete all the materials.

Q: So, do you agree if important materials are taught in detail while less significant ones are left out at the senior high school level? Or what do you think?

A: Regarding materials to be left out at the senior high school level, I believe we should teach from K1, i.e. introducing students that this is the creation of the God. For example, for plan reproduction theory, before the human is involved in the reproduction, teachers explain that animals involved in the process, such as birds. However, it is more modern now. It is the human who helps plan reproduction. Teachers invite students to listen to an interesting explanation. Teachers should not open a book and explain materials in the book. They should make students interested in biology. Indeed, students have to like all subjects, not just biology. Teachers can also administer a pretest and posttest to find out the success of teaching and learning process. Maybe students can only retain information for a short period of time and will forget it soon.

3 Q: For the third question, perhaps as a biology teacher you have an expectation about the ideal curriculum for biology. What do you consider as ideal for biology curriculum, especially about materials to be taught?

A: The ideal curriculum for biology needs to cover more simplified materials. The basic competence for flora and fauna should be simplified, not too bias. We should teach simpler flora and fauna first. Sometimes, the syllabus is fine, until (…minute 7:50) third grade. The materials are perfectly organized, but there is room for simplicity.

Q: Do you mean that the scope of materials is simplified because it will be taught again at the university?

A: Yes, to simplify the materials. In Islam, everything is made simple, such as Quran and Hadeeth. So, just simplify them.

Q: That's all I have for you. Do you have any suggestion for me?

A: My advice to the Faculty of Teacher Training and Education, related parties, or Aceh Government is that they provide more skill training for teachers, not only about teacher forum or Curriculum 2013 but also about the use of lab equipment because not all biology teachers are graduates of Faculty of Teacher Training and Education.

Appendix E2

Indonesian Transcripts of Interview

Kode Transkrip: Transcript_1

Catatan: P: Penanya; J: Responden

1 P : Jelaskan elemen penting yang menurut Ibu seharusnya ada dalam proses belajar mengajar yang dapat mengonstruksi pengetahuan siswa

J : Menurut saya yang paling penting itu adalah keterampilan karena dengan keterampilan itu daya anak untuk menyerap ilmu lebih kuat karena dengan melihat dan melakukan bukan hanya mendengar saja.

P : Terus kalau dikurikulum biologi elemen itu termasuk proses *teaching and learning, assessment,* ada teaching material, konten, kondisi belajar, ada kompetensinya dan aturan-aturannya. Jadi menurut ibu elemen apa lain yang penting untuk mengonstruksi pengetahuan siswa?

J : Yang sangat mendukung instruksi dalam mengajar adalah sarana dan juga kompetensi yang dimiliki oleh pendidik. Harus ada keseimbangan/strategi antara personal dengan material yang diajarkan dan juga metode yang digunakan. Jadi, ada unsure man dan sarana/prasarana

P : Berarti strategi guru, bagaimana menggunakan sarana dan kompetensi dia dalam mengajar.

J : Iya. Selain itu, informasi juga dianggap sangat penting.

2 P : Disekolah Ibu sudah menggunakan kurikulum 2013, kira-kira apa tantangan dan atau peluangnya?

J : Sebenarnya banyak kelemahan, kekuatan, tantangan, dan peluang yang dihadapi di sekolah. Kekurangan/ kelemahan utama pada sekolah mandiri adalah dukungan finansial yang harus disubsidi oleh pihak sekolah, namun ini tidak menjadi kendala karena kekurangan dana dapat ditutupi dengan dana operasional. Kekurangan lainnya adalah dari segi pelatihan karena tidak semua guru dipanggil untuk mengikuti pelatihan. Kekurangan dari segi pelatihan ini dapat diminimalisir karena jika ada delegasi guru yang diundang untuk mnegikuti pelatihan kemudian merE dapat menjadi penyambung informasi dari tempat pelatihan kepada guru lainnya yang tidak mengikuti pelatihan. Jadi, tantangan kedepan adalah otomatis guru harus menghadapi program oleh pemerintah sehingga kami di sekolah harus mengambil peluang penggunaan kurikulum 2013 tersebut.

P : Terus jika dilihat dari sisi peluangnya bu?

J : Sebenarnya, ada peluang yang bagus dari kurikulum 2013, misalnya dari segi penilaian yang otentik yang mewakili aspek pengetahuan, aspek sikap, dan aspek keterampilan. Sistem penilaian yang diberikan pada kurikulum 2013 sangat detil. Jika ditelaah dari segi pengetahuan berupa adanya penilaian tes tulis, penilaian lisan, penugasan yang jelas dan ada kriteria-kriteria yang dinilai. Kemudian instrumen dan rubrik apa yang digunakan, deskripsi, serta bagaimana cara menghitung penilaian tersebut yang dapat dimasukkan kedalam lembar penilaian sehingga penilaiannya bersifat obyektif bukan subyektif dan sangat jelas. Begitu juga dengan sikap, banyak aspek yang dinilai. Penilaian siswa tidak hanya dilakukan oleh guru tetapi juga oleh siswa itu sendiri atau sesama teman meskipun mugnkin agak bias. Misalnya ketika ditanyakan kepada siswa apakah sudah shalat kemudian siswa menjawab “Tidak bu”

dari segi jujur ia sudah jujur, mengakui tidak shalat, nah dari situ bisa dinilai aspek jujurnya.

P : Guru-guru sendiri merasa kesulitan atau tidak? Meskipun pedoman yang diberikan sudah jelas ya.

J : Memang beban kerja bertambah, namun seorang guru yang professional akan menggunakan elemen penilaian sebaik mungkin sehingga ketika proses belajar mengajar di sekolah akan digunakan waktu yang optimal untuk menilai siswa sehingga guru tersebut merasa tidak cukup waktu untuk menyelesaikan tugas tersebut. Otomatis untuk guru yang kurang professional akan merasa terbebani. Tetapi dengan bantuan IT beban tadi tergampangkan hanya saja apakah si guru bisa memanfaatkan aplikasi IT tersebut. Otomatis SDM guru harus ditingkatkan dari segi misalnya penggunaan komputer, dsb yang juga menjadi tantangan baru. Sehingga dana sertifikasi yang sebagai tunjangan untuk peningkatan kompetensi guru digunakan untuk meningkatkan kapasitas diri guru, misalnya untuk guru yang belum mampu menggunakan computer akan menggunakan tunjangan tersebut untuk kursus computer atau untuk meningkatkan sumber daya dirinya. Sebenarnya bagus sEli programnya.

3 P : Pertanyaan terakhir adalah apa pertimbangan Ibu E terhadap kurikulum yang ideal dalam hal materi pokok biologi. Setiap orang memiliki gambaran tentang kurikulum yang ideal jadi apa yang memnjadi pertimbangan ibu tentang suatu kurikulum biologi yang ideal?

J : Kurikulum ideal yang ada dipikiran saya jika kita kaitkan dengan segi ekonomi adalah adanya integrasi kurikulum dengan kewirausahaan. Artinya anak tidak hanya dibEli dengan materi tetapi dia juga memiliki jiwa entrepreneur sehingga muncul implementasi ilmu.

P : Berarti untuk materi biologi itu bagaimana materi biologi yang dipilih tapi berhubungan juga dengan kewirausahaan seperti itu ya. Setidaknya anak dapat memanfaatkan materi biologi yang telah didapat untuk menyambung kehidupannya melalui usaha. Kemudian yang saya impikan adanya kurikulum yang berbasis keunggulan lokal, bisa jadi setiap sekolah disamping memiliki kurikulum nasional juga memiliki kurikulum sekunder yang berbasis keunggulan lokal. Misalnya sekolah dibagian pesisir sebaiknya memiliki kurikulum mengenai kemaritiman atau sebagainya sehingga anak-anak memiliki bEl dan tidak keurangan informasi. Kurikulum lokal disesuaikan dengan kondisi lingkungan ditempat sekolah itu berada dengan menyisipkan kearifan lokal sehingga anak-anak juga bisa menjaga kearifan lokal daerah setempat.

P : Jadi artinya begini, kalau kurikulum biologi sekunder itu menyangkut kearifanan lokal dimana siswa belajar maka topic itu diberikan secara lebih mendalam. Misalnya jika didaerah pesisir maka mengenai biota laut lebih banyak atau ekologi lautnya. Menarik sekali ide Ibu.

J : Iya, benar. Jadi, sebaiknya kurikulum kearifan lokal ini lebih mendalam ketika diajarkan. Adanya kurikulum muatan lokal yang berbasis keunggulan lokal. Kurikulum nasional tetapi juga mengakomodir lokal tempat kurikulum itu berpijak.

P : Kemudian Bu E, kira-kira ada lagi tidak yang ingin Ibu sampaikan tentang kurikulum kita khususnya untuk materi Biologi?

J : Untuk materi biologi sebenarnya sudah kompleks bu, hanya sErang permasalahannya arahnya/sifatnya itu maunya lebih keterapan. Selanjutnya, yang menjadi harapan saya adalah pemerintah banyak melakukan pelatihan dan adanya uji kompetensi guru jangan sampai apa yang diajarkan untuk siswa adalah sesuatu yang salah/keliru. Karena budaya kita malas membaca tidak sama dengan orang asing. Tetapi dengan adanya pelatihan yang sering dan uji kompetensi guru dapat memacu semangat guru untuk pengingkatan ilmu biologi khususnya.

Kode Transkrip: Transcript_2

Catatan: P: Penanya; J: Responden

1 P : Di kurikulum itu ada beberapa elemen, dari bahan bacaan Saya dapat elemen-elemen kurilukum itu seperti penilaian, siswa, kondisi belajar, konten, tujuan pembelajaran biologi, materi dan topic, proses belajar mengajar. Kalau Kak Jumiati sendiri maksudnya elemen penting apa yang seharusnya ada dalam proses mengajar dalam memfasilitasi mengonstruksi pengetahuan siswa? Maksudnya faktor apa yang men-support pembentukan pengetahuan siswa?

J : Sepertinya proses, jika prosesnya bagus seperti penggunaan media yang tepat. Kalau prosesnya bagus kalau di kurikulum 2013 juga termasuk penilaian didalamnya. Terhadap materi A jika penilaiannya tidak sesuai maka tidak tereliminasi dengan bagus juga.

P : Jadi, jika prosesnya bagus dan penilaian yang bagus mampu mengkonstruksi pengetahuan siswa. Maksudnya mengonstruksi itu kita membantu siswa membentuk pengetahuannya.

J : Iya, betul.

2 P : Kira-kira dalam melaksanakan kurikulum 2013 ini apa tantangan dan peluangnya?

J : Tantangan yang dihadapi ialah penilaian yang rumit. Tidak semua guru mampu melaksanakan penilaian dengan tepat karena itemnya banyak dan ribet.

P : Katanya ada juga sudah direduksi/ dikurangi untuk peniliaan dalam kurlikulum 2013?

J : Setelah adanya kurikulum revisi beberapa item penilaian memang sudah dikurangi misalnya penilaian antar teman, penilaian diri, KI 1 dan KI 2 indikator untuk semua

pelajar sudah tidak ada lagi kecuali agama dan PKN dan itu sudah lebih mudah setelah dikurangi.

P : Terus misalnya seperti peluang, misalnya peluang siswa belajar menggunakan kurikulum ini dibandingkan dengan kurikulum sebelumnya bagaimana kira-kira?

J : Peluang pada kurikulum 2013 adalah lebih terarah jika dibandingkan dengan kurikulum sebelumnya.

P : Peluang ini hanya untuk siswa atau untuk kedua-duanya, untuk guru dan siswa?

J : Untuk guru juga. Guru memiliki pedoman dan petunjuk yang jelas sehingga siswa lebih gampang ketika menerima apa yang diajarkan.

3 P : Ini soal terakhir, Cuma tiga pertanyaan soalnya

J : (tertawa)

P : Menurut Ibu pribadi kurikulum biologi yang ideal itu seperti apa? kemudian apa yang menjadi pertimbangan dalam kurikulum ideal itu sendiri, terutama dalam materi pokok karenakan materi kita banyak seperti itu.

J : Ini khusus untuk kurikulum 2013 ya?

P : Gak, maksudnya secara general. Setiap guru kan mungkin punya mimpi sendiri tentang kurikulum yang ideal itu seperti apa. Apakah yang di desain oleh pemerintah itu sudah ideal atau bagaimana?

J : Kurikulum yang ideal menurut saya khusus untuk biologi baiknya yang mendesain kurikulumnya adalah orang-orang biologi dan praktikumnya atau observasi lebih diperbanyak. Siswa kan kalau belajar biologi harus lebih banyak praktikum. Kalau diizinkan yang menyusun kurikulum itu guru biologi itu sednirj dan diperbanyak praktikumnya.

P : Saya dengar kita di Kementerian belum ada sub bidang biologi penyusunan biologi. Tapikan mungkin ada orang-orang IPA. Saya juga gak tahu struktur yang jelasnya hanya yang pernah Saya baca seperti itu. Mungkin sains secara general, mugnkin saja digabung fisika, kimia, dan sebagainya. Belum ada memang departemen khusus biologi orang-orang biologi sendiri. Kemudian di kurikulum 2013 disyaratkan dilaksanakan secara inquiri, menurut Saya laboratorium itu termasuk salah satu yang inquiri. Mungkin itu sudah ada tapi …. (terputus)

J : Iya, tetapi masih kurang.

P : iya kurang. atau dalam pelaksanaannya belum dilengkapi.

J : Maksudnya gini, misalnya media-media sederhana. Artinya setiap materi yang mau diperoleh siswa sepertinya lebih baik didapatkan melalui proses inquiri jika untuk materi sains.

P : Berarti mungkin yang kita butuhkan dukungan sarana dan prasarana. Guru-guru sudah ada pedoman untuk melaksanakan inquiri namun belum terlalu detail untuk setiap topik ya. Hanya dijelaskan apa itu inquiri, sebagaimana, dan beberapa contoh.

J : Iya, masih umum juga.

Kode Transkrip: Transcript_3

Catatan: P: Penanya; J: Responden

1 P : Menurut literature yang saya baca dan juga dokumen kurikulum kita ada beberapa elemen kurikulum seperti siswa, penilaian, kompetensi, kondisi pembelajaran, konteks. Kalau dikurikulum kita ada beberapa seperti tujuan pembelajaran biologi, materi/topik dan isi, peneilaian juga. kalau menurut Ibu sebenarnya elemen mana yang penting dlm proses belajar mengajar yang dapat membentuk/mengonstruksi pengetahuan biologi siswa?

J : Elemen yang paling penting untuk mengkonstruksi pengetahuan siswa yang pertama harus ada indikator untuk materi yang diajarkan sehingga dapat membimbing guru untuk mencapai tujuan pembelajaran. Kedua, sebaiknya pemerintah ketika meminta guru mencapai tujuan pembelajaran dengan berbagai model yang disarankan sebaiknya juga disertakan contoh-contoh model yang dibuat sehingga guru tidak meraba-raba ketika menggunakan model tersebut. Memang revisi kurikulum 2013 sudah membolehkan guru memakai model apa saja, mungkin karena dilapangan didapat guru yang kebingungngan menggunakan model yang ditentukan sehingga sekarang boleh menggunakan model apa saja. Sementara sekarang guru banyak diberikan pengetahuan tentang pembaharuan kurikulum 2013 alangkah baiknya jika guru juga diberikan contoh pemakaian model-model tersebut sehingga guru bisa mengimplementasikan model yang dianjurkan. Kemudian juga lebih sering untuk memberikan perhatian terhadap pendalaman materi oleh guru-guru karena materi yang harus diajarkan sekarang berbeda jauh dari materi yang guru dapatkan saat kuliah dahulu sedangkan materi sekarang sangat luar biasa perkembangan ilmu

pengetahuan. Mirisnya, sekarang guru kurang menguasai perkembangan ilmu tersebut. Hal ini mungkin karena kurangnya diberikan pelatihan terhadap guru.

P : Intinya pemerintah seharusnya dalam pengembangan profesionalisme guru itu mencakup banyak hal termasuk materi, contoh penerapan model pembelajaran. Iya memang kadang-kadang penulis menganggap semua guru paham, tahu cara penggunaan model yang ia tuliskan tanpa melihat kondisi ril di lapangan.

J : Iya, benar.

2 P : Kemudian Ibu sudah menggunakan kurikulum 2013 kan, kira-kira tantangannya apa dalam menggunakan kurikulum 2013 atau apa masalah-masalahnya?

J : Sebenarnya kurikulum 2013 memberi kemudahan kepada guru didalam proses pembelajaran yang mana guru tidak lagi menjadi sentral pembelajaran. Tetapi didalam pelaksanaannya menurut saya pribadi didalam pengelolaan kelas itu anak dalam keadaan diskusi terus menerus karena memang dituntut anak untuk bisa bekerjasama dsb jaid banyak sekali proses pembelajaran dilakukan secara diskusi dan disitu guru harus cerdas untuk menggunakan berbagai tehnik agar anak tidak bosan. Semua pelajaran anak dituntut untuk berdiskusi, mengonstruksi sendiri pengetahuannya oleh sebab itu, kelemahannya menurut pengalaman Saya pribadi Saya harus memiliki banyak trik/ model belajar sehingga ketika melakukan diskusi tidak membosankan siswa. Jadi tidak model itu-itu saja yang dipakai.

P : Iya, betul.

J : Jadi tantangan bagi Saya adalah saya harus lebih banyak mencari model-model pembelajaran yang akan dilaksanakan didalam kelas.

P : Menurut Ibu kira-kira peluang dalam proses belajar mengajar biologi itu seperti apa? Misalnya peluang siswa untuk memahami biologi itu seperti apa dengan kurilukum 2013 ini apakah lebih bagus dari kurikulum sebelumnya?

J : Sebenarnya peluang yang ditawarkan kurikulum 2013 untuk anak lebih bagus karena anak yang aktif untuk memperoleh pengetahuan sendiri. Tetapi itu kami guru harusnya lebih banyak dilatih untuk memperoleh cara-cara pembelajaran.

P : Seperti bagaimana membuat pembelajaran itu lebih aktif ya? *Student centre* tetapi guru tetap diberikan bekal.

J : Iya, Jadi proses pembelajarannya tetap student center tetapi guru tetap diberi pengatahuan unutuk memperoleh cara-cara atau model-model pembelajaran baru dalam melaksanakan materi didalam suatu pemebalajarn sehingga dapat membuat suasana belajar lebih aktif. Sebenarnya kurikulum 2013 ini mendukung pelajar biologi karena kita menggunakan laboratorium yang membutuhkan model inkuiri yang mana anak dapat mengonstruksi sendiri pengetahuannya di lab. Tetapi sayangnya lab disekolah tidak semua alat bahan tersedia, misalnya jika ingin melakukan percobaan ternyata alat atau bahannya tidak ada sehingga hal ini menjadi kendala bagi guru.

P : Iya, sebenarnya ini pernah menjadi pertanyan oleh professor Saya, bagaimana kalau di Indonesia itu kondisi laboratoriumnya itu seperti apa? dukungan sekolah/ pemerintahnya? Saya jawab dulu waktu saya SMA Saya masuk laboratorium itu cuma seklai/ dua kali. Sedangkan pada kurikulum 2013 ini diterapka inquiri, mungkin salah satu yang paling mudah itu adalah punya fasilitas lab yang bagus dan mereka sangat tertarik. Saya juga belum ytau kondisi yang sebenarnya seperti apa

tapi ada juga guru yang bilang bahaw disekolah mereka ada lab tapi tidak bisa masuk karena lab nya selalu dikunci kepsek.

J : Mungkin juga karena tidak ada laboran. Atau mungkin labnya ada tapi bahannya tidak ada. Sehingga ketika ingin melakukan suatu pembelajaran tidak ada bahannya. Padahal pembelajaran biologi itu paling cocok untuk k13 diterapkan, kita menggurung anak untuk mendapat pengetahuan sendiri.

3 P : Kemudian menurut Ibu kira-kita apa yang menjadi pertimbangan Ibu tentang kurikulum biologi yang ideal dalam materi pokok pembelajaran biologi itu?

J : Untuk materi pokok yang sudah diberikan oleh pemerintah atau bagaimana bu?

P : Yang sekarang sudah ada dalam kurikulum itu.

J : materi pokok materi-materi yang diterapkan didalam silabus saya rasa cocok, sudah pas bagi anak-anak untuk mendapatkan uraian yang konkrit sampai yang abstrak. Bagi Saya ini sudah cocok dan oke hanya saja pelaksanaannya sedikit terbatas karena terkait ketersediaan alat maupun bahan di laboratoirum yang minim.

P : Berarti menurut Ibu kurikulum biologi itu sudah ideal lah ya. Kalau di Amerika guru itu bisa memilih materi apa saja yang ingin diajarkan atau tidak, mungkin karena beberapa factor tapi saya kurang tahu smeua juga mungkin ada karena tidak menguasai materi tersebut, ada yang memang menurut merek tidak penting untuk apa diajarkan. Jadi ada gak kondisi seperti ini menurut Ibu?

J : Mungkin kalau materi dikelas X seperti organisasi kehidupan.

P : Makanya saya tidak tahu, dengan asusmsi itu akan diajarkan untuk semua siswa? Namanyakan pendahuluan, siswa pasti akan memahami.

J : Organisasi kehidupan, itukan sebenarnya dari kelas VII smp sudah diajarkan tapi mungkin karena siswa kita terlalu banyak pelajaran jadi ketika ditanyakan lagi mengenai materi tersebut mereka sudah lupa/ tidak terekam lagi diingatan mereka. Saya pikir organisasi kehidupan itu sebenarnya tidak perlu diajarkan.

P : Iya, betul betul.

J : Sebaliknya materi Klasifikasi sangat sedikit diulas didalam silabusnya, malahan klasifikasi itu ikut nebang di Organisasi. Padahal, menurut saya, klasifikasi itu harusnya dibahas sendiri karena materi tersebut penting. Materi kalsifikasi sangat kurang sekali dibahas di K13.

P : Iya, memang pernah Saya buat penelitian kenapa di ujian nasoinal itu siswa banyak berniali rendah dimateri klasifikasi ternyata guru-guru bilang terlalu banyak hafalan dan terlalu banyak yang harus siswa ingat.

J : Iya, sebenarnya materi Organisasi itu ga penting-penitng sekali. Tetapi terkadang mungkin guru-guru lulusan FKIP kurang mendapatkan/ mendalami ilmu tentang klasifikasi sehingga guru-guru ketika mengajar tidak diajarkan secara mendalam kepada siswa.

Kode Transkrip: Transcript_4

Catatan: P: Penanya; J: Responden

1 P : Sebelumnya kan Ibu sudah pernah mengisi angket Saya. Ini ada tiga pertanyaan lagi untuk wawancaranya.

J : Iya

P : Yang pertama, Ibu tahu gak elemen-elemen dalam kurikulum?

J : Silabus ya?

P : Elemen kurikulum itu kalau menurut literature misalnya pembelajar, peneilaian, kondisi pembelajaran. Nah kalau dikurikulum itu ada tujuan pembelajaran biologi, teaching material dan konteks, kondisi kelas, dan lain-lain. Jadi pertanyaan Saya kira-kira menurut Leni elemen apa yang seharusnya ada didalam praktik belajar mengajar dalam mengonstruksi pengetahuan siswa?

J : Sarana dan prasarana.

P : Kira-kira kenapa sarana dan prasarana?

J : Jika di desa sarana dan prasarana sangat minim, contohnya laboratorium, tidak semua sekolah disini memiliki lab biologi sementara lab menjadi sangat penting untuk menunjang materi.

P : KIra-kira seberapa besar laboratorium di tempat ibu dapat mendukung proses belajar mengajar biologi?

J : Jika lab ada dan bahannya juga lengkap kemungkinan besar sekitar 80% dapat mendukung proses belajar mengajar. Rata-rata sekolah disini memiliki lab tetapi masih digabung yaitu laboratorium IPA dan juga bahan yang tersedia masih sangat terbatas.

P : terus pernah tidak Ibu melakukan kegiatan seperti belajar di luar ruangan yang bisa kita desain sendiri tanpa menggunakan lab?

J : Untuk belajar outdoor memang pernah dilakukan, tapi kan tidak semua materi bisa dikondisikan di luar ruangan. Ada beberapa materi yang bisa dikondisikan tanpa bantuan alat laboratorium yang ada disekolah tetapi bebarapa lalinnyakan tidak.

2 P : Pertanyaan yang kedua, Saat ini Ibu menggunakan kurikulum 2013 atau 2006 di sekolah?

J : Gabung, Sekolah tempat saya mengajar menggunakan k13 mandiri, ada sekolah yang k13 memang sudah ditetapkan oleh pemerintah.

P : Yang sudah menjadi sekolah sasaran gitu ya?

J : Iya. Jadi dikabupaten Bener Meriah ada tiga sekolah yang k13 menjadi sasarnnya, sebagian lagi itu sekolah mandiri. Artinya kelas X menggunakan kurikulum 2013 sedangkan untuk kelas XI dan XII masih menggunakan KTSP.

P : O seperti itu ya, tapi tidak apa-apa juga karena penelitian ini tentang topic biologinya yang ingin diketahui. Memang professor Saya suru pilih satu kurikulum saja dan yang terbaru dengan anggapan semua sekolah mengimplementasikan atau kearah mengimplementasikan seperti itu. Nah kira-kira apa tantangan yang eprnah Leni temui dalam pelaksanaan kurikulum 2013 itu dan 2006?

J : Tantangan saya dapati adalah masih mengambang/ kurang paham mengenai kurikulum itu sendiri karena pelatihan yang diberikan masih kurang dan pelatihan yang diberikan kepada guru tidak cukup menunjang K13. Jadi pada saat pemanggilan pelatihan ditingkat provinsi ditentukan oleh tim di provinsi sedangkan ditingkat

kabupaten ditentukan oleh tim kabupaten guru mana yang dikirm untuk pelatihan dan biasanya guru yang itu-itu saja jadi tidak merata kesemua guru.

P : Ooo tidak merata. kecuali mungkin dinas yang panggil secara acak mungkin lebih merata ya. terus kalau tantangan dikelas apa yang sulit dari kurikulum 2013 ketika diajarkan?

J : Sulit sih tidak malah lebih gampang sebenarnya dengan K13 Cuma pemahamannya saja yang kurang. Memang dievaluasi yang agak sedikit ribet.

P : Tapi katanya sekarang penilaian kategori sikap sudah dikurangi ya? sudah direvisi gitu.

J : Memang kurikulum 2013 sudah direvisi smentara disekolah kami belum ada pelatihan mengenai revisi tersebut.

P : Jadi sampai saat ini masih terpaku system evaluasi yang awal.

J : Iya.

P : Kira-kira menurut Leni peluang untuk sekolah itu bisa tidak menjadi lebih baik dengan menggunakan kurikulum 2013?

J : Jika diterapkan sebenarmya kurikulum 2013 lebih baik jika dibandingkan dengan KTSP. Jika dilihat dari segi materi memang tidak banyak perubahan antara KTSP dengan K13 hanya sistimnya saja yang lebih sistematis. Jadi kalau diterapkan lebih bagus sebenarnya tetapi harus ada pemahaman dari gurunya terlebih dahulu.

P: Dalam hal ini dapat disimpulkan bahwa ada kurangnya pengembangan professional guru.

J : Iya, untuk guru sangat dibutuhkan pelatihan-pelatihan lah.

3 P : Kemudian secara pribadi saja ini karena sya pun tidak mencatumkan identitas. Kira-kira menurut Leni pribadi apa yang menjadi pertimbangan tentang kurikulum biologi yang ideal dalam hal materi pokok. Apakah kurikulum kita ini sudah ideal dengan semua materi pokok yang harus diajarkan atau bagaimana? harus ada yang dikurangi atau bagaimana?

J : Menurut Saya kurikulum 2013 sudah bagus tetapi lebih baik lagi jika lebih dikembangkan karena ada materi-materi yang hanya sepintas lalu diajarkan dan sementara menurut saya materi itu penting. Tapi kalau setingkat SMA diajarkan ada yang complain juga.

P : Betul, karena kurikulumnya sama ya antara SMA, MA, SMK. Terus kalau misalnya kurikulum materi itu penting semua. Yan anti saya akan membandingkan kurikulum Amerika dengan kurikulum Indonesia maksudnya secara sekilas Amerika itu mengkover secara lebih detail tetapi tidak lebih banyak sedangkan menurut Leni apakah siswa kita sanggup menerima semua materi biologi?

J : Itulah yang Leni bilang tadi Kak. JIka tingkat SMA seberapa sih materi yang seharusnya diterima oleh siswa, terus materi yang penting apa-apa saja itu harus menjadi perhatian.

P : Jadi menurut Leni sudah ideal lah ya kurikulum 2013 kita? istilahnya sudah cukup bekal siswa mengetahui pengetahuan biologi?

J : Iya, menurut saya untuk saat ini materi yang ada disilabus sudah cukup menjadi bekal bagi siswa.

Kode Transkrip: Transcript_5

Catatan: P: Penanya; J: Responden

1 P : Sebelumnya ibu Y sudah pernah mengisi kuesioner yang Saya berikan ya, disitu kan ada pertanyaan mengenai topic biologi yang penting dan mana yang tidak penting. Disitu ada dilihat penilaian, strategi belajar mengajar, dan juga topic biologi. Nah menurut Ibu Y elemen penting apa yang harus ada dalam praktik mengajar untuk memefasilitasi pembentukan pengetahuan siswa. Apakah penilaian, materi, sumber bacaan/ bahan gitu?

J : Elemen yang paling penting adalah sumber bacaan, metode pembelajaran, alat-alat pendukung pembelajaran. Untuk sumber bacaan, mislanya guru menjelaskan ke anak-aank tetapi mereka tidak memiliki buku bacaan jadinya mereka bergantung kepada guru, guru menjadi sumber utama. Tetapi jika siswa juga memiliki buku bacaan selain mereka dapat ilmu dari guru mereka juga dapat ilmu dari buku. Kemudian alat pembelajaran misalnya torso itu penting bagi saya.

P : Oo seperti media pendukung gitu ya?

J : ya, sebagai media pendukung dan itu penting. Sekolah tempat saya mengajar berada diperbatasan antara kota lhokseumawe dengan aceh utara, jadi anak-anak sebagian besar berasal dari daerah perbatasan aceh utara. Dari segi ekonomi memang siswa-siwa tersebut terbatas jadi disekolah jika kita mengharapkan pengadaan buku dari mereka pribadi memang tidak mampu jadi semuanya bergantung pada sekolah. Disekolah memang ada disediakan buku misalnya 25 buku tetapi untuk digunakan satu meja satu buku. Jadi, anak-anak tidak menggunakan buku tersebut untuk dibaca

dirumah sehingga mereka tidak mempersiapkan diri ketika sebelum masuk kelas dan baru dibaca saat masuk dengan guru dikelas.

P : Itu karena tidak bisa dibagi satu buku untuk setiap siswa ya jadinya kongsi dua?

J : Iya, dan bukunya tidak bisa dibawa pulang kerumah. Jadi itu elemen yang paling penting, materi dari guru, sumber, dan alat pendukung.

2 P : Trus selama ini ibu Y sudah menggunakan kurikulum 2006 KTSP atau kurikulum 2013?

J : Kami sudah tiga tahun mneggunakan kurikulum 2013.

P : Jadi menurut Y apa tantangan dalam mengimplementasikan kurikulum 2013 ini?

J : Tantangannya karena siswanya mengalami keterbatasan ekonomi jadi guru agak susah untuk mengimplementasikan kurikulum 2013 ini. Kurikulum 2013 mendorong agar siswa mendapatkan sendiri ilmu sedangkan kenyataan dengan permasalahan yang ada guru menjadi sumber ilmu karena sumber bacaan tidak ada. Misalnya diberikan tugas kelompok yang mana sumbernya dicari dari internet tetapi siswa-siswa ini tidak bisa karena didaerah mereka tidak ada warnet atau wifi, hanya ada satu dua siswa yang memiliki fasilitas internet.

p : Di warung kopi juga tidak ada fasilitas internet ya?

J : Tidak ada. Cuma satu dua siswa yang ada laptop punya kakaknya dan punya wifi, ya Cuma seperti itu. Jadi sangat susah bagi guru untuk memajukan pemikiran siswa.

P : Iya padahal kalau buku biologi di kurikulum 2013 bisa di download tapi mungkin bellum ada biaya untuk ngeprint.

J : Ya gitulah, ga ada warnet. Adanya di kota, kalau ke kota jauh. Tantangan selanjutnya adalah penilaian, yaitu rapor siswa yang sangat sering berubah-ubah aplikasi format setiap semester sehingga guru dan wali kelasnya bingung.

P : itu rapornya di kertas atau dibuku kayak kita dulu?

J : Nilai siswa di-input ke aplikasi sehingga nanti muncul nilai akhir untuk rapornya dan kemduian di-print. Tapi ya itu format-formatnya berubah-ubah terus.

P : Oo ini jadi tantanganlah, maksudnya banyak juga kerjaan buat guru. Kalau dari sisi positifnya apa dari kurikulum 2013 ini?

J : Kalau sisi positifnya sebenarnya banyak tetapi karena mengaplikasian disekolah kami terbatas jadi tidak sempurna.

P : Jadi lebih banyak tantangannya gitu ya, walaupun itu positif gitu ya.

J : Iya, sebenarnya positif kurikulum ini, membentuk karakter siswa kita harapkan dan akhlaknya bisa diperbaiki.

P : Jadi integrasi karakter yang sudah Y terapkan disekolah itu seperti apa?

J : Integrasi karakter siswa yang pernah diimplementasikan dikelas seperti pada saaat awal masuk kelas berdoa untuk membentuk karakter religious, mengumpulkan tugas tepat waktu untuk membentuk karakter disiplin, pada saat berdiskusi siswa harus mendengarkan dan menghormati pendapat teman.

P : Kalau pada saat mengajar topic tertentu gitu apa pernah dimasukkan integrasi karakter?

J : Iya ada, semua dimasukkan.

P : Berarti karakter di K13 lebih kepembentukan kepribadian menyeluruh ya? bukan hanya misalnya ilmu biologi dikaitkan dengan ilmu ini, gak kan?

J : Gak, memang menyeluruh. Misalnya siswa cepat masuk pelajaran kita atau kumpul tugas, sudah menanamkan karakter juga disitu.

3 P : Betul, betul. Pertanyaan ketiga menurut Ibu Y sebagai guru bagaimana sih kurikulum biologi yang ideal itu? Mungkin yang dalam pikiran Ibu Y atau inginnya seperti apa kurikulum biologi yang ideal?

J : Kurikulum 2013 memang sudah bagus, materi sudah lebih sempit, silabus sudah ditentukan oleh pemerintah guru tinggal mengembangkan, misal materinya bisa guru kembangkan, alat pembelajaran dapat didukung dengan metode pembelajarannya, dari segi penilaian juga sudah bagus ada penliaian sikap, pengetahuan, dan keterampilan. Secara umum sudah bagus semuanya. Alhamdulillah pada kurikulum 2013 revisi penilaian sikap sudah dikurangi, jadi kalau dulu harus menilai satu-satu persiswa itu membuang banyak waktu guru.

P : Iya, betul

J : Tetapi sekarang penialian sikap lebih intensif kepada siwa yang bermasalah saja. Anak bermasalah saja yang kita nilai.

P : Terus kalau untuk materi biologi yang sekarang sudah ada kira-kira tergolong banyak gak? atau harus dikurangi atau sudah pas?

J : Materi sebenarnya sangat banyak, seperti pada kelas XI itu materi system banyak sekali disemester dua sehingga ada kala tidak terkejar materi diakhir semester sehingga anak-anak kadang saya beri latihan saja jadi sangat luas ilmunya, bab-babnya sangat banyak.

P : Jadi seperti saat kita kuliah ya?

J : Iya, seperti materi kuliah saja. Kalau materi kelas XII banyak juga tapi masih sanggup diajarkan oleh gurunya tapi kalau materi kelas XI terlalu luas seperti system pencernaan itu banyak sekali materi jadi apalagi untuk anak yang tidak memiliki buku seperti siswa kami ini jadi kita harus mengajari tahap demi tahap sedikit demi sedikit sampai mereka mengerti karena mereka tidak punya buku bacaan dirumah dan sangat tergantung pada guru.

P : Jadi sebenarnya itu juga sedikit menghambat ya. Jadi tidak menghemat waktu.

J : Iya, Sehingga tidak menghemat waktu.

P : Setelah membaca angket Saya ada saran gak?

J : Semoga penelitian Ibu berhasil

Kode Transkrip: Transcript_6

Catatan: P: Penanya; J: Responden

1 P : Pertanyaan yang pertama, kira-kira elemen penting apa yang dapat membantu mengonstruksi pengetahuan siswa?

J : tentunya alat bantu dan alat peraga. Sebelumnya. Di Aceh Tenggara ada ketidakjelasan mengenai penggunaan kurikulum, apakah menggunakan kurikulum KTSP atau kurikulum 2013. Karena sekolah kecil maka kami menggunakan kurikulum KTSP tetapi metode pengajaran yang digunakan mengacu pada kurikulum 2013. Khusus pada pelajaran biologi, ilmu pengetahuan yang harus ditampilkan gambar atau alat peraga. Untuk alat peraga alhamdulillah sekolah telah memiliki beberapa bantuan dari dinas. Kemudian masalah lainnya adalah laboratorium yang tidak memenuhi standar. Khususnya pada mikroskop karena alat labarotarium yang ada adalah barang bantuan yang diberikan oleh dinas tetapi ketika kita terima dan dicoba ternyata mikroskopnya banyak tidak bagus. Tentu kurikulum, alat bantu, dan alat peraga itu yang penting.

2 P : Kemudian Pak, Bapak kan masih menggunakan kurikulum 2006 tetapi metode pengajarannya mengacu kepada K13. Jadi, menurut Bapak apa tantangan dan peluang yang Bapak hadapi ketika menggunakan kedua kurikulum ini?

J : Tantangan belajar mengajar menggunakan kurikulum 2013 kalau untuk materi biologi jika kita pacu sepertinya tidak tercapai secara maksimal. Dikarenakan dalam kurikulum 2013 ini mengacu pada belajar kelompok, objektif siwa lebih diberatkan kepada dia belajar mandiri seperti siswa yang membahas, mengerjakan soal,

mengerjakan makalah, juga merangkum siswa tetapi terkadang waktunya yang kurang untuk mencapai itu semua.

P : Kemudian kalau dari sisi positifnya/ peluangnya dari kurikulum 2013. Kira-kira bagaimana prospek kedepan dari penggunaan kurikulum 2013 ini?

J : Peluang Memang caranya lebih responsive K13 karena banyak memakai alat peraga yang membantu siswa mengingat lebih mudah dan metode-metode pengajarannya tidak seperti CBSA yang mana guru harus menulis materi di papan tulis yang mana metode ini kurang cepat untuk ditangkap oleh siswa lain halnya dengan metode kurikulum 2013 yang cepat ditangkap oleh siswa. Contohnya seperti ini, guru menggambar contoh sel hewan dan sel tumbuhan beserta organela selnya. Guru tidak memberikan label nama untuk setiap nama organela sel tetapi siswa dapat mengetahui bahwa gambar tersebut adalah gambar sel. Jadi, siswa lebih cepat merespon materi yang disampaikan jika guru menggunakan kurikulum 2013. Hanya saja masalahnya adalah waktu yang harus benar-benar dipacu untuk dapat menyelesaikan materi.

P : Jadi Bapak sedikit setuju ya jika ada beberapa topic yang penting diajarkan lebih dalam atau yang kurang penting tidak usah diajarkan dulu di SMA itu, bagaimana Pak?

J : Mengenai seharusnya ada materi yang tidak perlu disampaikan di bangku SMA menurut Saya memang dalam mengajar dimulai dengan K1 yaitu mengenalkan kepada siswa bahwa ini cipataan Tuhan YME Allah swt. Begini contohnya, teori perbanyakan tanaman, dahulu belum ada manusia yang melakukan perbanyakan tanaman tentu guru menjelaskan adanya bantuan para hewan seperti burung-burung.

Tetapi sekarang karena sudah lebih modern, manusia yang melakukan perbanyakan tanaman. Guru mengajak bercerita-cerita seremonial sehingga bagaimana cara agar guru dalam menerapkan pembelajaran agar digemaari oleh siswa itulah dengan metode-metode pencerahan. Tidak langsung guru membuka buku dan menyampaikan materi-materi. Jadi guru membuat siswa menyukai pelajaran biologi. Guru tahulah memang siswa itu harus menyukai semua mata pelajaran tidak hanya biologi saja. Guru juga dapat melakukan pre-test dan post-test untuk mengetahui keberhasilan proses belajar mengajar. Mungkin siswa dapat mengingat dalam jangka waktu pendek setelah itu mungkin materinya sudah lupa.

3 P : Kemudian soal ketiga, mungkin Bapak sebagai guru biologi punyalah impian tentang kurikulum biologi yang ideal. Jadi, apa yang menjadi pertimbangan Bapak untuk suatu kurikulum biologi yang ideal tentang materi pokok biologi itu sendiri?

J : Pertimbangan kurikulum yang ideal untuk mata pelajaran biologi kalau bisa disederhanakan, kompetensi dasar pertama dunia hewan dan tumbuhan kalau bisa disederhanakan. Tidak terlampau bias sekali. Kita ajarkan ketingkat tumbuhan atau hewan yang masih sederhana dulu. Kadang-kadang jika kita lihat dalam silabus memang betul, sampai nanti ke (...menit 7:50.) kelas XII. Kalau urutan memang sudah sesuai tetapi impian kita kalau bisa lebih disederhanakan luasnya materi.

P : Berarti cakupan atau luasnya materi yang diajarkan lebih disederhanakan? Karena nanti dikuliahan juga diajarkan lagi ya kalau

J : Iya disederhanakanlah, didalam islam juga disedehanakan misalnya alquran dan hadis. Jadi, disederhanakan saja.

P : Itu saja Pak pertanyaan dari saya, kira-kira mungkin Bapak ada masukan untuk Saya?

J : Masukan kepada FKIP/ pihak terkait/ pemerintahan Aceh adalah semoga kedepannya diperbanyak pembinaan *skill* kepada guru bukan hanya mengenai MGMP atau K13 tetapi juga keterampilan guru untuk menggunakan alat laboratorium karena tidak semua guru biologi adalah lulusan FKIP.