



Content Structure Analysis of Merdeka Curriculum on Chemical Equilibrium Topic in F Phase

Siti Sarah, Faizah Qurrata Aini*, Zonalia Fitriza

Study Program of Chemistry Education, Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Negeri Padang, Jl. Prof. Dr. Hamka, Air Tawar Padang, West Sumatra, Indonesia 25131

* Corresponding Author e-mail: faizah_qurrata@fmipa.unp.ac.id

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Abstract

The implementation of the merdeka curriculum as an improvement and replacement for the previous curriculum needs to be studied on the structure and depth of its learning content. This study aims to describe the suitability of the content structure of chemical equilibrium material based on Bloom's Revised Taxonomy and university textbooks as standards. The research method used is descriptive qualitative to describe the object according to the data and information obtained. The research design uses the Model of Educational Reconstruction (MER) by Reinders Duit which focuses on Content Structure Analysis. The data analysis technique uses the Miles and Huberman model by collecting, reducing, presenting, and concluding data. There are research instruments: knowledge, skill, and attitude level analysis sheets, as well as content standard analysis of chemical equilibrium topic. The results of curriculum analysis show a deriving in operational verbs from the level of knowledge, skills, and attitudes based on the Pancasila profile. For content analysis, it is found that the depth and breadth of chemical equilibrium learning materials from the Cambridge book grade XI of the Ministry of Education and Culture and the University textbook by Brady are consistent but the development of the material sequence is different. The sub-chapter on equilibrium constants K_c and K_p should be the prerequisite material before learning the concept of equilibrium shift.

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INTRODUCTION

The curriculum has a strategic role as a description of the vision, mission, and goals of education (Bahri, 2017). The curriculum is a device that guides the development of the learning process in the form of student activities in an effort to achieve an educational goal. Curriculum design is based on needs analysis and uses a certain model that refers to effective design (Huda, 2017). The Merdeka curriculum is a diverse intracurricular learning curriculum with optimization content so that students have enough time to explore concepts and strengthen their learning competencies. So that learning can be tailored to the learning needs and interests of students, teachers as educators are given the freedom to develop various teaching tools.

The Merdeka curriculum policy, which is relatively new, has not been fully equipped with the needs of teachers to adapt to the demands of the curriculum. The difference in demands from the previous curriculum is the teacher's job to re-analyze the preparation of learning. A teacher can teach in a structured and directed manner with a learning tool called a teaching

module (Waty, 2021). In compiling teaching modules based on the specified Learning Outcomes (CP), guidelines are needed. This is so that the teaching modules prepared are in accordance with the demands of the curriculum. These guidelines include the need to analyze the structure of learning content.

The limited information and sources of structure and content in the Merdeka curriculum are an obstacle for teachers in developing learning that is in accordance with the demands of the curriculum. The facts found in the field show the obstacles faced by teachers in compiling teaching modules. Based on the results of interviews with chemistry teachers of class XI at SMAN 2 Padang and SMAN 9 Padang, one of the obstacles faced is the limited source of material in the form of books produced by the Merdeka curriculum for class XI. The limited source of material in the form of books will make it difficult for teachers to determine the sequence and depth of material in accordance with the Merdeka curriculum. Some of the teachers interviewed explained that the lack of Merdeka curriculum output books for grade XI made them continue to guide the 2013 curriculum book. Meanwhile, Cambridge books as a guideline for the Merdeka curriculum output are considered by teachers to be difficult to understand and have higher standards, so they are rarely used.

Some changes in the Merdeka curriculum become obstacles for teachers at the planning stage. These obstacles are in terms of preparing teaching modules. The teaching modules that are compiled must implement the flow of learning objectives that have been developed by teachers from learning outcomes based on the Pancasila learner profile. Teachers are given freedom in developing teaching modules but cannot be separated from the components and aspects that have been determined. One of these obstacles is understanding how to reduce CP to Learning Objectives (TP). Teachers do not understand how to reduce CP so that the material provided does not refer to essential material but still refers to the previous curriculum (Novi and Jaya, 2022).

To make it easier for teachers to measure aspects of structure and content, it is necessary to analyze the results by referring to the appropriate standards. The structure and content that includes the domains of knowledge, attitudes, and skills can be derived from the taxonomy. In this case, Bloom's Revised Taxonomy and University Textbooks can be the standard in analyzing the structure and content of teaching and learning in accordance with the learning objectives in the curriculum.

Chemical topic in learning are conceptual and abstract (Taber, 2009). This abstract nature is considered to make chemical materials difficult for students to understand (Marsita, 2011). In studying equilibrium material there are many concepts that must be learned, but the students themselves have difficulty in understanding abstract chemical concepts. The subject matter of chemical equilibrium is needed as a prerequisite in understanding further chemical materials that will be studied such as acid base, salt hydrolysis, buffer solution, solubility and solubility product. The results of research conducted by Indriani (2017) revealed that students' understanding of chemical equilibrium is still low, there are student learning difficulties in understanding chemical equilibrium material on the concept of dynamic equilibrium is high, the equilibrium constant is low, and the factors that affect the equilibrium shift are low. So learning planning in the form of teaching modules must be prepared by analyzing in terms of curriculum review and material.

METHOD

In this research, a descriptive qualitative research was conducted. The research was conducted to describe an object in accordance with the information and reality encountered. The information can be in the form of words or text which is then analyzed. From the data

obtained, the researchers makes an interpretation to capture a picture of the object. The final result of this research is a description that is poured in the form of a flexible written report.

The research design is a series of designs for collecting, processing, analyzing, and presenting data systematically and objectively to solve problems. The research design used for this research is using the Model of Educational Reconstruction (MER) or commonly known as the Educational Reconstruction Model. This design was developed by Reinders Duit in 2012 which in this MER design consists of 3 flows, namely: (1) Content Structure Analysis, (2) Teaching and Learning Research, (3) Implementation and Evaluation (Duit & Tesch, 2010). However, this research focuses on the Content Structure Analysis design. There are two things done in this analysis, namely: curriculum analysis and content analysis.

The data collection technique used in this research is the documentation study technique. The documentation study technique took the form of Permendikbud Number 56 of 2022 concerning Guidelines for Curriculum Implementation in the Framework of Learning Recovery, Bloom's Taxonomy Revised, university textbooks, and other relevant books.

RESULTS AND DISCUSSION

There were two things that were done in the research, namely: curriculum analysis and content analysis. The following are the results of the curriculum analysis and context analysis carried out on chemical equilibrium material.

Curriculum Analysis

In the Merdeka curriculum in learning for high school chemistry subjects consists of 2 phases. The first phase for class X SMA or what is called Phase E and also the second phase for classes XI and XII SMA or what is called phase F.

Table 1. Knowledge Level Analysis

Learning Outcomes (CP)	Knowledge Level
Elements: Chemical Understanding	
1. Observe, investigate and explain everyday phenomena according to the rules of scientific work in explaining chemical concepts in everyday life.	<ul style="list-style-type: none"> • Observing (C2) • Investigating (C3) • Explaining (C2) (Anderson et al., 2001)
2. Apply mathematical operations in chemical calculations	<ul style="list-style-type: none"> • Applying (C3) • Calculate (C3) (Anderson et al., 2001)
3. Studying the nature and structure and interaction of particles in forming various compounds including their processing and application in daily life.	<ul style="list-style-type: none"> • Learning (C2) • Applying (C3) (Anderson et al., 2001)
4. Understand and explain the energy aspects of chemical reaction rate and equilibrium	<ul style="list-style-type: none"> • Understand (C2) • Explain (C2) (Anderson et al., 2001)
5. Using acid-base concepts in everyday life	<ul style="list-style-type: none"> • Using (C3) (Anderson et al., 2001)
6. Using chemical energy transformations in everyday life including thermochemistry and electrochemistry	<ul style="list-style-type: none"> • Using (C3) (Anderson et al., 2001)
7. Understand organic chemistry including its application in daily life	<ul style="list-style-type: none"> • Understand (C2) • Apply (C3) (Anderson et al., 2001)

Learning outcomes in phase E and phase F consist of chemical understanding elements and process skills elements. The results of the content structure analysis for phase F on chemical equilibrium material which includes levels of knowledge, skills, and attitudes based on the Pancasila profile (Table 1).

The results of the analysis of the formulation of chemistry learning objectives in the Merdeka Curriculum from the knowledge dimension refer to the decline in Anderson and Krathwohl's Revised Bloom Taxonomy. For the analysis of the knowledge level in Learning Outcome point 1 in Phase F chemistry material, there are 8 elements of operational verbs from 2 categories, namely Understanding which includes the operational verbs Observing, Studying, Explaining, and Understanding and the Applying category which includes the operational verbs Investigating, Calculating, Applying, and Using.

In the Understand category, students are expected to construct meaning or understanding of the basic knowledge they have. This includes integrating new knowledge into learners' existing thinking patterns. This category includes seven cognitive processes namely interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining. Applying involves using a particular procedure to perform an exercise or solve a problem. Applying is closely related to procedural knowledge and does not focus solely on this knowledge. This category includes two cognitive processes namely executing and implementing.

Table 2. Skill Level Analysis

Learning Outcomes (CP)	Concrete Skills	Abstract Skills
Elements: Process Skills		
1. Understand Able to select appropriate tools to make measurements and observations. Pay attention to relevant details of the object	<ul style="list-style-type: none"> Doing (P2) (Simpson et al, 1972) 	<ul style="list-style-type: none"> Observing (KA-1) Selecting (KA-2) (Dyer et al., 2011)
2. Questioning and predicting Formulate scientific questions and hypotheses that can be investigated scientifically		<ul style="list-style-type: none"> Formulate (KA-4) (Dyer et al., 2011)
3. Plan and select research methods Students plan and select appropriate research methods based on references to collect reliable data, considering risks and ethical issues in using the methods. Students select and use appropriate tools and materials including the use of digital technology to collect and record data systematically and accurately.	<ul style="list-style-type: none"> Using (P3) Collecting (P3) (Simpson et al., 1972) 	<ul style="list-style-type: none"> Selecting (KA-2) (Dyer et al., 2011)
4. Process, analyze data and information Interpret information obtained honestly and responsibly. Use various methods to analyze patterns and trends in data. Describe relationships between variables and identify inconsistencies. Use scientific knowledge to draw conclusions that are consistent with the research results	<ul style="list-style-type: none"> Using (P3) (Simpson et al., 1972) 	<ul style="list-style-type: none"> Describing (KA-4) Concluding (KA-4) (Dyer et al., 2011)

<p>5. Evaluate and reflect</p> <p>Evaluate conclusions through comparison with existing theory. Point out strengths and weaknesses of the inquiry process and its effect on the data. Point out problems with the methodology and propose suggestions for improvement for the next investigation process.</p>	<ul style="list-style-type: none"> • Showing (P3) (Simpson et al., 1972)
<p>6. Communicating results</p> <p>Communicate the results of the investigation as a whole including safety, environmental and ethical considerations supported by arguments, language and scientific conventions appropriate to the context of the investigation. Demonstrate systematic thinking patterns according to the prescribed format</p>	<ul style="list-style-type: none"> • Communicating (KA-5) (Dyer et al., 2011)

In analyzing the skills domain which includes abstract skills and concrete skills as well as the affective/attitude domain refers to the decline of Simpson (1972) and Dyer (2011) Revised Bloom's Taxonomy. In the realm of concrete skills includes the activities of using, parsing, assembling, modifying, and making. While in the realm of abstract skills includes the activities of writing, reading, calculating, drawing, and composing. In the results of the analysis of concrete skills there are categories of Doing (P2) Using (P3). Collecting (P3), and Showing (P3). At the Manipulation level (P2) includes student skills to perform a work step through instruction and practice trying. Students are invited to familiarize the movement (mechanism) by making, doing, forming, and completing. Whereas at the Precision level (P3) students are asked to be able to carry out activities or assignments that use a skill / skill with performance quickly and well and efficiently without assistance or instructions. At this level students are asked to be proficient in performing work steps by demonstrating. Complete, demonstrate, perfect, calibrate. Control, and control.

Furthermore, at the abstract skill level analysis, there are categories of Observing (KA-1), Selecting (KA-2), Formulating (KA-4), Describing (KA-4), Drawing conclusions (KA-4), and Communicating (KA-5). Observing learning ability (KA-1) is described by students' attention during activities both when observing an object, reading sources, and listening carefully to explanations. From this observation, it can be seen the focus of the object and the length of time students observe. The learning ability of the Questioning category (KA-2) describes the quality and quantity of questions asked by students which include factual, conceptual, operational, and hypothetical questions.

The learning ability of Reasoning/associating/processing information (KA-4) describes how students develop interpretations, arguments and conclusions regarding the interrelationship of information from two facts/concepts, interpretations of arguments and conclusions regarding the interrelationship of more than two facts/concepts/theories, synthesizing and arguments and conclusions regarding the interrelationship between various types of facts/concepts/theories/opinions; develop interpretations, new structures, arguments, and conclusions that show the relationship of facts/concepts/theories from two or more sources that do not conflict; develop interpretations, new structures, arguments and conclusions from different concepts/theories/opinions from various types of sources. In the Communicating/Presenting category, students are asked to be able to present the results of the observations

made until the reasoning process for the results of these observations in written and multimedia form (Nafiati, 2021).

Table 3. Attitude Level Analysis

Learning Outcomes (CP)	Attitude
Pancasila's Profile	
1. Believing, fearing God, and having noble character.	<ul style="list-style-type: none"> • Have faith (A3) • Pious (A3) • Have noble character (A5) (Krathwohl et al., 1964)
2. Global diversity	<ul style="list-style-type: none"> • Global diversity (A1) • Mutual respect (A2) • Recognize and appreciate culture (A3) • Reflection and responsibility (A4) (Krathwohl et al., 1964)
3. Bergotong royong	<ul style="list-style-type: none"> • Bergotong royong (A2) • Collaboration (A2) • Care (A1) • Sharing (A4) (Krathwohl et al., 1964)
4. Merdeka	<ul style="list-style-type: none"> • Merdeka (A4) • Awareness of self and situation (A4) (Krathwohl et al., 1964)
5. Critical reasoning	<ul style="list-style-type: none"> • Making decision (A5) (Krathwohl et al., 1964)
6. Creative	<ul style="list-style-type: none"> • Creative (A4) • Produce original ideas (A4) (Krathwohl et al., 1964)

Analysis of the attitude level in the Merdeka curriculum based on the Pancasila profile, there are categories of global diversity (A1), caring (A1), mutual respect (A2), mutual cooperation (A2), collaboration (A2), faith (A3), piety (A3), knowing and appreciating culture (A3), reflection and responsibility (A4), independence (A4) sharing (A4), awareness of self and situation (A4), creative (A4), producing original ideas (A4), noble character (A5), and making decisions (A5). At the Accepting level (A1) students are able to accept a value and pay attention to that value. The Responding level (A2) means that students are willing to answer a value and there is an interest in giving that value. Furthermore, the Appreciating level (A3) describes that students can consider the value as a good thing, like, and commit to the value. At the internalizing level (A4) means that students can include the value as part of their value system. Finally, the Practicing level (A5) describes that students can develop the value as a characteristic of themselves both in thinking, speaking, and acting. Overall, the values learned can become characters that are implemented in students.

Content Analysis

Content analysis is an analysis of the subject matter of chemical equilibrium using University chemistry textbook sources as standards including books by Brady (2012). This analysis aims to obtain the correct concept in terms of scientific knowledge of learning materials. The following table shows the results of the content analysis of chemical equilibrium of chemistry subject material.

Table 4. Content Standard Analysis

Learning Outcomes	Chemical Equilibrium Material in Cambridge Books of the Ministry of Education	Chemical Equilibrium Material in University Textbooks (Brady, 2012)
Learners are able to observe, investigate and explain daily phenomena according to the rules of scientific work in explaining chemical concepts in daily life; apply mathematical operations in chemical calculations; study the nature, structure and interaction of particles in forming various compounds; understand and explain aspects of energy, rate and equilibrium of chemical reactions; use the concept of acid-base in daily life; use chemical energy transformation in daily life; understand organic chemistry.	8.1 Reversible reactions 8.2 Equilibrium position - Dynamic equilibrium - Equilibrium in closed systems - Shifting the equilibrium position - Some examples of reversible and equilibrium reactions 8.3 Changing concentrations 8.4 Changing pressure 8.5 Changing temperature 8.6 Effect of physical state of reagents and addition of catalysts on equilibrium - Physical state of the reactants - Catalyst 8.7 Equilibrium constant K_c - Evaluating K_c for a reaction 8.8 Using equilibrium constants - Finding the equilibrium mixture composition 8.9 Equilibrium constant K_p 8.10 Factors affecting the value of K_c or K_p	15.1 Dynamic Equilibrium in Chemical Systems 15.2 Equilibrium Laws 15.3 Equilibrium Laws Based on Pressures or Concentrations 15.4 Equilibrium Laws for Heterogeneous Reactions 15.5 Position of Equilibrium and the Equilibrium Constant 15.6 Equilibrium and Le Châtelier's Principle 15.7 Calculating Equilibrium Constant 15.8 Using Equilibrium Constant to Calculate Concentrations

Note: 8. ... is a sub-chapter in the Cambridge book and 15. ... is a chapter in the Brady book.

From the results of the analysis of the subject matter which includes the depth and breadth of material from the Cambridge book produced by the Ministry of Education and Culture as a source of learning chemistry material in the Merdeka Curriculum, there is a match in content with the University textbook. However, from the arrangement and sequence of material subchapters, there are differences in the development of subject matter.

In Brady's book the material starts with Dynamic Equilibrium which is the basic concept of understanding equilibrium reactions. This section is an abstract concept but needs to be emphasized to learn the following subchapters. In chemical equilibrium, the terms reactant and product do not have the usual meaning because the reaction takes place in both directions simultaneously. Next is about the law of equilibrium. The law of equilibrium studies the relationship between the concentration of reactants and products in the equation. In this section, the concepts of equilibrium constant based on concentration (K_c) and equilibrium constant based on pressure (K_p) are also applied. With this understanding, students can identify that the numerical product will affect the amount of equilibrium that occurs in the reaction.

In equilibrium reactions, it is known that reactions can involve substances in one or more phases. This is the sub-chapter on homogeneous and heterogeneous equilibrium. In this section students can know that substances in the solid phase (s) and liquid phase (l) do not

have concentration values so that the equation only involves the gas phase (g) and solution (aq). Then proceed with the equilibrium position material from the previous concepts, then learn the Le Châtelier Principle. This principle states how factors affect equilibrium. After that the material continues on the calculation of the equilibrium constant to determine the K value of the equilibrium reaction. With this sequence of material, it is hoped that the continuity of concepts can make students understand better and minimize misconceptions.

Whereas in the Cambridge book by the Ministry of Education and Culture, the initial material has almost the same sequence, starting with the concept of reversible reactions and dynamic equilibrium. However, without the introduction of legal material and equilibrium settings, it is directly addressed to the subchapter of the factor of changes in the direction of equilibrium, which is feared that without an understanding of the law and equilibrium settings, students tend to find it difficult to understand because they do not master the prerequisite material. By adjusting the sequence of material based on university textbook sources, it is hoped that learning will be more meaningful and easy for students to understand.

CONCLUSION

Analysis of the content structure of the independent curriculum on chemical equilibrium material obtained the results of curriculum analysis and content analysis. Curriculum analysis shows the desired level of cognitive, affective, and psychomotor achievement for students so that the preparation of teaching modules must be adjusted to that level. For content analysis, it was found that the depth and breadth of chemical equilibrium learning material from the Cambridge book grade XI of the Ministry of Education and Culture and the University textbook by Brady had compatibility even though the development of the material sequence was different. The subchapters on equilibrium constants K_c and K_p should be prerequisite material before learning the concept of equilibrium shifts. By adjusting the sequence of materials based on university textbook sources, it is expected that learning will be more meaningful and easily understood by students. These findings are expected to help streamline the implementation of the Merdeka curriculum by applying the concept of freedom to teachers while still guiding existing standards.

RECOMMENDATIONS

This research can be developed for other topics in chemistry learning. This can be done by going through the curriculum first to understand how the curriculum standardizes the development of materials by teachers by adjusting to the Ministry of Education's resources. In addition, this flow can be continued for teaching and learning research using the Model of Educational Reconstruction (MER). With the amount of analysis carried out, it is hoped that it can be a source of guidance for teachers in planning and compiling teaching modules to suit the demands of the curriculum. Good understanding and development of the curriculum can affect the improvement of the quality of learning and curriculum implementation.

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