

# The Development of Rubric to Assess Metacognition Knowledge

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**Abstract**—Prospective teacher's metacognition knowledge such as declarative knowledge, procedural knowledge, and conditional knowledge is becoming crucial in the development of an efficient learning design. This lead to the urgency in measuring the level of metacognitive knowledge of prospective teachers. Currently, rubric to measure prospective teacher's metacognition knowledge in designing learning instruction is very limited. Therefore, this study aims to develop a rubric to assess metacognition knowledge in designing learning instruction. The Research and development methods are employed with the development design model including the preliminary study phase, development study phase, and evaluation stage. The rubric prototype resulted includes declarative, procedural and conditional knowledge in designing learning instruction on GPA aspects, learning objectives, learning materials, learning strategies, learning steps, learning media, learning resources, and learning outcomes assessment.

**Keywords**—*rubric; instructional design; metacognition*

## I. INTRODUCTION

Pedagogical content knowledge (PCK) is the blending of content and pedagogy knowledge [1]. PCK totally precondition owned by the teacher or prospective teacher for effectiveness of learning process. In order to the learning process to be carried out effectively [2,3], then the prospective teacher should be responsible for the plans of the instructional design are made it. Not only follow the instructional process or designing the instructional process but also the prospective teacher realized the reason why they do that process. By realizing why, they are doing this, indicates that the prospective teacher is thinking about his thinking process or monitoring the thinking process when designing learning. This implies that teacher candidates are cognizant. This indicates that the prospective teachers in the process of metacognition.

Metacognition can be assessed by a variety of methods, including questionnaires, interviews, observations, think aloud protocol, self-report, and error detection [4-9]. In order to assessing cognition knowledge as one of the components of metacognition, interviews and questionnaires are the most dominant methods that are used [10].

Questionnaires in the form of open ended questions as a method of assessing metacognition knowledge require a reference or assessment criteria called rubrics [11]. Development of rubrics to access metacognition knowledge has been developed in the concept of chemical bonds [7]. However, the rubric to reveal the metacognition knowledge of the prospective teacher in designing learning instruction is rarely found. It is therefore highly desirable to design rubric to assess the knowledge of metacognition of prospective teacher in instructional design.

## II. METHOD

This research employed the research and development method which is adapted from the development model of Gall et al. with some modification. Procedure of the research including: 1) preliminary study phase, 2) development study phase, and 3) evaluation phase [12].

The preliminary study phase is focused on documentation study activities, and literature studies. Documentation studies conducted related to the Basic Competency Standards (SKL) of Primary and Secondary Education. Literature studies related to assessment have been used in exploring metacognition knowledge. Literature study was conducted to explore the types of assessments commonly used to measure metacognition knowledge.

The development phase of the study was to design a rubric using a top-down approach adapted from Brookhart and Nitko [13]. The evaluation phase is carried out to validate the rubric

that has been developed. Rubric validation is carried out by experts in the field of chemical education and curriculum.

### III. RESULTS AND DISCUSSION

The main result of this study is to obtain a rubric design that can measure the metacognition knowledge of prospective chemistry teachers in learning design. The result was described in the preliminary study, development and evaluation phase.

#### A. Preliminary Study Phase

Based on several expert reviews, the important role of metacognition in learning were: as a major component in developing students into lifelong learners, the key of developing conceptual understanding of science, supporting the ongoing meaningful learning process, and the last is an important learning principle and must be integrated into the curriculum for all fields subject [14-17].

Integration of metacognition into the curriculum has been realized through the education curriculum in Indonesia. Through the Graduates Competency Standard (SKL) which is a criterion of graduate ability qualifications [18], metacognition is one of the qualifications that must be owned by graduates of both primary and secondary education. This expressly reveals that the importance of metacognition provided to students from the beginning. However, there were obstacles to finding rubrics that can access this metacognition knowledge. The development of the rubric for assessing metacognition knowledge was developed by Rompayom, but no one has developed a rubric to assess the knowledge of metacognition in designing learning [7]. Therefore, it is necessary to develop a rubric to assess metacognition knowledge in the context of designing learning.

#### B. The Development Phase

Knowledge about cognition can be accessed through a questionnaire [6,19,20]. The questionnaire that has been developed so far is more dominant using questionnaires with closed questions. The questionnaire was chosen because it was simple to implement with a large number of respondents. Based on these reasons, this study uses a questionnaire with open ended questions to assess prospective teacher's metacognition knowledge because open ended questions provide opportunities for respondents to express their thoughts in deeply.

Assessing metacognition knowledge using a questionnaire with open ended questions requires a rubric in measure it. This rubric can be delivery both a holistic rubric and an analytical rubric [11]. For the purposes of this study, an analytical rubric is used due to it will assess performance in detail. The intended performance is the teacher's metacognition knowledge related to the components of the learning plan, where the desired criteria divergent for each component.

The approach used in designing the rubric using a top-down approach is deductive concept adapted from Nitko and Brookhart, starting with a conceptual framework related to content and performance assessed [11,13]. The top down approach is chosen with the consideration that metacognition

knowledge in designing learning is a new thing that will be introduced in the subjects to treatment so that it must be clearly defined in each component to be assessed.

The first step taken in designing a rubric based on a top-down approach is to formulate the aspects assessed. In this case, the aspect assessed is the prospective teachers' metacognition knowledge according to Schraw which includes declarative knowledge, procedural knowledge, and conditional knowledge [21]. Learning design includes lesson plan components, namely indicators of competence achievement, learning objectives, learning materials, learning strategies, learning steps, learning media, learning resources, and learning outcomes assessment based on the Standards for Primary and Secondary Educational Processes [22]. In this case, each lesson plan component a declarative, procedural, and conditional knowledge is measured by the prospective teacher.

The second step is to define aspects that are assessed related to metacognition knowledge. Declarative knowledge is knowledge about something, procedural knowledge is knowledge of how to do something, and conditionally is knowledge of why and when to do something [21]. The next stage is to determine the scale used in relation to the score achieved.

#### C. Evaluation Phase

The assessment rubric prototype developed was further validated by two experts in the field of chemical education, and one expert in the curriculum field. This effort is carried out to maintain the validity of the instrument [23,24]. In general, there are some suggestions given regarding the developed rubric prototype, shown in table 1. Based on the validator's suggestions, improvements were made to the suggested aspects and obtained by the rubric as in table 2.

TABLE I. SUGGESTIONS OF SOME VALIDATORS TO RUBRIC PROTOTYPE

Assessment Aspect	Suggestions
Material	All components of the learning design have been displayed, but the individual aspect for each component are not available. The indicators of competence achievement and learning objectives should not be combined
Construction	Rubric offerings are improved so that they are easy to understand
Language	The language used is still less communicative and provides multiple interpretations

**TABLE II. EXAMPLES OF RUBRICS MEASURE TEACHER'S METACOGNITION KNOWLEDGE IN DESIGNING LEARNING**

Components of Lesson Plan	Metacognition Knowledge		
	Declarative knowledge	Procedural knowledge	Conditional knowledge
Indicator of Competence Achievement	Formulate indicators with operational verbs and material	Formulate indicators with operational verbs and material Formulation of indicators is done through basic competence analysis	Formulate indicators with operational verbs and material Formulation of indicators is done through basic competence analysis Formulation of indicators is done through basic competence analysis, is carried out to determine the abilities that students are expected to achieve according to the curriculum requirements
Scores	1	2	3
Learning materials	Making learning material items in the form of facts, concepts, principles and procedures	Making learning material items in the form of facts, concepts, principles and procedures Preparation of learning material items through: (1) Analysis of the breadth of material based on the basic competence analysis; (2) Depth analysis of material based on references (general chemistry textbook)	Making learning material items in the form of facts, concepts, principles and procedures Preparation of learning material items through: (1) Analysis of the breadth of material based on the basic competence analysis; (2) Depth analysis of material based on references (general chemistry textbook) Analysis of material breadth is carried out to determine the scope of the material to be taught (facts, concepts, principles or procedures) based on competency demands in the curriculum illustrated in indicators of competence achievement. The depth analysis of the material is carried out to ensure the truth of the contents of the learning material whose truth has been tested according to several international scientists.
Scores	1	2-3	4-5

**IV. CONCLUSION**

Based on the development research conducted starting from the preliminary, development and evaluative study phase, a prototype of the assessment rubric was obtained which can

assess the teacher's metacognition knowledge in designing learning instruction. The research rubric developed is an analytic rubric where the design uses a top-down approach. The rubric prototype developed includes declarative, procedural and conditional knowledge in designing learning on GPA aspects, learning objectives, learning materials, learning strategies, learning steps, learning media, learning resources, and learning outcomes assessment.

**ACKNOWLEDGMENT**

The authors would like to thank all participants who contribute in this research. ELA thanks The Ministry of Research Technology and Higher Education Republic Indonesia for scholarship.

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