**The quality of cognitive learning achievement test items at the food engineering education study program**

Prihastuti Ekawatiningsih1, Sugijono2 and Wika Rinawati3

Department of Culinary Engineering Education, Faculty of Engineering, Universitas Negeri Yogyakarta, Indonesia

Email: Prihastuti@uny.ac.id

**Abstract**. This study aims to examine the quality of cognitive learning achievement test items in the Food Engineering Education study program. This study used the document analysis approach and multiple- choice items responses in the 2018/2019 academic year. Data collection was done by item review and item analysis sheets using the ANATES program to determine reliability, difficulty level, discriminating power and point biserial correlation. The theoretical study of the essay questions finds 2 questions that do not address the indicator, 2 questions in the form of short answers give rise to multiple meanings and answers that are it is expected to be unclear and 1 essay question does not require answers to be unraveled. The results of the theoretical study of multiple-choice questions find 5 items leading to correct answers, 2 items have answer options that are not the same length, 2 items have very homogeneous answer options. The results of the empirical study of 55% of the questions are in the easy category, 66% low differentiation power and 52% significant/ very significant item correlation.

1. **Introduction**

The assessment of learning achievement aims to provide information on the achievement of learning objectives (1)(2). Through assessment of learning achievement, a lecturer may identify the relative position of each student in comparison to their fellow classmates as well as their success in passing the course. Lecturer may also figure out which student is strong or weak in certain tasks. The assessment process of learning achievement at the study program level is the personal right of each lecturer, and therefore is confidential. In regard to this, the assessment process has never been evaluated of the study program, which means that the quality of the assessment instrument or test items have not been identified.

There are several levels of cognitive learning assessment, namely LOTS/ lower order thinking skills, MOTS/middle order thinking skills and HOTS/higher order thinking skills (3). In accordance with the high competition level of the global job market, there is a demand that learning achievements must address the HOT level. By addressing the HOT, it is expected that students master the abilities of problem solving, critical thinking, creative thinking, reasoning, dan decision making (4)(5). However, in the typical cognitive learning assessment, most only address the elements of LOTs, namely remembering and comprehension.

Based on these problems, this study attempts to analyze the quality of test items in the cognitive learning learning achievements at the Food Engineering Study Program. This study aims to: (1) examine theoretically the quality of cognitive learning assessment test items; (2) examine the empirical quality of the multiple choice test items; (3) identify the distribution of LOTs, MOTs, and HOTs cognitive levels in the test items of the cognitive learning achievement at the Food Engineering Study Program.

Bloom classifies cognitive competence into six levels, from low to high as illustrated in Figure 1. The lowest cognitive level is the LOTs, while the highest is the HOTs, which includes analysis, evaluation, and creation. Bloom’s cognitive domains can be seen in Figure 1.

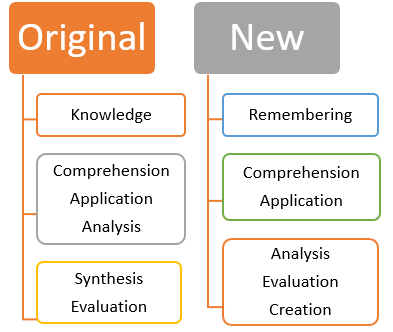


Figure 1. The Taxonomy of Cognitive Competence

(Darmawan, 2013: 32)(6)

* 1. *Remembering*

The ability to “remember” is demonstrated when the test participant can retell the past experience and reactions they have previously learned (Bartlet, 2010:1)(7). Assessment of learning achievement should not address the “remembering” aspect as it may drive students to cheat and be less effective in training students to think creatively in solving problems. Examples of the “remembering” level test items

What is the **definition** of food processing technique?, **Mention** 10 traditional food from West Java

* 1. *Comprehension*

Once an individual obtains information or knowledge, they will save the information into memory, which they can retrieve and express in their own words. If the student expresses information in the exact way they receive it, they may not be in the comprehension level yet, and still in the realm of remembering or memorizing. Comprehension is an ability to understand the meaning of a concept or an action (8) (9) states that measuring comprehension focuses on organization of ideas, interpretation of information, and translation. Examples of the comprehension level test items. What is the **difference** between sponge and creaming method in the cake batter?

* 1. *Application*

The application level of the cognitive competence is concerned with “the ability to use and apply the learned ideas, procedures, methods, formulas, theories, and information in a work condition or other new contexts” This allows learners to use knowledge, skills, or techniques in new situations through application (10). The assessment of learning achievement in this level can be done by proposing a problem that is similar to the previously learned materials, and asking students to solve the problem using their knowledge with similar methods or procedures. Examples of the application level test items

Determine the amount of ingredients required to make 100 portions of fried noodle!

Modify the recipe for potato croquette into taro croquette!

* 1. *Analysis*

The analysis level of cognitive competence measures *the ability to separate materials or concepts into groups based on any similarity or difference to be reorganized in more comprehensible structures*

What makes the texture of mayonnaise to break or not homogenous?, What makes a sponge cake fails to rise?, Why does a case hardening occur when frozen meat is boiled?

* 1. *Evaluation*

Evaluation is a high level of cognitive competence in which learners can identify the criteria of a correct answer, give an example of the correct answer, and provide a solution or know how to fix a wrong answer. It is evident by the ability to criticize a job or a product, determine the conformity of a process or product in regard to a problem, or examine the inconsistency of a theory (11).

Examples of evaluation level test items

In assessing student ability in conducting an evaluation, teacher must first set a standard or criteria. Evaluation on the learning results can be done by giving assignments or tasks that address the learning objectives, e.g. The following is a standard pineapple tart recipe. Find ingredients that do not belong in the recipe. Assess the creativity of the *tumpeng nasi kuning* (traditional dish of turmeric rice shaped as a cone with various side dishes) presentation using the assessment rubric.

* 1. *Synthesis/Creation*

Having the competence to synthesize or create in this context implies that the student has possessed various knowledge which they use to develop either a plan/program, a proposal, a form of scientific work, a report, practicum preparation, design, etc. Creation is indicated by the ability to combine elements of learning to create a whole new thing, and utilize them to produce a new form, pattern or structure. Examples of creation level test items A project or assignment is typically used in assessing student learning results in the synthesis level. Teacher prepares rubric to assess student learning results. The examples of assignment instructions based on the learning objectives can be seen below.

Develop a family lunch menu with variations in ingredients, cooking techniques, and tastes!, Develop a catering business plan, Design a marketing strategy for *dodol carica*! Design a table setting for a buffet menu.

1. **Methods**

The study used a document analysis approach carried out in the Food Engineering Education Study Program, Department of Fashion and Food Engineering Education, Faculty of Engineering, Yogyakarta State University in 2019. The source of data in this study is the test items document for the written examination for theory courses and the answer sheet for multiple choice questions. The data collection instruments are item study cards published by Puslitbagsisjian (12) with exceptions of some no longer relevant criteria. The study cards for essay questions are presented in Table 1, while those for multiple choice questions can be seen in Table 2, as quoted by Thomas M. Haladyn.

Table 1. Essay Questions Study

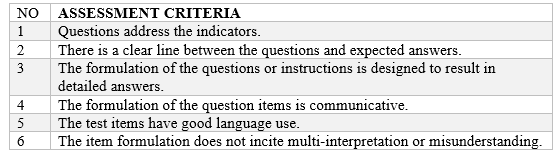
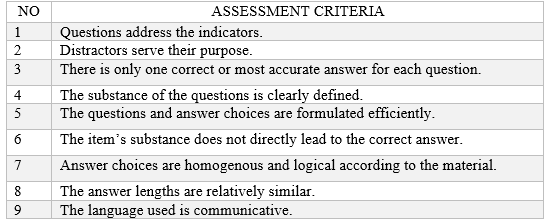


Table 2. Multiple Choice Questions Study Cards



Data analysis was used descriptive statistical analysis (13) on the empirical study of the multiple-choice test item responses. The analyzed substances involved reliability, difficulty level, discriminating power, and item correlation. The following formula was used to calculate the item difficulty level. An item is considered easy when the percentage of the correct answer is more than 75%, moderately difficult between 25 and 75, and difficult, when it is less than 25 (Michela Gnaldi 2013: 5)(14).

1. **Results**

There are two items that “do not address the indicators” as the assessment of learning achievement has been conducted in various forms, namely structured assignments, class participation, and the mid-term examination. Items with no” clear line between question and expected answer” are those with short answers. There are no questions or instructions designed to obtain detailed answers in the Basic Patisserie course as most question items can be addressed with short answers. The theoretical study on multiple-choice items is conducted on the criteria for low quality items. Most questions with moderate difficulty level have distractors that work well. Some answers are similar to each other, resulting in students tricked into selecting the wrong answer. There are four items leading to the right answer, namely on the duties of a vice principal. Homogenous and logical answer choices from the material aspect result in questions with a high level of difficulty. Test participants are not distracted by the length difference of the answer choices as the correct answer is the most selected.

Questions in the Education Management course are categorized as easy. There are only 15% difficult and very difficult questions from the total question items. Easy questions are made to give a sense of satisfaction for students and allow them to get a good score and pass the examination. Easy questions do not necessarily mean bad questions, as they may indicate that the test takers are smart and have the abilities to answer correctly. Easy questions result in a low item discriminating power. When more than half of the questions are in the “easy” category, many test takers from the lower group can answer correctly. The negative discriminating power implies that many of the lower group answer correctly by guessing, while the upper group has more incorrect answers. This kind of question requires re-examination for improvement. There is a good item distribution of the HOT level with >50% in the essay questions. This addresses the demands of the increasingly competitive global job market.

1. **Conclusion**

Based on the theoretical study of the essay questions, it is found that two courses, Food & Tourism and Food Quality Control, do not address the indicators as the assessment has been done based on the assignments and the mid-term examination. Questions with short answer are prone to double interpretation and unclear expected answers. The essay questions in the Basic Patisserie course have short answers instead of detailed ones. The findings of theoretical study on the multiple-choice questions show 5 items leading to the correct answer, 1 item with different lengths of answer choices, and 2 items with highly homogenous answer options. The questions have addressed the indicators of having one correct answer option and no double negative statements. The theoretical study on multiple-choice questions also show most questions are in the “easy” category, hence the low discriminating power. Easy questions are resulted from the students’ mastery on the learning material. The distribution of the cognitive level in the essay questions for the academic year 2018/2019 consists of 16 LOTs items, 23 MOTs items, and 45 HOTs items.

**Funding**

This work was supported by the Competitiveness Growth Program of the Federal Autonomous Educational Institution of Higher Professional Education National Research Nuclear University MEPhI (Moscow Engineering Physics Institute) under Grant No. [R07GM589654].

**Acknowledgement**

The authors would like to thank their colleagues for their contribution and support to the research. They are also thankful to all the reviewers who gave their valuable inputs to the manuscript and helped in completing the paper.

1. **References**

|  |  |
| --- | --- |
| [1] | Harden RM. *Learning outcomes and instructional objectives: Is there a difference?* Med Teach. 2002;24(2):151–5 |
| [2] | Khan T, Hande S, Bedi S, Singh T, Kumar V 2012 *Learning Objectives: “Perfect is the Enemy of Good!” Int J User-Driven Healthc* ;2(3):44–62 |
| [3] | Kusuma MD, Rosidin U, Abdurrahman A, Suyatna A 2017 *The Development of Higher Order Thinking Skill (Hots) Instrument Assessment In Physics Study* IOSR J Res Method Educ;07(01):26–32 |
| [4] | Kemendikbud 2017 Modul Penyusunan Soal HOTS. *Kementrian Pendidikan dan Kebudayaan* 48 p. |
| [5] | Nachiappan S, Damahuri AA, Ganaprakasam C, Suffian S 2018 *Application of Higher Order Thinking Skills (HOTS) in teaching and learning through communication component and spiritual, attitudes and values component in preschool* Int J Early Child Educ Care 7(1):24–32 |
| [6] | Darmawan IPA, Sujoko E 2013 Revisi Taksonomi Pembelajaran Benyamin S. Bloom. Satya Widya;29(1):30 |
| [7] | Bartlett FC, Kintsch W, Bartlett FC, Kintsch W. A 2010 *Theory of Remembering. Remembering*;197–214 |
| [8] | Wang Y 2017 *The Cognitive Process of Comprehension: A Formal Description. J Cogn Informatics Nat Intell*;4(5):1–14 |
| [9] | Yahya AA, Osman A, Taleb A, Alattab AA 2013 *Analyzing the Cognitive Level of Classroom Questions Using Machine Learning Techniques*. Procedia - Soc Behav Sci [Internet]. 97:587–95. Available from: http://dx.doi.org/10.1016/j.sbspro.2013.10.277 |
| [10] | Adams NE 2015 *Bloom’s taxonomy of cognitive learning objectives J Med Libr Assoc JMLA*, [Internet]. 2015;103(July):152–3. Available from: https://www.theguardian.com/science/shortcuts/2016/oct/30/what-protocol-aliens-make-contact-arrival |
| [11] | Tofade T, Elsner J, Haines ST 2013 *Best practice strategies for effective use of questions as a teaching tool* Am J Pharm Educ;77(7) |
| [12] | Puslitbangsisjian. Bahan penataran pengujian pendidikan. 1996 |
| [13] | T M Wardhany and S E Y Suprihatin 2020 The development of three-dimentional media chart to make golbi cleavage in sewing technology course Journal of Physics: Conference Series **1446**, p. 012066 |
| [14] | Gnaldi M, Matteucci M, Mignani S, Falocci N. 2013 *Methods of item analysis in standardized student assessment: An application to an Italian case study*. Int J Educ Psychol Assess [Internet];12(2):78–92. Available from: http://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,url,cookie,uid&db=psyh&AN=2013-27692-005&site=ehost-live&scope=site%5Cnfalocci.nicola@crumbria.it%5Cnstefania.mignani@unibo.it%5Cnm.matteucci@unibo.it%5Cngnaldi@stat.unipg.it |