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The Level of Higher Order Thinking Skills for Chemical Equilibria Among Form Six Chemistry Students

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Abstract: This study aims to determine the level of Higher-Order Thinking Skills (HOTS) for the topic of Chemical Equilibria among form six students. A convenience sampling method was used to gather 121 form six students who studied Chemistry for their Malaysian Higher School Certificate (STPM) in Penang. For data collection, open-ended questions consisting of the HOTS Test of Chemical Equilibria encompassing the four highest cognitive levels of Revised Bloom's Taxonomy were used. The data were analyzed using descriptive analysis methods. The results indicate that students in Form Six have a low level of HOTS for the topic of Chemical Equilibria. The percentage of students with high achievement levels decreases with each cognitive level, beginning with the level of applying (47%) and progressing through the levels of analyzing (34.7%), evaluating (26.4%), and ultimately creating (8.3%). This level of achievement pattern also indicates that most students have difficulty answering HOTS Chemical Equilibria Test questions requiring higher cognitive levels and cannot solve real-world problems. The implication of this study is to provide teachers with the knowledge necessary to enhance their students' HOTS using effective teaching and learning strategies.

Keywords: *Higher-order Thinking Skills (HOTS), Chemical Equilibria, Form Six Students, Bloom's Taxonomy*

1. Introduction

Curriculum modifications in the Malaysia Education Blueprint 2013-2025 have centered on the HOTS concept to produce a competitive generation in response to the educational demands of today. Through HOTS, students can solve Chemistry problems and prepare themselves for international competition [1]. A person with high HOTS possesses a collection of cognitive abilities [2]. The use of language, drawing conclusions, calculating results, making decisions, and solving problems are indicators of HOTS in the learning process. For learning Chemistry at the STPM level, students must master HOTS to be able to solve problems related to concepts, increase awareness of the role of Chemistry in understanding nature and the universe, and be able to think maturely, be knowledgeable, and convey ideas effectively using various forms of communication [3].

To meet the challenges of the 21st century, students need not only reading, writing, and arithmetic skills but also HOTS, which is the primary catalyst of 21st-century skills [4,5]. In addition to making students effective thinkers, HOTS enables students to view concepts holistically [6]. Malaysia's level of achievement for high-level science questions, including Chemistry, is low according to the TIMSS 2019 National Report [7]. Students have not been adequately trained to deal with problems that require them to apply HOTS such as applying, analyzing, evaluating, and creating [8]. In addition, there are few studies on HOTS at form six or pre-university levels in Malaysia, particularly in the field of chemistry [9]. To determine the level of HOTS

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for the topic of Chemical Equilibria among form six chemistry students in Penang, this study was conducted.

HOTS is the ability to make decisions with clear and rational thought [10]. HOTS is one of the skills heavily emphasized in learning science, particularly Chemistry, to enable students to confront and solve various problems that exist in daily life and the environment [11]. In addition, HOTS ability is one factor determining an individual's marketability in the increasingly competitive job market [12]. According to Hasan and Pardjono [13], HOTS is a fundamental talent that is a priority when evaluating a graduate's employment qualifications.

HOTS is an essential component of the learning process because it enables students to access, manage, interpret, and apply information [14]. Thinking skills are part of the general abilities that must be incorporated into all subjects [15] because student performance can be improved with HOTS [16]. In addition, HOTS assists students in classifying and relating various components, enabling them to identify valuable information and apply it to the resolution of environmental issues [17]. Students should be able to analyze, synthesize, and evaluate information and ideas logically and critically to solve problems [3].

The assessment and evaluation system has changed as a result of the transformation of the Malaysian educational system. The application of HOTS elements to the curriculum of science subjects marked the beginning of their incorporation into the National Education Philosophy [18]. In addition, HOTS elements are being incorporated into all examination papers that are scored based on the suitability of students' thinking levels for different age groups (Malaysia Education Blueprint, 2013-2025). This transformation necessitates that instructors and students become proficient in HOTS.

However, according to the report of STPM Chemistry exam results for semester 1 from 2015 to 2019, the overall level of student achievement remained low, with full pass rates of 52.41 percent, 48.43 percent, 53.82 percent, 59 percent, and 63.3 percent, respectively. In addition, the majority of STPM candidates are unable to provide accurate responses to HOTS questions, as indicated by the report's comments. In addition, the report revealed that the majority of candidates were unable to respond to non-routine questions involving the application of the concept of Chemical Equilibria to reactions in an environment that required candidates to analyze, synthesize, make connections, and apply theory, knowledge, or procedures to various situations. This indicates that students' HOTS mastery is not yet stable. The Trends in International Mathematics and Science Study (TIMSS) 2019 National Report demonstrates that Malaysia's level of achievement for high-level questions based on international benchmarking in Science is lower than the international average and Singapore [7].

According to Gilbert [19], a high content load results in a Chemistry curriculum that overemphasizes minor information, leaving students unable to draw connections for those facts and failing to obtain meaningful learning. When asked differently (non-routine questions), students struggle to answer problems utilizing the same concept and do not comprehend why they need to study a given Chemistry subject [20]. Thus, instructors' teaching approaches are critical in providing students with opportunities to build problem-solving abilities and cognitive activities, hence contributing to the development of HOTS in students [20]. To ensure the development of students' HOTS, emphasis should be placed on attempts to help students understand the concept of Chemistry. As a result, there is a requirement in this study to determine the level of HOTS of form six chemistry students for the level of applying, analyzing, evaluating, and creating without ignoring the application of scientific process skills and scientific products.

2. Materials and Methods

This study is a survey-based quantitative investigation. In this study, students' HOTS were assessed using open-ended questions from the HOTS Chemical Equilibria Test, which were adapted from STPM exam questions. The following section addresses sampling, instruments, and data analysis.

2.1. Sampling

This study employs a simple sampling method (convenience sampling) to select the study sample. A total of 121 science students from form six centers and colleges in the province of Penang were selected as a study sample. Based on the willingness of the centers and colleges to offer their students to participate in this study, this methodology is employed [21]. In addition, the population in this research is homogeneous, consisting of form six students in the science stream who have completed the Chemical Equilibria study [22].

2.2. Instrument

The HOTS Chemical Equilibria test set's open-ended questions are used to collect data. Students have one hour and thirty minutes to complete the written test questions. This HOTS test set includes three structure questions and one short essay question that addresses the four highest cognitive stages of revised Bloom's Taxonomy, which are applying, analyzing, evaluating, and creating [23]. According to McConnell et al. [24], the use of open-ended questions helps promote critical thinking and HOTS in students. According to Suhaimi and Zahari [25], open-ended questions necessitate students' HOTS to explain, project, or analyze a topic, situation, or problem. The test items are intended to evaluate the student's level of achievement on HOTS questions about Chemical Equilibria. Table 1 depicts the test specification table, which includes a breakdown of questions based on subtopics of Chemical Equilibria and cognitive levels. Table 2 shows the split of question items based on the Revised Bloom's Taxonomy's cognitive level.

Table 1. Test specification table

Subtopics of Chemical Equilibria	Applying	Analyzing	Evaluating	Creating	Total
Unit 1: Reversible equilibria and derivation of equilibrium constant, K_c and K_p	1	3	3	1	8
Unit 2: Factors Affecting Chemical Equilibria: Le Chatelier's Principle		3	1	2	6
Unit 3: Effect of Temperature Toward Equilibria	1		1	1	3
	2	6	5	4	17
	12%	35%	29%	24%	100%

TABLE 2. Classification of HOTS Chemical Equilibria test items by Revised Bloom's Taxonomy's cognitive level

Test Item	Revised Bloom's Taxonomy Cognitive Levels			
	Applying	Analyzing	Evaluating	Creating
1 a) i.	/			
1 a) ii.		/		
1 b) i.		/		
1 b) ii.			/	
2 a)		/		
2 b)			/	
2 c) i.		/		
2 c) ii.			/	
3 a) i.	/			
3 a) ii.			/	
3 a) iii.		/		
3 b)			/	
4 a) i.		/		
4 a) ii.				/
4 a) iii.				/
4 b) i.				/
4 b) ii.				/

2.3. Data Analysis

Using descriptive analysis, the level of achievement of students in answering HOTS questions was analyzed. Based on student responses to the HOTS Chemical Equilibria test, a descriptive analysis of the percentage value and the mean score of students was calculated for this purpose. The answer scripts of the students are reviewed and evaluated according to the scoring scheme. Using the following formula, the student's cumulative score will then be converted to a percentage value.

(Student score)/(Overal score) ×100%

In addition, the percentage scores of students are organized by achievement level, which is classified as low, medium, and high. This category of accomplishment level is determined by the Malaysian Examination Council following the STPM grading system. Table 3 depicts the achievement scale that will be used in this investigation.

TABLE 3. Classification of student achievement levels according to the STPM grading system

Score Range (Percent)	Grade	Grade Value	Result	Category
0 → 29	F	0.00	Fail	Low
30 → 34	D	1.00	Partial Pass	
35 → 39	D+	1.33		
40 → 44	C-	1.67		
45 → 49	C	2.00	Full Pass	Medium
50 → 54	C+	2.33		
55 → 59	B-	2.67		
60 → 64	B	3.00		
65 → 69	B+	3.33		High

Moreover, percentages and the mean are used to analyze student scores based on the cognitive level of applying, analyzing, evaluating, and creating. To ascertain the level of student achievement in responding to HOTS questions, all achievement categories are compared.

3. Result and Discussion

Figures 1 and 2 display the outcomes of student achievement according to categories and results.

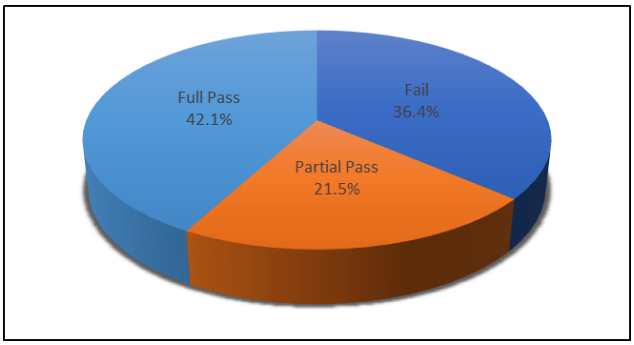

FIGURE 1. Student achievement level based on results

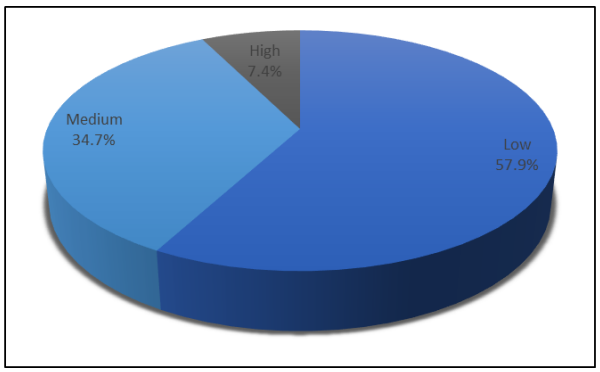

FIGURE 2. Student achievement level based on category

Based on Figure 1, the analysis of the form six students' performance on the HOTS Chemical Equilibria questions reveals that 42.1% (51) of the students received a full pass, 21.5% (26) received a partial pass, and 36.4% (44) received a fail. Figure 2 displays the outcomes of an analysis of student achievement levels by category. Comparing the analyses in Figure 1 and Figure 2, it can be seen that only 7.4% (9) of the students who passed all of their courses received high grades, whereas 34.7% (42) of the students received average grades. This finding indicates that high-achieving students also struggle to answer HOTS Chemical Equilibria test questions. Partial pass results at the STPM level indicate that the student has achieved a minimum level. The results of the analysis depicted in the two figures above indicate that a significant number of form six Chemistry students struggle to answer the HOTS Chemical Equilibria questions. Figure 3 depicts the analysis of students' achievement levels on HOTS Chemical Equilibria test items based on the four cognitive levels of the revised Bloom's Taxonomy.

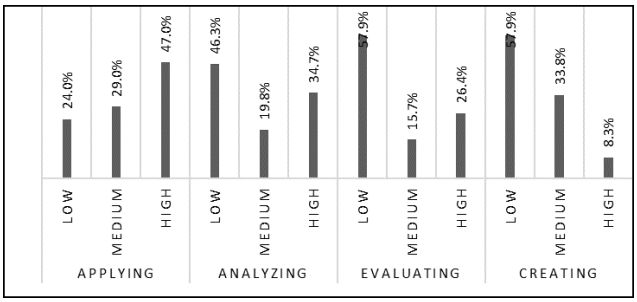

FIGURE 3. Levels of student achievement on the HOTS Chemical Equilibria test based on the cognitive level of applying, analyzing, evaluating, and creating

Figure 3 demonstrates that the percentage of the level of achievement of form six students for applying cognitive level items is the highest for high and medium achievement, at 76%, compared to cognitive level items for analyzing (53.7%), evaluating (42.1%), and creating (42%). Comparatively, 57.9% of students scored poorly on cognitive-level tasks involving evaluating and creating. The findings also indicate that the percentage of students with high achievement levels decreases with each cognitive level, beginning with the level of applying (47%) and ending with the level of creating (8.3%). This level of achievement pattern indicates that students have difficulty answering questions requiring higher cognitive levels on the HOTS Chemical Equilibria test. Figure 4 depicts an analysis of the mean percentage of students' scores on HOTS Chemical Equilibria test items based on cognitive level, which reveals the pattern of declining student achievement. In the context of this investigation, the level of achievement of form six students on HOTS Chemical Equilibria Test questions is low.

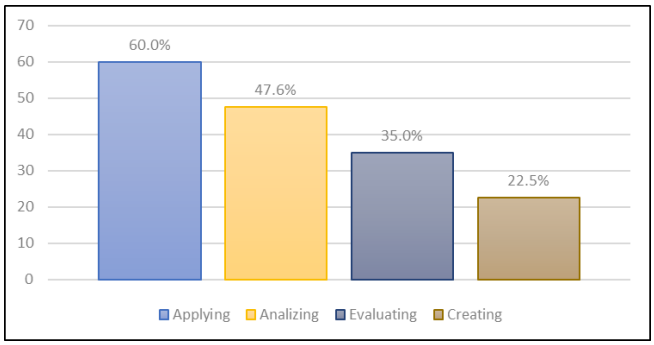

FIGURE 4. Distribution of mean student scores on the HOTS Chemical Equilibria test based on the cognitive level of applying, analyzing, evaluating, and creating

3.1. Applying Level

In comparison to other cognitive levels, the applying level is the lowest. The study results for this level indicate that 57 students received high scores, 35 students received median scores, and 38 students received low scores. Compared to other cognitive levels, the number of students with high grades or accomplishments is the highest. This result was anticipated, as items at the cognitive level only assess students' ability to apply previously learned concepts or principles in question-based situations or contexts [26]. However, there are still a significant number of students who cannot adequately respond to this item, particularly item 1 a(i). 34 students received a perfect score (2), 70 students received a score of 1, and 17 students received a score of 0. Item 1 a(i) only requires students to define dynamic balance in the context of the Touch Process. This demonstrates that form six students' mastery of the fundamental concept of Chemical Equilibria remains inadequate.

3.2. Analyzing Level

The level of analyzing is the second cognitive ability assessed for HOTS Chemical Equilibria test items. To complete the tasks at this level, students must have a thorough understanding of the concept of Chemical Equilibria and the ability to make connections. 42 students received a high score, 23 students received a median score, and 56 students received a low score, according to the

findings of this study. This demonstrates that students are incapable of making connections between previously taught concepts to solve the presented problems. Analysis of student response templates revealed that the majority of students provided answers outside the problem's context without first analyzing the question's requirements. The analysis reveals that the lowest level of student achievement is for item 2 c(i), where 110 students scored zero. Students are required to provide explanations for why the calculated K_c value based on the neutralization procedure differs from the actual value. Analysis of student response templates revealed that the majority of students provided answers outside the problem's context without first analyzing the question's requirements. In addition, the results of the analysis of student scripts revealed that a significant number of students were unable to solve the analysis-level questions that required calculations. This is supported by the analysis of item 1 b(i), which revealed that 97 students received a score of zero. In addition, the analysis revealed that numerous students have misconceptions regarding Chemical Equilibria.

3.3. Evaluating Level

In general, for items at the evaluating level, students must evaluate and interpret, formulate, discuss, and make decisions, among other tasks [26]. Analysis of the results of the evaluating level revealed that only 32 students received a high score, 19 received a medium score, and 70 received a low score. This finding indicates that student achievement at the evaluating level is low. The majority of students received a score of 0 on items 1 b(ii) and 2 c(ii) based on an evaluation of the level items. Consequently, the student could not accurately calculate the partial pressures of ammonia and hydrogen sulphide for item 1 b(ii) based on the situation presented in the question. Similarly, the analysis of student response scripts for item 2 c(ii) revealed that many students suggested "eye level must be perpendicular to..." as an enhancement for the neutralization reaction so that the Kc value can be accurately calculated. In addition, numerous students responded "to control the temperature" as a recommendation. These student responses demonstrate that they are unable to make accurate interpretations and do not fully comprehend the concept of Chemical Equilibria.

3.4. Creating Level

The cognitive level of creating is the highest in the revised version of Bloom's Taxonomy. This cognitive level correlates closely with students' critical and creative abilities. Items at this level test the student's ability to apply previously learned concepts and necessitate critical thinking. The HOTS Chemical Equilibria test administered to the students in this investigation consists of four questions. Only 8.3% (ten) students received a high achievement score on the HOTS Chemical Equilibria test questions on the cognitive level of creation, as determined by the aggregate analysis. This finding demonstrates that the level of mastery of the concept of Chemical Equilibria among form six students is still generally low. The analysis of all four items comprising the cognitive level of creating demonstrates this, specifically items 4 a(ii), 4 a(iii), 4 b(i), and 4 b(ii). Analysis of item 4 a(ii) revealed that only three students earned a perfect score (3), while item 4 a(iii) yielded eleven students. The analysis of student responses revealed that students were unable to integrate their understanding of Chemical Equilibria with previously taught concepts using critical thinking. Additionally, students are unable to correctly identify the system components in Equilibrium, making it challenging for them to predict and explain Le Chatelier's effect on the system. In addition, the analysis of item 4 b(i) revealed that 25 students received a high score, whereas no students received a high score on item 4 b(ii). These items assess the student's capacity to make real-world connections between previously learned concepts. Analysis of student responses to items 4 b(i) and 4 b(ii) reveals that students do not comprehend the learning content because they are unable to create learning descriptions for real-world situations. This finding is consistent with Fibonacci et al. [27] assertion that the disparity between what is learned in class and what is encountered in real life is the most challenging aspect of learning Chemistry for students. Abdul Razzak [28] concurs with this point, stating that students with poor cognitive skills are unable to present a convincing argument against a scientific concept. Consequently, the achievement level of form six students on HOTS Chemical Equilibria test questions remains low.

3. Conclusion

In conclusion, this study provides a descriptive analysis of students' HOTS at the levels of applying, analyzing, evaluating, and creating among form six chemistry students in the state of Penang. This study's sample included 121 form six students from form six centers and colleges who took chemistry classes. The primary objective of this study is to determine the level of HOTS for the four highest cognitive levels of revised Bloom's Taxonomy encompassing the levels of applying, analyzing, evaluating, and creating among chemistry students using the HOTS Chemical Equilibria Test. The results of the study indicate that the majority of form six chemistry students have insufficient levels of HOTS. The findings also indicate that the proportion of students with high achievement levels decreases with each cognitive level, beginning with the level of applying, followed by the levels of analyzing and evaluating and ending with the level of creating. This level of achievement pattern demonstrates that students struggle to answer HOTS Chemical Equilibria test questions requiring higher cognitive levels, particularly those requiring the solution of real-world problems. Specifically, many students responded without first analyzing the requirements of the question by providing answers outside the context of the

problem; they were unable to make an accurate interpretation; they did not understand the concept of Chemical Equilibria; and they did not comprehend the learning content because they were unable to create a learning description for a real-world situation. Therefore, based on the findings, the researcher recommends the use of an *e*-Module that emphasizes higher-order thinking skills for the topic of Chemical Equilibria by integrating the use of technology and effective learning strategies, such as problem-based learning, to assist teachers in enhancing students' HOTS. The recommendation is pertinent because 21st-century learning emphasizes technology and a student-centered approach. In addition, the researcher recommended that a more comprehensive study be conducted on the HOTS process among students. Therefore, we can gain a greater understanding of the cognitive process in students' minds and may be able to enhance their HOTS, particularly at the levels of applying, analyzing, evaluating, and creating.

REFERENCES

[1] A. Dian Purnamasari and B. U. Suryadi, "Analysis of STEM-PBL Based E-Module Needs to Improve Students' Critical-Thinking Skills", Journal of Physics: Conference Series, IOP Publishing, Vol. 1511, No. 1, p. 012096, 2020. (DOI: 10.1088/1742-6596/1511/1/012096)

[2] P. A. Facione, Critical Thinking: What It Is and Why It Counts, California: Measured Reasons and the Californias Academic Press, 2015.

[3] Malaysian Examination Councils, Malaysian Higher School Certificate Examination: CHEMISTRY Syllabus and Specimen Papers, Malaysian Examination Councils, 2012.

[4] E. Ad'hiya and E. W. Laksono, "Students' analytical thinking skills and chemical literacy concerning chemical equilibrium", AIP Conference Proceedings, AIP Publishing LLC, 2018, Vol. 2021, No. 1, p. 080005. (DOI: 10.1063/1.5062824)

[5] N. N. Ibrahim, A. F. Ayub, A. S. M. Yunus, and R. Mahmud, "Effects of higher order thinking module approach on students' performance at primary rural school", Malaysian Journal of Mathematical Sciences, 13(2), 211-229, 2019. (http://psasir.upm.edu.my/id/eprint/76366)

[6] D. Shukla, and A. P. Dungsungnoen, "Student's Perceived Level and Teachers' Teaching Strategies of Higher Order Thinking Skills: A Study on Higher Educational Institutions in Thailand", Journal of Education and Practice, 7(12), 211-219, 2016. (https://files.eric.ed.gov/fulltext/EJ1099486.pdf)

[7] Educational Planning and Research Division MOE, TIMSS National Report 2019 - Trends in International Mathematics and Science Study, First Print 2020, Ministry of Education Malaysia, 2019.

[8] E. Ellizar, S. D. Putri, M. Azhar, and H. Hardeli, "Developing a discovery learning module on chemical equilibrium to improve critical thinking skills of senior high school students", Journal of Physics: Conference Series, IOP Publishing, Vol. 1185, No. 1, p. 012145, 2019. (DOI: 10.1088/1742-6596/1185/1/012145)

[9] N. S. Rusli, N. H. Ibrahim and C. Hanri, "The Need Analysis Of e-Module Development Integrated with Problem-Based Learning on Chemical Equilibria to Improve Students' Higher-Order Thinking Skills", In ICE2022 Proceedings, 45, Published in December 2022.

[10] Ministry of Education Malaysia, Kemahiran Berfikir Aras Tinggi: Aplikasi Di Sekolah. Curriculum Development Division, Ministry of Education Malaysia, 2014.

[11] M. N. A. Mat Nor, N. Kamaruddin, U. K. Abd. Manaf and M. H. Mohd Puad, "Kemahiran Berfikir Aras Tinggi (KBAT) Dalam Pengajaran Dan Pembelajaran Reka Bentuk Dan Teknologi (RBT) Sekolah Rendah", Jurnal Penyelidikan Dedikasi, 16, 27-45, 2021. (https://myjms.mohe.gov.my/index.php/jd/article/view/12349)

[12] M. F. R. Gani, "Keberkesanan kemahiran berfikir aras tinggi pelajar dalam matematik melalui kaedah pembelajaran luar bilik darjah", Journal of Advanced Research in Social and Behavioural Sciences, 10(1), 80-90, 2018. (https://www.akademiabaru.com/doc/ARSBSV10_N1_P80_90.pdf)

[13] A. Hasan and P. Pardjono, "The correlation of higher order thinking skills and work readiness of vocational high school students", Jurnal Pendidikan Teknologi dan Kejuruan, 25(1), 52-61, 2019. (DOI: 10.21831/jptk.v25i1.19118)

[14] S. Balisteri, F. T. D. Giacomo, I. Noisette and T. Ptak, Global Education: Connections, Concepts, and Careers, New York: College Board, 2012. (https://files.eric.ed.gov/fulltext/ED562681.pdf)

[15] R. R. Y. Rahayu and H. Sutrisno, "The Effect of Chemistry Learning Based On Analogy On Higher Order Thinking Skills Of Senior High School Students In Equilibrium Concepts", European Journal of Education Studies, 2019. (DOI: 10.46827/ejes.v0i0.2361)

[16] Y. M. Heong, Widad, Jailani, T. T. Kiong, Razali and Mimi, "The level of Marzano higher order thinking skills among technical education students", International Journal of Social Science and Humanity, 1(2), 121-125, 2011. (http://www.ijssh.org/papers/20-H009.pdf)

[17] A. I. Sitthipon, "Development of teachers' learning management emphasizing on analytical thinking in Thailand", Procedia-Social and Behavioral Sciences, 46, 3339-3344, 2012. (DOI: 10.1016/j.sbspro.2012.06.063)

[18] H. Mohd Nazri, M. Ramlee, N. Y. Nik Azimah and M. Rosnidar, "Pembangunan modul kemahiran berfikir aras tinggi di dalam mata pelajaran sains sekolah rendah: analisis keperluan guru", Sains Humanika, 9(1-5), 2017. (DOI: 10.11113/sh.v9n1-5.1185)

[19] J. K. Gilbert, "On the nature of "context" in chemical education", International Journal of Science Education, 28(9), 957-976, 2006. (DOI:10.1080/09500690600702470)

[20] G. Tsaparlis, "Higher and Lower-Order Thinking Skills: The Case of Chemistry Revisited", Journal of Baltic Science Education, 19(3), 467-483, 2020.

[21] L. M. Given, (Ed.), The Sage Encyclopedia of Qualitative Research Methods, Sage Publications, USA, 2008.

[22] A. Abdul Muqsith, Pembangunan model ENi berasaskan aktiviti inkuiri bagi program latihan kemahiran kejuruteraan Institut Latihan Kemahiran Malaysia. Ph. D. thesis, Universiti

Malaya, 2018.

[23] L. W. Anderson and D. R. Krathwohl, (Eds.), A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives, New York: Longman, 2001. (http://eduq.info/xmlui/handle/11515/18824)

[24] D. A. McConnell, D. N. Steer and K. D. Owens, "Assessment and active learning strategies for introductory geology courses", Journal of Geoscience Education, 51(2), 205-216, 2018. (DOI: /10.5408/1089-9995-51.2.205)

[25] M. Z. Suhaimi and M. S. M. Zahari, "Common acceptable cuisine in multicultural countries: Towards building the national food identity. World Academy of Science, Engineering and Technology", International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering, 8(3), 859-865, 2014. (DOI: 10.5281/zenodo.1093522)

[26] Curriculum Development Division MOE, Spesifikasi Kurikulum Kimia Tingkatan Empat. Putrajaya, Malaysia: Ministry of Education Malaysia, 2012.

[27] A. Fibonacci, A. Wahid, U. Lathifa, M. Zammi, T. Wibowo and H. H. Kusuma, "Development of chemistry e-module flip pages based on chemistry triplet representation and unity of sciences for online learning", Journal of Physics: Conference Series, (IOP Publishing), Vol. 1796, No. 1, p. 012110, 2021. (DOI: 10.1088/1742-6596/1796/1/012110)

[28] N. Abdul Razzak, "Strategies for effective faculty involvement in online activities aimed at promoting critical thinking and deep learning", Education and Information Technologies, 21, 881–896, 2016. (DOI: 10.1007/s10639-014-9359-z)