

Performances in English Proficiency Course with Students' Ability in Answering Higher Order Thinking Skills Questions

Rafidah Rasol¹, Nur Syimal'ain Azmi², Sharipah Ruzaina Syed Aris², Wan Razarinah Wan Abdul Razak²

¹ School of Biological Sciences, Faculty of Applied Sciences, Universiti Teknologi MARA, 40450 Shah Alam, Selangor Malaysia.

² Faculty of Education, Universiti Teknologi MARA, 42300 Kampus Puncak Alam, Selangor Malaysia

rafid738@uitm.edu.my, syimalainazmi@gmail.com, sruzaina@uitm.edu.my, razarina408@uitm.edu.my,
Tel of 1st Author: +603-55435733

Abstract

This study investigates how English writing skills' effect on the students' performance in answering Higher Order Thinking (HOT) questions in Molecular Biology final examination. The samples consisted of Biology degree students from two consecutive semesters in UiTM Shah Alam and UiTM Jengka. Mean percentage of students performance was obtained and correlated with marks obtained in English course. The two campuses demonstrated different correlation between students' achievement in English and their ability in answering HOT questions. The results of this study are hoped to assist biology educators in crafting appropriate teaching approaches, as well as in strengthening English language proficiency.

Keywords: Higher Order Thinking Skills; Molecular Biology; English Proficiency; Bloom's Taxonomy.

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1.0 Introduction

Molecular Biology is considered a challenging subject as it involves deep conceptual understanding of complex Biology processes at the molecular level and advanced molecular techniques. It incorporates biochemistry and genetics in a living system. In UiTM, students from Bachelor of Science (Hons) Biology are required to take Molecular Biology (BIO615) during semester four and semester five depending on their modes of entry. There are two different types of entry mode, which are from the Diploma of Science or Foundation in Science and Science Matriculation. Different levels of students' achievement generally produce other methods of entry. Mlambo (2011) stated that factor that has a significant effect on the students' academic performance in various settings is entry qualification. Adebayo and Tinuola (2014), in their study, depicted that students have better and consistent grades with higher entry qualifications than those with lower-level qualifications. However, in this study, different modes of student's entry and their relation in answering HOTS questions in BIO615 were not highlighted.

2.0 Literature Review

English is used in all programmes offered in UiTM whether Science and Technology based or the Social Science-based (Arsad *et al.*, 2014). Therefore, in the Faculty of Applied Sciences where BIO615 is offered, the medium of instruction in lectures, laboratory sessions and tutorials used in English. In order to strengthen the students' command in English, those from Bachelor of Science (Hons) Biology are required to take three English subjects namely Preparatory College English (ELC400), English for Academic Reading (ELC450) and English for Academic Writing (ELC 550) for the first three semesters of their degree-level study. ELC550, which is the highest English code taken by Biology students, has course learning outcomes (CLO) focusing on the ability to analyse and respond critically to academic texts and integrate information to prepare an academic text outline besides being able to present them orally. Furthermore, students

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must have a certain level of Malaysian University English Test (MUET) before entering the first-degree program. Therefore, sufficient exposure to thinking, conversing and writing in English is hoped to assist UiTM degree students in delivering their answers in English during the examination. For those whose first language is not English (Wardlow, 1999), there is a need to polish or increase their skills in this language since English proficiency is vital for completing their studies in English medium institutions.

Malaysia is lagging in preparing adequate utilisation to enhance HOTS in learning whether in higher education or secondary education (Chinedu *et al.*, 2015). Moreover, learning objectives in training and curricular focus tremendously on the lower levels of the taxonomy, including comprehension and knowledge. This problem is in the radar of the Ministry of Education. HOTS is defined as the capability to apply knowledge, skills and value in reasoning, reflection, problem-solving, decision making, innovating and creating something new. Zohar and Dori (2003) referred HOTS to a thinking process that consists of complicated procedures and needs to be based on various skills such as analysis, synthesis, comparison, interference, interpretation, assessment and inductive and deductive reasoning to be employed in solving unfamiliar problems. Through myriad forms of the thinking process, students are capable of finding the answer or accomplishing target goals (Budsankom *et al.*, 2015). Therefore, HOTS is the skills used by students to apply and evaluate the knowledge, which require deep conceptual understanding (Gulistan *et al.*, 2015; Zoller, 1993).

Quality of student learning is significantly impacted by the improvement of assessments in education (Entwistle & Entwistle, 1992). Hence, Crowe *et al.* (2008) stated that a more comprehensive tool is needed for undergraduate biology instructors so that they can easily evaluate students' knowledge, guide the development of teaching approaches and enhance students' metacognition in biological science as developed by Blooming Biology Tool (BBT). In Bloom's Taxonomy, there are six categories of cognitive skills ranging from lower-order skills that require less cognitive processing to higher-order facilities as well as deeper learning and a greater degree of cognitive processing (Adams, 2015). Teachers in Malaysia are expected to include the HOTS element to foster deeper thinking activities among students in the 21st century to respond to the vision of the Ministry of education (Sulaiman *et al.*, 2017). Charif (2010) stated that educators should think about methods that fit in higher level of thinking and problem solving since it is necessary for students today to think critically to face real world problems. Marin and Halpern (2011) confirmed that critical thinking can help shaping the foundation of students' early adult life for them to enter the society as professional adults. There are various techniques that can be done to implement HOTS in learning. One of the ways is by constructing open-ended questions for building understanding, which will motivate further conversation among students, thus promoting higher-level thinking (Huerta & Jackson, 2010). Magsino (2014) opted for problem-based learning to enhance HOTS in Marine Biology class. Similar to this situation, HOTS were asked in BIO615 final examination according to Bloom's Taxonomy classification and Table of Specification Test (TOS), which a tool to ensure the reliability, validity, fairness and consistency of final examination. According to Fives and DiDonato Barnes (2013), test blueprint or TOS is a table that assists teachers in teaching by aligning the objectives, instruction and assessment that are usually used for traditional summative test. When constructing or selecting a test, a teacher can use TOS as tool to verify their professional judgment. Due to the observation of high failure rate in BIO615 in these two campuses, this study aimed at identifying the relationship between the students' performance in ELC550 and their scores in answering HOTS in BIO615 final examination.

3.0 Methodology

Research Design: The researcher adopted descriptive research in this study to answer the research questions and applied quantitative research method to acquire the data. Descriptive research is related to the description of characteristics of a particular individual or a group.

HOTS identification: HOTS questions in BIO615 final examination from Semester Sept-Jan 2016 and Mac-July 2016 were chosen. These HOTS questions were identified according to classification of Bloom's Taxonomy and Table of Specification Test. Bloom's Taxonomy Indicator version 3 developed by Curriculum Affairs Division, UiTM was used in assisting the identification of HOTS questions into the three levels known as analysis, synthesis and evaluation. The percentages of marks for HOTS questions for these two semesters were 10-30% specifically for Year 3 students. This translated to 18 marks in the Sept-Jan 2015 semester and 12 marks from semester Mac-July 2016. The questions asked are displayed in Table 1.

TABLE 1: HOTS Questions asked in BIO615 final examination.

Examination	Question Number	Question	Marks	Accumulative marks
December 2015	1 (b)	Chromosome organisation allows a 2 m long DNA to be squeezed into a 2 μ m cell nucleus. Explain the other four levels of chromosome organisation that builds up from your answer in 1a).	8	
	3	During screening of blue-white transformants in the molecular cloning process, X-gal is added into the screening medium. Justify the significance of X-gal addition.	6	18
	6 (a)	You have just isolated the chloroplast genome DNA of mungbean (<i>Vigna radiata</i>) with the size of 150 kb. You planned to build a genomic library of around 9-20 kb restriction digests. Determine the appropriate vector and explain your choice.	4	
June 2016	2(b)	The pBR322 plasmid, first created in the late70s became less popular after the introduction of the pUC plasmid. Explain the	3	15

	reason for the abandonment of the pBR322 plasmid and the importance of the new characteristic found in the pUC plasmid.	
6(b)	Discovery of a new species of beetle in Borneo rainforest revealed that its mRNA is different by having a poly (G) tail instead of poly (A) tail as per eukaryotic organisms. Describe how you can construct a cDNA library of this beetle. Include a labelled diagram to help visualise your answer.	12

The questions utilised the verbs describe, explain, justify and determine. Question 1(b) from December 2015 and 2(b) from June 2016 both utilised the verb explain, which can be used in higher level questions (C5 or C6) in this context. The long essay question 1(b) required the students to visualise the complex chromosome structural organisation and relate it to its purpose to recall that information. Meanwhile, Question 2(b) from June 2016 involved comparison and connection between the characteristics of pBr and pUC plasmids as well as the disadvantage of the former plasmid. As for Question 6(b) from semester June 2016, describe was used in a higher level question (C6) as the students need to understand the concept of cDNA library right from the first process of priming for the poly (A) tail as the question was twisted from a normal condition. Therefore, the evaluation type question (C6) needs the synthesis of knowledge and ability in visualising the process to answer it. Question 3 from December 2015 permits the student to give reason for their action when facing a situation related to a scientific experiment. Finally, Question 6(a) from December 2015 paper let students to decide (C6) if given a condition in an experiment.

Students' performance scoring: Student marks in answering selected HOTS questions in BIO615 were obtained from the Examination's unit for the Semester Sept-Jan 2015 and Mac-July 2016 final examination. The marks for the identified HOTS questions were tabulated together with results of ELC550 accordingly.

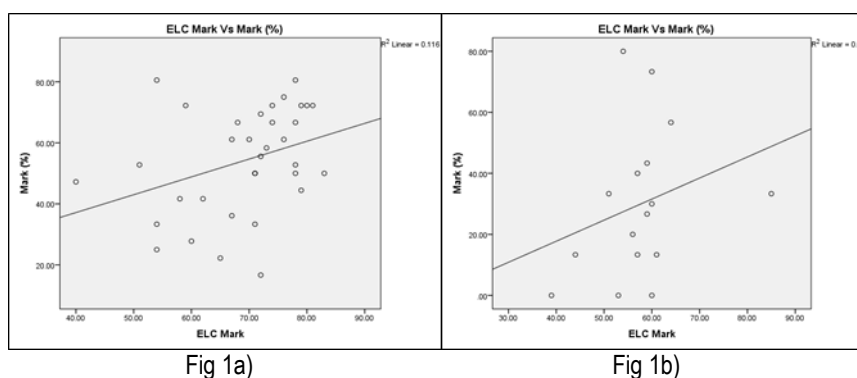
Research Instrument: The HOTS questions utilised by this study were based on Bloom's Taxonomy that focuses on three levels that require creative and critical thinking followed by analysis, synthesis and evaluation. Meanwhile, the Table of Specification Test (TOS) was used to identify the questions as HOTS questions in the BIO615 final examination.

Population and Sampling: The population of this study comprised 61 students in UiTM Jengka, Pahang and 51 students from UiTM Shah Alam in the Faculty of Applied Sciences. The sample of population for this study includes students from the Bachelor of Science (Hons.) Biology who are taking BIO615 as one of their subjects in semester 4 or 5 depending on their entry either from the Diploma in Science, Science Foundation or Science Matriculation. Therefore, the sampling was purposive sampling in which the researcher acquired the marks of the ELC and HOTS score from Examinations' unit for December 2015 and June 2016.

Data Analysis: The data collected was analysed and synthesised using Statistical Package for Social Science (SPSS 17.0) to observe the significance between students' performance in answering HOTS questions in the BIO615 final examinations and its association with their ELC 550 marks

4.0 Results

Results shown in 1 a) and b) include the correlation between ELC marks and the respective students' ability to answer HOTS question in BIO615 final examination in UiTM Shah Alam. Both semesters of Sept-Jan 2016 and semester Mac-July 2016 showed a weak relationship with R values of 0.341 and 0.275, respectively. Results shown in 1 c) and d) display the correlation between ELC marks and the respective students' ability to answer HOTS question in BIO615 final examination in UiTM Jengka. In semester Sept-Jan 2016, Fig 1 c) shows the correlation value of R=0.526 considered as intermediate relationship, whereas the R value for semester Mac-July 2016 [Fig 1 d)] was slightly lower (0.193) but was still categorised as having a weak relationship.



Correlation of ELC marks with BIO615 final examination marks in students from
 Fig.1: a) UiTM Shah Alam campus from Semester Sept-Jan 2016
 Fig.1: b) UiTM Shah Alam campus from Semester Mac-July 2016

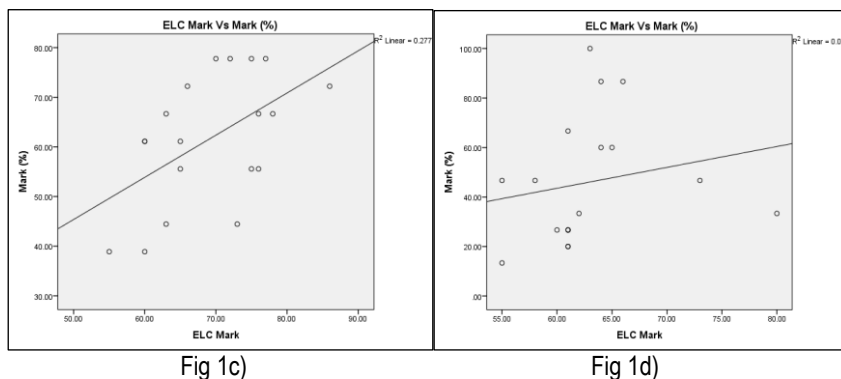


Fig.1: c) UiTM Jengka campus from Semester Sept-Jan 2016
 Fig.1: d) UiTM Jengka campus from Semester Mac-July 2016

5.0 Discussion

From the results, it can be deduced that students with better performance in ELC 550 were not necessarily able to answer HOTS in BIO615 final examination as seen in the weak value of most of the relationships. However, for semester Sept-Jan 2016 in UiTM Jengka, the intermediate relationship showed that scorers in ELC550 were better in answering some of the HOTS questions in BIO615 final examination. Stoddart et al. (2002) in their study suggest that science learning and language learning have a reciprocal and synergistic relationship. There was a myriad of formats such as in writing, oral idea deliverance, drawing and creating tables and graph to communicate their understanding of BIO615. Furthermore, low English skills hindered the students from having depth understanding about concepts of this course because they have to interpret it in their mother tongue, which is Bahasa Melayu, before translating it back into English (Hiew, 2012). Therefore, Noor and Azmah (2006) stated that the main source of poor academic performance among students is having low proficiency in English since it can cause students to face difficulties in understanding the basic knowledge, thus contributing to poor written essay (Arsad et al., 2014). Cummin (1991) proved a significant relationship between English reading and writing academic achievement. In addition, most of the reference works and textbooks at the university level are written in English (Noor & Azmah, 2006). Last but not least, students can retain academic information by having a strong language skills including writing and speaking (Huerta & Jackson, 2010).

Another study that is not in line with the results obtained in this study is a study by Sharifah and Syed (2004) that showed significant correlation between the fluency in English language and students to excel in overall academic performances in their study. Besides, Huerta and Jackson (2010) concluded that various media of language such as writing, data tabulation and figure construction in BIO615 can help students in keeping their memory, thus improving their academic performance. International students need to have a TOEFL (Test of English as Foreign Language) while in Malaysia, the local undergraduates require MUET as a prerequisite to pursue degree level. Martirosyan et al. (2015) discussed in their study that there were significant differences in the academic performance of international students with different English language proficiency where the students who scored higher in TOEFL have high GPA, while those who scored lower in TOEFL have low GPA.

BIO615 utilised the normal lecture and laboratory session approach. Oral presentation is compulsory for every semester. In this way, educators can encourage communication skills that would also reflect an individual ability to critically discuss a subject matter. There are a few methods practiced in literature that can enhance critical thinking skills in students. Case-based studies that emphasised on problem solving and discussion had also increased students' abilities to answer application and analysis-type questions in Introductory Biology course (Chaplin, 2009). Secondly, teaching science through inquiry had also promoted HOTS by using scientific research articles. Hugerat and Kortam (2014) administered pre-test and post-test to Biology/Chemistry majors together with an intervention that emphasised on inquiry teaching. Besides leading to positive emotional and cognitive satisfaction, this intervention increased HOTS development among the participants. Moreover, inquiry-based learning had been applied to chemistry laboratory where inquiry-type experiments were given and assessed using proper tools, resulting in improvement of ability in asking scientific questions (Hofstein et al., 2004). In MSU-Balindong High School, chemistry students favoured the HOTS questions as it was interesting, challenging though difficult (Valdez et al., 2013). Problem-based learning was found as an effective instructional strategy within a conventional curriculum that can enhance critical thinking in marine biology (Magsino, 2014). Given these strategies to increase critical thinking skills, it is an approach that can be implemented by BIO615 educators to increase critical thinking skills in the class, therefore overcoming the need to rely on English course alone to inculcate critical thinking skills in Biology students.

6.0 Conclusion

Bachelor of Science (Hons) Biology students in two UiTM campuses have been seen showing a weak relationship between majority of ELC550 marks and their ability to answer HOTS question in BIO615 final examination. Other variables that can be the factors such as entry requirement and instructors' leniency that influence students' achievement should be further examined.

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