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The Role of the Classroom in the Development of Higher-Order Thinking Skills in Secondary School Students

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Abstract:

According to research published by Shahril Sabudin, Azlin Norhaini Mansor, Subahan Mohd Meerah, and Azliza Muhammad (2018), students from Malaysia showed a decline in their science and mathematics proficiency levels on an international scale between 2007 and 2015, as revealed by the Program International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS) [28]. Simultaneously, studies have shown that students' exposure to a scientific laboratory environment could impact their growth in HOTS. Similar findings were reached by Mubarak, Suprpto, and Adam (2018)[21], who noted that laboratory investigative activities would impact the HOTS. No studies have been carried out in Malaysia on the relationship between HOTS and the learning environment in scientific labs as of yet. Consequently, this quantitative study uses the HOTS of secondary school students in Kuala Nerus, Terengganu to investigate the relationship between these factors and the classroom environment. The first section of the survey inquires about the nature of the scientific classroom environment, whereas the second section concerns the students' HOTS. Part B uses a set of researchers' subjective questions, while Part A uses SLEI, which was devised by Fraser et al. (1992). A total of 89 students from two separate schools were selected at random by the researchers. The findings showed that the students' HOTS were related to the learning setting in which they were taught the content. The research found that if science labs had enough materials and equipment, students' HOTS would be better. In order to ensure that the Malaysian Ministry of Education (MOE) has sufficient funding to purchase scientific supplies and equipment, this research's conclusions are useful.

Keywords: learning environment, higher order thinking skills, material environment, Ministry of Education Malaysia, materials and laboratory apparatus.

I. INTRODUCTION

The stated goal of the Malaysian Education Development Plan (2013–2025) is to "provide equitable access of the quality education international standards" (Mazlini Adnan, Aminah Ayob, Tek, Mohd Nasir Ibrahim, Noriah Ishak & Jameyah Sheriff, 2016). This aligns with the present changes in the educational system of the country, which strives to create diverse and capable individuals who can compete on a global scale. [20]. If our students want to be competitive on a global scale, Nur Hawa Hanis Abdullah and Ghazali Darusalam (2018) contend that they should emphasize strengthening their Higher Order Thinking Skills (HOTS). The integer 23. The international standards known as TIMSS and PISA will be used to assess the academic progress of students in Malaysia (KPM, 2012). [13]. However, the low test scores of Malaysian

students demonstrated that they struggled to use HOTS (KPM, 2012). [13]. The rationale for this is that the Malaysian Ministry of Education (MOE) aspires to have Malaysian schools rated among the world's top three on the TIMSS and PISA assessments by the year 2025. The Ministry of Education in Malaysia has therefore embraced 21st Century Learning (21CL), also known as "Pembelajaran Abad ke 21, PAK21," a curriculum that prioritizes the use of HOTS in the classroom.

II. BACKGROUND OF THE STUDY

Communication, teamwork, critical thinking, creativity, and the application of moral and ethical principles are the cornerstones of 21st Century Learning (21CL), a student-centered approach to education (Wayan Redhana, 2019). [20]. Furthermore, according to Khair Mohamad Yusof (as cited in KPM 2016), 21CL also implies that instructors prioritize student-centered learning and

place an emphasis on developing HOTS in their students. [16]. The focus of instruction and study in a HOTS classroom will shift from the instructor to the students. Through activities like inquiry, investigation, and project-based learning, in which instructors serve as facilitators, student-centered learning has the potential to enhance students' thinking (KPM, 2014) [14]. Research by Mubarak,

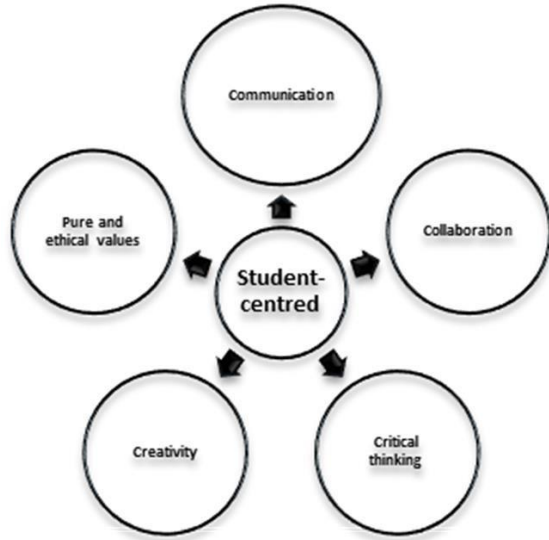


Figure 1

However, Malaysia's achievements in the TIMSS (Trends in International Mathematics and Science Study) and PISA (Program International Student Assessment) from 2007 to 2015 showed a decline in the mastery of science and mathematics subjects among Malaysian students internationally (Shahril Sabudin, Azlin Norhaini Mansor, Subahan Mohd. Meerah & Azliza Muhammad, 2018) [28].

Drawing on the issue of the weakening of the HOTS among the Malaysian students, the elements of the science laboratory learning environment were chosen as the variable in this study. Studies abroad have found that the science laboratory learning environment will influence the HOTS students' (Akani, 2015; Hofstein, Dkeidek, Katchevitch, Nahum, Kipnis, Navon, Shore, Taitelbaum & Mamlok-Naaman, 2019; Madhuri, Kantamreddi & Goteti, 2012) [1][12][19]. However, the study by Arni Yuzie Mohd Arshad and Ruhizan Mohd Yasin (2015) [3] found that students' level of thinking skills were modest and still in the cognitive domain of the app. Overall, the majority of students in the cognitive domain of the application were 61%, the analysis was 33%, the assessment was 26% and the design was 20%.

No studies have been found in Malaysia on the study of the relationship of learning environment in science laboratory to students' high level thinking skills. So, this has prompted researchers to study the relationship between the science laboratory learning environment and HOTS as they have never been able to find a study of the relationship.

III. RESEARCH QUESTIONS

The research questions of the study are

Suprpto, and Adam (2018) [21] corroborated this conclusion, showing that laboratory investigations would affect HOTS. The reason for this is because the students were already actively learning in the lab while they were exploring (Nur Liyana Ali, Ta, Sharifah Zarina Syed Zakaria, Mazlin Mokhtar & Sharina Abdul Halim, 2014) [24].

1. What is the level of the dimension of science laboratory learning environment in the secondary school?
2. What is the level of the dimension of higher order thinking skill (HOTS) among the secondary school students?
3. Is there a relationship between the dimension of science laboratory learning environment and the dimension of the higher order thinking skills (HOTS) among the secondary school students?

IV. METHOD

A. Research Design

In generally, this study was correlated using a cross-sectional approach in the quantitative data collection process through respondents. A set of questionnaires was used to collect data to identify the direction and influence of the study constructs (Creswell, 2014; Bakker, 2018) [10]. The questionnaire consisted of two sections; Part A is the science laboratory learning environment and Part B is the higher order thinking skills (HOTS).

B. Sampling Design

The population of respondents was from all the form two students in the district of Kuala Nerus, Terengganu. Two secondary schools were selected by a simple random sampling. This sampling was chosen because it was suitable to use when the population almost had a uniform characteristics. This sampling was in line with the two following assumptions; (1) every member of the population has the same opportunity to choose, (2) the choice of one subject is independent and independent of the other (Azizi, Shahrin, Jamaludin, Yusof & Abd.Rahim, 2007) [5].

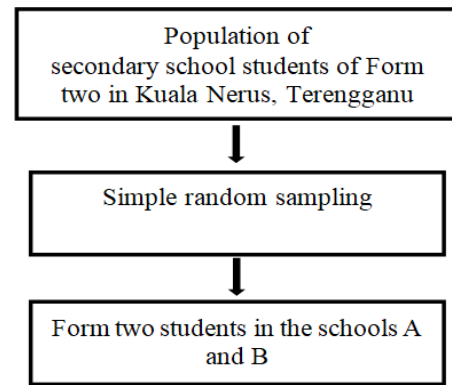


Figure 2

C.

D. Instrument

The instrument was used in this study adapted and modified by Che Nidzam Che Ahmad (2011) [6] from the Science Laboratory Environment Inventory (SLEI) which was developed by Fraser et al. (1992). The original version of the SLEI had 35 items, presented in five different scales; student’s cohesiveness, open-endedness, integration, rule clarity and material environment. Each scale in SLEI has seven items.

According to a study by Stanger-Hall (2012) [29] who found that the structured questions was better in promoting the higher order thinking skills among students. Therefore, a set of structured question instruments were developed by the researchers. The questions were adapted and modified from Form Three Assessment, “Pentaksiran Tingkatan 3, PT3” questions of 2016 and 2017 {KPM, 2018} [17] and were based on Bloom's Taxonomy (2001). The construct verifications in the assessment were carried out by two experienced and specialised teachers from AKRAM (Angkatan Kerja Rajin dan Mulia) Terengganu. Subsequently, alpha

G. Data Analysis

cronbach tests were performed to determine the reliability of the instruments. There are ten structured questions, which include the subscales of applying, analysing, evaluating and creating.

E. Alpha Cronbach

a satisfactory reliability values above 0.6 (Ary et al., 2002; Nunnally, 1978; Coakes, Steed & Ong 2009) [4][22]. However, some researchers recommended an alpha coefficient of 0.6 and above, especially for the preliminary studies (Fauzi Hussin, Jamal Ali & Mohd Saifoul Zamzuri Noor, 2014) [11].

F. Data Collection

Prior to initiate the data collection process, the researchers firstly applied the permission from the Education Planning and Research Division (EPRD) (MOE) before starting the study. After obtaining the permission from Terengganu State Education Department and then from the school’s principal, the researchers went to the involved schools for distributing the questionnaire to the selected respondents.

Table 1

SLEI Dimension	Item No.	Item Dropped	Alpha Cronbach Value , α
Student’s cohesiveness	1, 2, 3, 4, 5	6*, 7*	0.70
Open-endedness	11, 12, 13	8, 9, 10, 14*	0.76
Integration	19*, 20*, 21*	15, 16, 17, 18*	0.83
Rule clarity	22, 23, 24, 25, 26	27*, 28*	0.75
Material environment	29, 30, 31, 32*, 33*, 34*, 35*	29, 30	0.74

The integration dimension had a good reliability value of over 0.8, while the other four dimensions had a sufficient reliability values for the measurement above 0.7 (Ary et al., 2002; Nunnally, 1978; Coakes, Steed & Ong 2009) [4][22].

Table 2

HOTS Dimension	Item No.	Alpha Cronbach Value, α
Applying	1, 5	0.72
Analysing	2, 6	0.71
Evaluating	3, 7	0.77
Creating	4, 8	0.65

All dimensions showed an adequate reliability values for the measurements above 0.7, except the creating dimensions had

Table 3

No.	Research Questions	Type Of Analysis
1	What is the level of the dimension of science laboratory learning environment in the secondary school?	Mean
2	What is the level of the dimension of higher order thinking skill (HOTS) among the secondary school students?	Mean
3	Is there a relationship between the dimension of science laboratory learning environment and the dimension of the higher order thinking skills (HOTS) among the secondary school students?	Spearman's Correlation

The Table 3 above shows the types of analysis that will be used in this study.

The research method involves in this study are descriptive and inference data analysis to answering research questions related to the current state of the science laboratory learning environment and higher order thinking skills among form two student in Kuala Nerus, Terengganu.

Table 4

Mean Score	Level
3.34 – 5.00	High
1.67 – 3.33	Medium
0 – 1.66	Low

Table 5

Score	Scale
1	Strongly Disagree
2	Disagree
3	Neither Agree or Disagree
4	Agree
5	Strongly Agree

V. RESULT

Research questions 1: What is the level of the dimension of science laboratory learning environment in the secondary school?

Table 4

Dimension SLEI	Mean	Std. Deviation
Student's cohesiveness	3.63	.54
Open-endedness	2.91	.55
Integration	2.79	.53
Rule clarity	3.84	.60
Material environment	3.11	.46

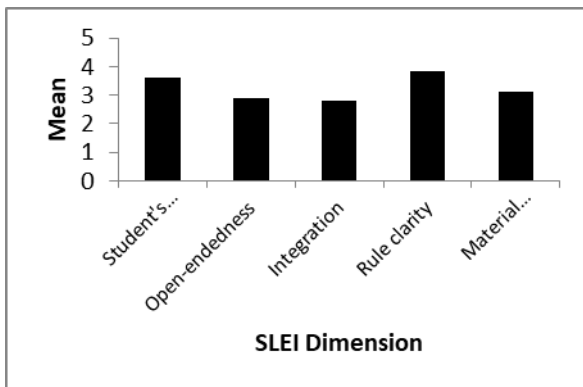


Figure 3

The results of the study for the two dimensions of SLEI showed at the high levels which are the rule clarity (mean = 3.84) and the student's cohesiveness (mean = 3.63). Meanwhile, the other three dimensions are at the medium level; material environment (mean = 3.11), open-endedness (mean = 2.91) and integration (mean = 2.79).

Research questions 2: What is the level of the dimension of higher order thinking skill (HOTS) among the secondary school students?

Table 5

HOTS dimension	Mean	Std. Deviation
Applying	1.05	.67
Analysing	1.67	1.06
Evaluating	1.05	.81
Creating	1.35	.97

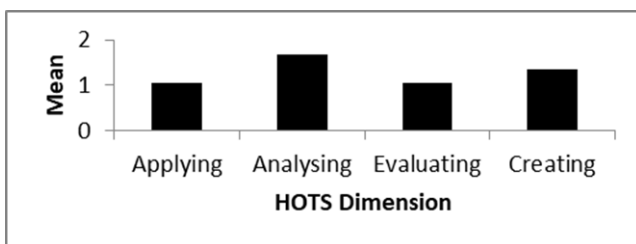


Figure 4

The results of this study showed that the analysing dimension (mean = 1.67) is at the medium level. Meanwhile, the other three dimensions are at the lower levels; creating (mean = 1.35), applying (mean = 1.05) and evaluating (mean = 1.05).

Research questions 3: Is there a relationship between the dimension of science laboratory learning environment and the dimension of the higher order thinking skills (HOTS) among the secondary school students?

Table 6

SLEI	HOTS							
	Applying		Analysing		Evaluating		Creating	
	r_{xy}	Sig.	r_{xy}	Sig.	r_{xy}	Sig.	r_{xy}	Sig.
Student's cohesiveness	.030	.782	.257*	.015	.059	.585	.049	.646
Open-endedness	.045	.676	.043	.692	.031	.776	.141	.186
Integration	.040	.713	.006	.959	.035	.744	.077	.472
Rule clarity	.080	.459	.106	.324	.033	.761	.061	.568
Material environment	.235*	.027	.234*	.027	.262*	.013	.303*	.004

* Significant level at 0.05

** Significant level at 0.01

There is a significant relationship between the dimensions of material environment and all the HOTS dimensions. Meanwhile, there is also a significant relationship between the dimensions of student's cohesiveness and the analysis dimension of HOTS.

VI. DISCUSSION

According to the averages, the classroom atmosphere was moderate (mean = 3.25) but students' ability to think critically was poor (mean = 1.28). Students' cohesion (mean=3.63) and rule clarity (mean=3.84) were likewise determined to be high. At the same time, the material environment dimensions were modest, with a mean of 3.11, open-endedness of 2.91, and integration of 2.79. This information is corroborated by Pyatt and Sims (2007) [25], who observed that the majority of scientific activities did not allow students to independently investigate and comprehend the phenomena they were studying. Teachers need to pay attention to the psychosocial aspects of their lessons, according to Che Nidzam Che Ahmad, Kamisah Osman, and Lilia Halim (2010) [6]. This includes making sure students have enough resources to conduct their own research and putting an emphasis on activities that help students make connections between classroom theory and laboratory practice. It is the responsibility of the educators to provide their pupils with opportunities to think creatively and plan their own experiments. Results showed a lack of proficiency in higher-order thinking abilities on average. On the other hand, the best mean was 1.67 for the analyzing dimension, followed by 1.35 for the generating dimension, and 1.05. For the applying and evaluating dimensions, the mean was also 1.05. These results were consistent with those of a study conducted on 384 first-year students in this nation by Tee Tze Kiong, Jailani Md Yunos, Razali Hassan, Yee Mei Heong, Atan Hj. Hussein, and Mimi Mohaffyza Mohamad (2012) [18] that also

indicated a severely lacking degree of higher-order thinking abilities. The learning environment for the material environment dimension was significantly related to the higher order thinking abilities. Consistent with their previous research, Akinbobola and Olufunmiyi (2015) [2] discovered that providing students with an appropriate material environment will improve their critical thinking and creative abilities. Additionally, the analytical component of HOTS was related to the student's cohesiveness qualities. Nevertheless, research conducted by Ramnarain and Hlatswayo (2018) [26] on educators in Mpumalanga, South Africa, corroborated that insufficient classroom size, lab space, and instructional resources were impeding students' ability to master course content.

they should train

VII. CONCLUSION

Overall, the results showed that the science laboratory learning environment was correlated with the higher order thinking skills of the secondary school students in Kuala Nerus, Terengganu. The material environment played an important role in enhancing student's critical skills and creativity. The adequate laboratory materials and apparatus would stimulate the student's skills, which would encourage them to innovate and creative in the science laboratory learning environment.

The teachers as a facilitators also should increase the activity in the science laboratory. The science laboratory learning environment had been proven to enhance the HOTS through the experimental activities. This finding was supported by Mubarak, Suprpto and Adam (2018) [21] who found that the investigative activities in the laboratory would influence the HOTS. Therefore, the

government through the MOE must always ensure an adequate provision for the purchase of materials and laboratory apparatus in schools whether in the urban or the rural.

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