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ICECoT 2021

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"Future Trends of Emerging Computational Technologies in the 21st Century"
"Strategizing IR4.0 in Conquering Covid-19 and Beyond"

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Preface

This e-book describes the research papers presented at the International Conference on Emerging Computational Technologies (ICECoT 2021), organised by Faculty of Computer and Mathematical Sciences (FSKM), UiTM Cawangan Melaka. The main discussions of the conference is on the technological advances that help shape the skills that are required to cope with the Fourth Industrial Revolution (IR 4.0). Considering that this is our first attempt at organising a conference, we are therefore greatly honoured that the Universitas Negeri Semarang (UNNES), Indonesia, Mahasarakham University (MSU), Thailand and University of Hail (UoH), Saudi Arabia have all agreed to become our partners by contributing several reseach papers as well as providing reviewers to assess the quality of the papers.

Out of the numerous research works that had been submitted and reviewed, the Editorial Board have selected 22 papers to be published in the e-book. The discussions of these papers pertain to the use of technologies within the broad spectrum of Computer Science, Computer Networking, Multimedia, Information Systems Engineering, Mathematical Sciences and Educational Technology. It is hoped that the research findings that are shared in this e-book can benefit those who are interested in the various areas of computational technologies; such as graduate students, researchers, academicians and the industrial players, to name a few.

As the Project Manager, I would like to thank all of the committee members from the bottom of my heart for their tireless efforts in ensuring the success of ICECoT 2021. Without their continual support and excellent teamwork, this conference would not have come to fruition. In fact, holding this major event has been a good learning experience for us all, and I sincerely believe that our future conferences will become more outstanding if the same spirit is maintained.

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Predictors of Perceived Higher Order Thinking Skills (HOTS) Among Diploma and Undergraduate Students

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Abstract— **The study determines the relationship between perceived higher order thinking skills (HOTS) of diploma and bachelor's degree students and the academic performance in the university. Samples are selected from all full-time students pursuing study in Universiti Teknologi MARA Cawangan Melaka (UiTMCM) using purposive sampling technique. Samples consist of 425 (60.9%) students of semester 1 and 273 (39.1%) students of semester 2 and higher from seven faculties pursuing studies at diploma and bachelor's degree study level. Results reveal that perceived analyzing, evaluating, creating thinking skills and overall HOTS among students are at moderate level. Male students perceive that they are significantly more evaluative and creative than female students. Diploma and bachelor's degree students show they are at the same moderate level in analyzing, evaluating, creating thinking skills and overall HOTS. Family permanent residents (rural, sub-urban or urban) are shown to have no effect on analyzing, evaluating, creating thinking skills and overall HOTS among students. Socio-economic status of students from family income RM8000 and above are proven to be significantly more creative and having higher overall HOTS level than those students from lower family income group. There is no significant difference in intake qualification (*Sijil Pelajaran Malaysia (SPM)*, diploma or *Sijil Tinggi Pelajaran Malaysia (STPM)/Asasi/*Matriculation) of students on analyzing, evaluating, creating thinking skills and overall HOTS. However, students of July/September intake perceived significantly higher creating thinking skills and overall HOTS compared to students of March/November intake. *Kemahiran Berfikir Aras Tinggi (KBAT)* experienced during schools are found to be significantly influencing the perceived evaluating, creating thinking skills and overall HOTS among students. Lastly, perceived overall HOTS only explains 2.8% of the variance in CGPA of students.**

Keywords—analyzing, creating, evaluating, higher order thinking skills (HOTS), Kemahiran Berfikir Aras Tinggi (KBAT), Sijil Pelajaran Malaysia (SPM)

I. INTRODUCTION

In 1956, Benjamin Bloom and a group of educational psychologists developed a system of classification referred to Bloom's Taxonomy for levels of cognitive skills and learning behavior [1]. Taxonomy means classifications or structures in which classification of Bloom's Taxonomy concerns thinking skill level and it is classified to six cognitive levels of complexity; knowledge, comprehension, application, analysis, synthesis and evaluation [1]. Based on terminology, structure and emphasis categories, Lorin Anderson and a group of cognitive psychologists updated the Bloom's Taxonomy to revised Bloom's Taxonomy [2]. The original version is updated to revised version based on terminology, structure and emphasis Fig. 1.
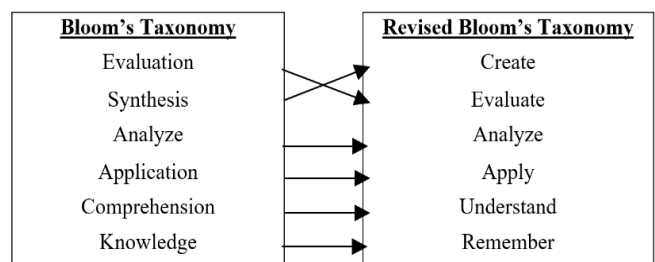

Fig. 1. Bloom's Taxonomy to Revised Bloom's Taxonomy

Thinking skills is very fundamental in educational process and it is associated with teaching and learning

activities. Both teachers and students must possess a certain level of thinking skills. In order to deliver knowledge, teachers must be equipped with high order thinking skills. Students also must have their own level of thinking skills as they are the recipient of knowledge. Ability to learn, speed and effectiveness of learning are affected by students' thinking skills [3] which are categorized into higher order thinking skills (HOTS) and lower order thinking skills (LOTS).

Kementerian Pendidikan Malaysia had introduced *Kemahiran Berfikir Aras Tinggi* (KBAT) through *Pelan Pembangunan Pendidikan Malaysia* (PPPM) 2013-2025. KBAT was first implemented in Malaysian schools in 2014. It is a continuation to *Kemahiran Berfikir Secara Kritis dan Kreatif* (KBKK) which was introduced in 1994. KBAT gives focus to high level thinking skills namely analyze, evaluate and create. KBAT is defined as the ability to apply knowledge, skills and values in making of reasoning and reflection for problem solving, decision making, innovative and able to create something (*Bahagian Pembangunan Kurikulum, Kementerian Pendidikan Malaysia*) [4].

The emphasis of this present study is on the top three levels of HOTS; analyze (5 items), evaluate (4 items) and create (5 items). Analyze means breaking materials into parts, determining how the parts are related to one another and to overall structure through differentiating, organizing and attributing. Evaluate means making judgments based on criteria and standards through decision or course of action justification. Create means putting elements together to generate new ideas, products, or ways of viewing things [2].

In their study on students' perception of Marzano HOTS level, [5] concluded that there exist insignificant differences in higher order thinking levels between male and female students, across socio-economic status and academic achievement. Study done by [6] also revealed there is no significant gender difference on mathematics performance in higher order thinking (applying skills and reasoning skills). Gulistan *et al.* [7] also reported there was no significant difference between students' level of higher order thinking skills and their gender with more male students were at lower level than female students. Based on these findings, it is very important for all students to enhance their higher order thinking skills not only in their tertiary education but also in preparation for their working world. Critical thinking skills of female students are a slight better than male students when solving mathematical problems [8]. Similar results show that students in Thailand have a moderate level of higher order thinking skills and male students are found to have a slight higher HOTS level when compared to female students [9]. In their study, [10] reported that male students are better at building an idea than female students. In studying the relationship of HOTS level and academic performance in physics of male and female students, [11] revealed that the HOTS level on analysis, evaluation and comparison have significant effect on academic performance of male students in physics. Study by [12] indicated technical students perceived that their comparing, inductive reasoning, deductive reasoning and investigation skills were at moderate level meanwhile their classifying, analyzing errors, constructing support, abstracting, analyzing perspectives, decision making, problem solving, experimental inquiry and invention skills were at low level.

Furthermore, students with HOTS are able to lessen their weaknesses, learn and subsequently improve their performance as suggested by [5] concluded that guided and free inquiry learning models positively significant towards students' ability in enhancing their HOTS level. Problem posing tasks can be characterized into "interpreting the problem condition and demand in term of mathematics communication", "manipulating information for constructing new problems in flexibility method", "analyzing the constructed problem regard to solvable or unsolvable", "create new and different problem which are solvable", "conclude a significant pattern or structure", and "finding the differences and similarities between two parts of tasks strategies" can be used to enhance HOTS level among engineering students as confirmed by [13]. In addition, open-ended test can be also used to train students critically and creatively in enhancing HOTS level among students as suggested by [3]. [14] recommended guided inquiry and free inquiry learning models are suitable to enhance students' HOTS level as these learning models are positively significant towards students' HOTS level with no gender difference for the two learning models.

The present study will investigate which perceived HOTS is/are significant among Universiti Teknologi MARA (UiTM) Cawangan Melaka students. The study also will examine for any difference in students' demography (gender, seniority of students, family permanent resident, socio-economic status, intake, intake qualification and field of study), and KBAT experienced during schools. Hence, to examine for any positive relationship between perceived HOTS level with academic performance.

II.   Methodology

Population of study consists of all full-time students of UiTMCM enrolling in 15 diploma programmes and 14 undergraduates programmes from seven faculties in semester September 2018 – January 2019. From each of the seven faculties, samples of diploma and bachelor degree students are selected using purposive sampling. This type of sampling can be useful if the targeted samples are to be reached quickly and proportionality is not the main concern [15]. Number of diploma and bachelor degree students selected from each faculty are listed in Table I.

The study utilized an instrument consisting three sections, A, B and C. Section A is a demographic profile, Section B is the education background, Section C consists of three constructs of perception of students on higher order thinking skills (HOTS) based on revised Bloom's Taxonomy. For Section C, questionnaire used 5-point Likert scale; 1 – strongly disagree, 2 – disagree, 3 – quite agree, 4 – agree, 5 – strongly agree for Part C. The questionnaires were distributed purposively using on-line Google Docs Form to respondents. The collected data were analyzed using SPSS Version 23.0.

TABLE I. PROPORTION OF RESPONDENTS BY FACULTY AND MODE OF STUDY

| Faculty | Mode of Study | | Total |
	Diploma	Bachelor Degree	
Akademi Pengajian Bahasa (APB)	40 (100.0%)	No bachelor degree programmes offered	40
Fakulti Komunikasi dan Pengajian Media (FKPM)	94 (88.7%)	12 (11.3%)	106
Fakulti Pengurusan Hotel dan Pelancongan (FPHP)	35 (50.0%)	35 (50.0%)	70
Fakulti Perakaunan (FPN)	75 (51.0%)	72 (49.0%)	147
Fakulti Pengurusan Perniagaan (FPP)	169 (67.3%)	82 (32.7%)	251
Fakulti Sains Komputer dan Matematik (FSKM)	37 (80.4%)	9 (19.6%)	46
Fakulti Senilukis dan Seni Reka (FSSR)	29 (76.3%)	9 (23.7%)	38
Total	**479 (68.6%)**	**219 (31.4%)**	**698**

III. RESULTS AND DISCUSSION

Total participants for the study are 698 students from seven faculties pursuing studies at diploma and bachelor degree levels in UiTMCM. Participants consist of 160 (22.9%) males and 538 (77.1%) females. Out of these 698 students, 479 (68.6%) are diploma students and 219 (31.4%) are bachelor degree students. Majority of the students (60.9%) were semester 1 and 39.1% students were in semester 2 and higher. Most of them (79.9%) are staying in campus while only 20.1% of them are non-residents.

A. Perceived High Order Thinking Skills (HOTS) Among Students

Reliability for each of HOTS is greater than 0.85 suggesting that the items of the thinking skills have relatively high internal consistency. Reliability of the overall 14 HOTS items is 0.949. For the present study, description of the scales is adapted from [15] as shown in Table II.

TABLE II. DESCRIPTION LEVEL OF HIGHER ORDER THINKING SKILLS (HOTS)

Scale	Description of HOTS Level
1.00 – 2.49	Low HOTS Level
2.50 – 3.49	Moderate HOTS Level
3.50 – 5.00	High HOTS Level

Table III shows that the study hypothesized each of perceived HOTS (analyze, evaluate, create) is at moderate HOTS level. Overall mean score of HOTS is 3.49. One sample t-test using test value 3.49 was conducted to examine the perceived HOTS levels for analyze, evaluate and create among students as shown in Table IV. Result shows that the perceived level of analyzing, evaluating and creating skills do not differ significantly from 3.49 at 0.05 level. This implies that the perceived HOTS among students for analyzing, evaluating and creating skills are all at moderate HOTS level. This finding is in line with the study reported by [9] that students have shown moderate level of HOTS. However, [5] showed that technical education students perceived they have moderate level for evaluating and creating thinking skills while analyzing thinking skill is at low level.

TABLE III. LEVEL OF PERCEIVED HOTS AMONG STUDENT

HOTS	Item	Mean Score	Description of HOTS Level
Analyze	I know to expand knowledge in the field of my study.	3.54	High
	I know to relate knowledge learnt to everyday life.	3.57	High
	I know to look at something from different perspectives.	3.57	High
	I know to analyze or to make comparisons what was learned in class.	3.50	High
	I know to link the knowledge learnt to one another.	3.52	High
	Average mean score	3.54	High
Evaluate	I do not have problems for completing a task given to me.	3.42	Moderate
	I am ready to act immediately to resolve any critical problems.	3.42	Moderate
	I am able to solve or evaluate problems based on different views and ideas.	3.50	High
	I have ideas when solving problems.	3.55	High
	Average mean score	3.47	Moderate
Create	I use my creativity when performing a task.	3.55	High
	I like to be innovative when performing a task.	3.51	High
	I know to realize new ideas when performing a task.	3.53	High
	I know to generate creative ideas.	3.44	Moderate
	I know to generate innovative ideas.	3.40	Moderate
	Average mean score	3.48	Moderate
Overall HOTS	**Total average mean score**	**3.49**	**High**

TABLE IV. SIGNIFICANCE OF HOTS

| HOTS | Perceived Mean Score | Test Value = 3.49 | |
		t-value	Significant Value
Analyze	3.54	1.812	0.070
Evaluate	3.47	-1.020	0.308
Create	3.48	-0.724	0.469

B. Difference of each Demographic Variables on Perceived Higher Order Thinking Skills (HOTS) Levels

Independent samples t-test was conducted to examine gender difference, seniority difference and intake difference. One-way analysis of variance (ANOVA) was used to test for any significant difference in family residential area, difference in family income group, difference in intake qualification and difference in field of study on each perceived HOTS (analyzing, evaluating and creating) among students.

Evaluating thinking skills and creating thinking skills both differ significantly between male and female students. Male students perceived their evaluating thinking skills and creating thinking skills higher significantly than female students. Both male and female students perceived their analyzing thinking skills at the same moderate HOTS level. Male students significantly have higher overall perceived HOTS than female students. These findings concluded that male students are more evaluative and creative at moderate HOTS level than female students while male and female

students have same moderate level of analyzing thinking skills. The finding is not coherent with the study [6] as in their study there is no significant gender difference on mathematics performance in higher order thinking. [7], Gulistan *et al.* also reported that there was no significant difference between students' level of higher order thinking skills and their gender which is also not in line with the present study.

Seniority of students are regrouped into junior students (first semester students) and senior students (students of semester 2 and higher). Results revealed that there are no seniority significant differences for analyzing, evaluating and creating thinking skills. This concludes the abilities of analyzing, evaluating and creating thinking skills are at the same level between junior and senior students.

Family permanent resident is categorized into rural, sub-urban and urban areas. Results showed that abilities of analyzing, evaluating and creating thinking skills are at the same level across family residential areas.

Socio-economic status is measured by family income group and this group is recoded into three categories: "1 - Less than RM4000", "2 - RM4000 < RM8000" and "3 - RM8000 and above". There was a statistically significant difference in perceived create thinking skills across family income group. Post-hoc comparison using Tukey test indicated that the mean score of perceived create thinking skills for income group RM8000 and above was at high HOTS level and was significantly different from income group less than RM4000 at moderate HOTS level and family income group RM4000 and less than RM8000 which is also at moderate HOTS level. Overall perceived HOTS also shown significant higher perceived level among students of income RM8000 and above at high HOTS level compared to students of income group less than RM4000 at moderate HOTS level. Results concluded perceived create thinking skills is significantly higher at high HOTS level among students of family income group RM8000 and above than those students of family income group less than RM4000. Table V stipulates the results.

Results revealed there is statistically significant perceived thinking skills of evaluating among students of March/November intake and July/September intake. Students of July/September intake perceived they have higher level of evaluating thinking skills compared to students of March/November intake. Results are summarized in Table VI.

Results indicated that perceived thinking skills of analyzing, evaluating, creating and overall perceived HOTS level did not differ significantly across intake qualification of students (*SPM*, Diploma, *STPM/Asasi*/Matriculation). Results concluded that students of different intake qualifications had the same perception on their analyzing, evaluating and creating thinking skills. Evidently, results also revealed that students of diploma and bachelor degree have the same perception on their level of analyzing, evaluating, creating and overall HOTS as proven in Table VII.

Linguistic students perceived the highest in analyzing, evaluating, creating and overall HOTS at high level. This is then followed by mass communication students that perceived all thinking skills at high level, and next by computer science students also perceived the thinking skills at high level as shown in Table VIII.

TABLE V. FAMILY INCOME GROUP DIFFERENCE ON PERCEIVED HOTS LEVEL AMONG STUDENTS

HOTS	Family Income Group	N	Mean	SD	F-value	Significant Value
Analyze	Less than RM4000	372	3.52	0.596	F(2,695) = 1.091	0.337
	RM4000 < RM8000	192	3.54	0.607		
	RM8000 and above	134	3.61	0.611		
Evaluate	Less than RM4000	372	3.43	0.644	F(2,695) = 2.393	0.092
	RM4000 < RM8000	192	3.50	0.630		
	RM8000 and above	134	3.57	0.619		
Create	Less than RM4000	372	3.41	0.630	F(2,695) = 7.934	0.000*
	RM4000 < RM8000	192	3.49	0.637		
	RM8000 and above	134	3.67	0.667		
Overall HOTS	Less than RM4000	372	3.45	0.569	F(2,695) = 4.085	0.017*
	RM4000 < RM8000	192	3.51	0.563		
	RM8000 and above	134	3.62	0.566		

TABLE VI. INTAKE DIFFERENCE ON PERCEIVED HOTS LEVEL

HOTS	Intake	N	Mean	SD	t-value	Significant Value
Analyze	March/November	154	3.48	.618	-1.313	0.189
	July/September	544	3.56	.597		
Evaluate	March/November	154	3.38	.652	-1.994	0.047*
	July/September	544	3.50	.631		
Create	March/November	154	3.45	.663	-0.604	0.546
	July/September	544	3.49	.641		
Overall HOTS	March/November	154	3.45	.584	-1.364	0.173
	July/September	544	3.52	.565		

TABLE VII. STUDY LEVEL DIFFERENCE ON PERCEIVED HOTS LEVEL

HOTS	Study Level	N	Mean	SD	t- value	Significant Value
Analyze	Diploma	479	3.5452	.59343	0.256	0.798
	Bachelor Degree	219	3.5326	.62078		
Evaluate	Diploma	479	3.4840	.62280	0.527	0.599
	Bachelor Degree	219	3.4566	.66735		
Create	Diploma	479	3.4715	.63281	-0.654	0.514
	Bachelor Degree	219	3.5059	.67329		
Overall HOTS	Diploma	479	3.5019	.55408	0.008	0.994
	Bachelor Degree	219	3.5015	.60326		

TABLE VIII. HIGHER ORDER THINKING SKILLS ACROSS FIELD OF STUDY

Field of Study		Analyze	Evaluate	Create	HOTS	Thinking Skill Level
Accounting	Mean	3.48	3.43	3.36	3.42	Moderate
	N	148	148	148	148	
	SD	0.577	0.633	0.663	0.571	
Art & Design	Mean	3.47	3.18	3.47	3.39	Moderate
	N	39	39	39	39	
	SD	0.555	0.492	0.565	0.472	
Business	Mean	3.50	3.44	3.43	3.46	Thinking skills at moderate level except analyzing thinking skill at high level
	N	251	251	251	251	
	SD	0.592	0.617	0.626	0.559	
Computer Science	Mean	3.64	3.54	3.61	3.60	High
	N	46	46	46	46	
	SD	0.610	0.584	0.676	0.535	
Hotel & Tourism	Mean	3.51	3.49	3.46	3.49	Thinking skills at moderate level except analyzing thinking skill at high level
	N	70	70	70	70	
	SD	0.538	0.612	0.551	0.500	
Mass Communication	Mean	3.62	3.59	3.62	3.61	High
	N	104	104	104	104	
	SD	0.668	0.713	0.680	0.618	
Linguistic	Mean	3.81	3.72	3.77	3.77	High
	N	40	40	40	40	
	SD	0.646	0.679	0.673	0.632	
Total	**Mean**	**3.54**	**3.48**	**3.48**	**3.50**	**Analyzing thinking skill and overall HOTS at high level while evaluating and creating thinking skills at moderate level**
	N	**698**	**698**	**698**	**698**	
	SD	**0.602**	**0.637**	**0.645**	**0.569**	

Results showed that perceived thinking skills of analyze, evaluate, create and overall perceived HOTS level differ significantly across field of study among students. Post-hoc Tukey test revealed that linguistic students perceived thinking skills of analyzing significantly higher than accountancy and business students, mass communication and linguistic students perceived thinking skills of evaluating significantly higher than art and design students, mass communication and linguistic students also perceived thinking skills of creating significantly higher than accounting and business students. Linguistic students also perceived the overall HOTS significantly higher than accounting, art and design and business students.

C. Perceived Higher Order Thinking Skills (HOTS) Levels by Kemahiran Berfikir Aras Tinggi (KBAT) Experienced During Schools

One-way ANOVA was conducted to find whether do perceived HOTS differ significantly by *Kemahiran Berfikir Aras Tinggi* (KBAT) experienced during school. KBAT experienced is categorized into 1 – No KBAT experienced, 2

– Partial KBAT experienced and 3 – KBAT experienced. Results showed that students with KBAT experienced during their school days perceived significantly higher evaluating, creating and overall HOTS thinking skills than students with no KBAT experienced and partial KBAT experienced. Students with KBAT experienced during schools perceived high level of evaluating and high level of creating thinking skills compared to students with no or partial KBAT experienced during schools. Summarized results are shown in the next Table IX.

TABLE IX. KBAT EXPERIENCED DIFFERENCE ON PERCEIVED HOTS LEVEL

High Order Thinking Skill (HOTS)	KBAT_experienced recode	N	Mean	SD	F-value	Significant Value
Analyze	No KBAT experienced	43	3.38	0.642	2.501	0.083
	Partial KBAT experienced	271	3.52	0.606		
	KBAT experienced	383	3.58	0.592		
Evaluate	No KBAT experienced	43	3.28	0.789	3.488	0.031*
	Partial KBAT experienced	271	3.44	0.621		
	KBAT experienced	383	3.52	0.625		
Create	No KBAT experienced	43	3.26	0.753	3.334	0.036*
	Partial KBAT experienced	271	3.46	0.660		
	KBAT experienced	383	3.52	0.619		
Overall HOTS	**No KBAT experienced**	**43**	**3.31**	**0.663**	**3.724**	**0.025***
	Partial KBAT experienced	**271**	**3.48**	**0.567**		
	KBAT experienced	383	3.54	0.556		

Student who perceived their HOTS at low level have mean CGPA 3.09, at moderate HOTS level 3.22 and at high HOTS level 3.28. Table X confirms that even though students scored good or excellent CGPA, their perceived HOTS level still varied from low to high. The result further suggests that students should be trained, guided and assisted in classrooms through effective teaching strategies regardless of students' academic performances.

A simple linear regression analysis is conducted and reveals that only 2.8% of the variance in CGPA is significantly explained by overall perceived HOTS among students. The result is in line with Yee et al. [5]. They concluded that there was a very low positive relationship between HOTS level and academic achievement. Results further indicated that students should be guided and assisted to acquire high HOTS level.

D. Relationship Between Perceived HOTS on Academic Performance

Table X shows that out of 138 students who perceived their HOTS at high level, 19.6% of them scored CGPA less than 3.00. This means despite less performed academically, they still perceived that their thinking skills at high level. The findings coherently alike with results of A. Zohar et al. [16]. Therefore, it is strongly recommended that students of all

academic performance level to get engaged in higher order thinking skills tasks. Contrary, a study by A. Zohar et al. [17] on teachers' beliefs about low-achieving students and higher order thinking skills show that 45% Israeli teachers believe higher order thinking is not suitable for low-achieving students.

TABLE X.   CROSS TABULATION OF HOTS LEVEL AND CGPA

HOTS Level	CGPA		Total
	Less than 3.00	3.00 and above	
Low HOTS	4 (36.4%)	7 (63.6%)	11
Moderate HOTS	37 (29.8%)	87 (70.2%)	124
High HOTS	27 (19.6%)	111 (80.4%)	138
Total	68	205	273

Student who perceived their HOTS at low level have mean CGPA 3.09, at moderate HOTS level 3.22 and at high HOTS level 3.28. Table X confirms that even though students scored good or excellent CGPA, their perceived HOTS level still varied from low to high. The result further suggests that students should be trained, guided and assisted in classrooms through effective teaching strategies regardless of students' academic performances.

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IV. CONCLUSION

The research evaluates the relationship between diploma and undergraduate students perceived higher order thinking skills (HOTS) and the university's academic performance. From the semester September 2018 to January 2019, 698 students from seven faculties pursuing diploma and bachelor degree studies at UiTMCM were asked via survey and 60.9% are from semester 1. The finding shows that the perceived HOTS for analyzing, evaluating and creating thinking skills among diploma and undergraduate students are at moderate HOTS level. Students perceived that they are at high level in analyzing thinking skills (34.2%) more than evaluating (31.9%) and creating (31.8%) thinking skills.

Male students are found to be more evaluative and more creative at moderate HOTS level than female students while male and female students have the same level of analyzing thinking skills at moderate level. Abilities of analyzing, evaluating and creating thinking skills between junior and senior students are found to be the same at moderate level. Across family residential areas either rural, sub-urban or urban, students have the same level in abilities of analyzing, evaluating and creating thinking skills at moderate level. However, across family income group, perceived create thinking skills is proven to be significantly higher at high HOTS level among students of family income group RM8000 and above than those students of family income group less than RM4000. It is also concluded that students of different intake qualifications either *SPM*, diploma or *STPM/Asasi*/Matriculation have the same perception on their analyzing, evaluating and creating thinking skills. It was also revealed that linguistic students perceived analyzing thinking skills significantly higher than accountancy and business students, mass communication and linguistic students perceived evaluating thinking skills significantly higher than art and design students, mass communication and linguistic students also perceived creating thinking skills significantly higher than accounting and business students. Besides that, linguistic students also perceived the overall HOTS at high level significantly higher than accounting, art and design and business students.

KBAT experienced during their school days is perceived to be significantly higher than evaluating, creating thinking skills and overall HOTS than students with no *KBAT* experienced and partial *KBAT* experienced. Students with *KBAT* experienced during schools perceived evaluating, creating thinking skills at high level compared to students with no or partial *KBAT* experienced during schools. Only 2.8% of the variance in CGPA is significantly explained by overall perceived HOTS among students.

These findings however are merely what students perceived about their abilities in analyzing, evaluating, creating thinking skills and overall HOTS. Future research is needed to study the actual HOTS level among students. It is also recommended that future studies continue to investigate effective teaching techniques in classrooms to prepare students for their future working world in Industrial Revolution 4.0 era. It is highly proposed that the revised curriculum should embed the elements of higher order thinking skills in the curriculum.

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