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An Application of Multiple Linear Regression Analysis to Establish the Relationship between Higher Order Thinking Skills and Affective Domain

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Abstract

The ability of the students to master higher order thinking skills remain the global education challenge due to the importance of this skill as stated in Malaysia Education Blueprint 2013-2025. Without the integration of higher order thinking skills and affective domains, students can be smart and still make poor decisions. Extensive researches are needed to investigate the mastery of higher thinking skills and this leads to the rationale to conduct a study on its relation to the affective domain application. In this study, we examine the relationship between the mastery of students' higher order thinking skills and their affective domain application. This study utilized a correlational research design to examine the relationship between the mastery of students' higher order thinking skills and their affective domain application. Regression analyses were conducted, and the study utilized clean data collected from 1167 Form Three students randomly sampled across the schools in Sarawak. The students were asked about their enjoyment, value and motivation with relation to their mastery of higher order thinking skills. Higher order thinking skills was directly related to all the affective domain application, naming enjoyment, value and motivation. Students who rate high in the mastery of higher order thinking skills tend to rate high also in the application of affective domain. In our results, motivation was found to be the strongest predictor of the mastery of students' higher order thinking skills. There is a need to develop cognitive and affective domains among students. Developing these qualities in individual can help in developing the higher mental abilities of students.

Keywords: Enjoyment, HOTS, Motivation, Regression, Value

Introduction

Integrating the higher order thinking skills in cognitive domain of learning with the affective domains are essential for success in academic achievement because without such integration, students can be smart and still make poor decisions (Lickona, 1993). This study utilized the higher order thinking skills (HOTS) and affective domain framework to gain a deeper understanding of the possible relationship between the mastery of students' higher order thinking skills, enjoyment, motivation and value.

According to Gupta and Mishra (2021), the HOTS are the competencies that enable students to identify, analyze and evaluate situations for the purpose of formulating responses and solutions. Beside this, Yee, et al (2015) revealed that HOTS are the ability to use the potential of mind to overcome new challenges in interpreting, analyzing or manipulating information. In particular, HOTS include critical, logical, reflective, metacognitive, and creative thinking (Sukla & Dungsungneon, 2016). HOTS are divided into problem solving, decision making, critical thinking, and creative thinking (Greenstein, 2012; Kay, 2009). On the other hand, affective domain refers to grouping associated with a person's attitude, personal belief, and value which range from receiving through responding, valuing and organization to characterization (Sharma, 2015). It includes classification of factors comprising feelings, attitudes, emotions and others.

The ability of the students to master HOTS remain the global education challenge due to the importance of this skill as stated in Malaysia Education Blueprint 2013-2025. As highlighted by Whitley (2006), learning HOTS is difficult due to the needs of reasoned thinking to gain insight while dealing with educational or real-world situation. HOTS are important in addressing the emerging needs of secondary education. In reality, cognitive domain is emphasized greater as compared to affective domain. A lacking of researches on the relationships between cognitive and affective domains has contributed to this happening. Snowman and Biehler (2006) regarded affective objectives as more difficult to define or assess than cognitive objectives because they are normally expressed indirectly. In addition, as Maftoon and Sabah (2012) have pointed out, the cognitive and affective factors have not been devoid of binary oppositions, meaning that, affective domain can be the key to the cognitive domain.

Silva (2020) reported that students demonstrated greater mathematics success with the implementation of Affective Domain Intervention while controlling for gender, ethnicity, and cumulative grade point average in a quantitative causal-comparative study. Guy et al (2015) reviewed that the affective domain corresponding to motivation and confidence in mathematics directly related to students' success in mathematics courses. Motivation and positive emotions are necessary requirements for the success in academics. Both aspects affected students' learning efforts (Lockl, et al., 2021). Students with positive emotions such as learning enjoyment have been found to obtain higher achievement (Stipek, et al., 2010) whereas students with motivation consistently perform at higher levels (Vansteenkiste, et al., 2006). Subsequently, as the student's academic self-efficacy increases, their academic achievement is expected to increase also (Fife et al., 2011). In summary, many researchers suggest that there is a back-and-forth relationship between the cognitive and affective domains of learning, where the emphasis in the affective domain is the 'development of a positive disposition toward learning regardless of the subject matter' (Facione, 2011; Hunt,

et al., 2009; Paul and Elder, 2006). Therefore, it would be wise to conduct further research on the effective use of the interventions of the two domains.

Extensive researches are needed to investigate the mastery of HOTS and this leads to the rationale to conduct a study on its relation to the affective domain application. Besides that, the mastery of HOTS and applications of affective domain appear to be largely absent among students. All these problem statements underlie the research objective guiding to the conduct of this study. In this study, we intend to examine the relationship between the mastery of students' higher order thinking skills and their affective domain application. In this study, operationally, HOTS is defined as the ability to apply knowledge, skills and values in reasoning, reflection, problem solving, decision making, innovating and creating something new (Ministry of Education, 2013). As for affective domain, it refers to the manner a person dealing with things such as enjoyment, value and motivation.

Methodology

This study utilized a correlational research design to examine the relationship between the mastery of students' higher order thinking skills and their affective domain application. This design is centered on clarifying our understanding of important phenomena by identifying relationships among variables (Fraenkel, et al., 2019). It is best suited for this study as the authors intend to examine the relationship between dependent variable and independent variables.

The population of this study enlists all Form 3 students in Sarawak. The sample consists of 1167 Form 3 students in Sarawak. The sample was selected based on random and proportionate sampling. A questionnaire was used to in this study. The questionnaire (Appendix 1) consists of eight items on value, six items on enjoyment, six items on motivation and three items on HOTS. The questionnaire was adapted from (Huang and Lin, 2015; Hixson, et al., 2012). The reliability of the respective item in the questionnaire was shown in Table 1.

The questionnaire was distributed to the targeted samples through google form by their respective teachers. The link of the google form were shared to the selected teachers. Following that, the teachers shared the google form to their students. The randomly selected students responded to the google form and submit their feedback online. They were free to answer the google form without any time constraint.

Table 1
The reliability of the items in the questionnaire

Items	Construct	Adapted from	Reliability (Cronbach alfa)
8 items – 6 Likert scale	Value in learning	Huang and Lin (2015)	0.85
6 items – 6 Likert scale	Enjoyment in learning		0.80
6 items – 6 Likert scale	Motivation in learning		0.79
3 items – 6 Likert scale	Higher order thinking skills	Hixson, Ravitz, and Whisman (2012)	0.80

The descriptive analytics of the IBM SPSS Statistics 26 used in this study included mean, standard deviation and frequency. Pearson Product-Moment Correlation was used to determine the relationship between the mastery of students' HOTS and their affective domain application. Multiple regression analysis was used to test the strength of the relationship between the mastery of HOTS and independent variables (value, motivation, enjoyment) as well as the importance of each of the independent variables to the relationship.

Result

The descriptive statistics table shows the mean rating for HOTS and affective domain (Table 2). Value has the highest rating (mean=4.85; SD=0.936; n=1167) followed by motivation (mean=4.48; SD=0.925; n=1167), and enjoyment (mean=4.45; SD=0.946; n=1167). HOTS has the lowest rating (mean=4.32; SD=0.967; n=1167). The lower SD for the motivation means that the rating on motivation is more consistent as compared to other variables.

Table 2
Descriptive statistics for HOTS and affective domain

	Mean	Std. Deviation	N
HOTS	4.32	.967	1167
value	4.85	.936	1167
enjoyment	4.45	.946	1167
motivation	4.48	.925	1167

Table 3 shows the correlation output between HOTS and affective domain. The output shows a positive and moderate relationship between HOTS and motivation ($r=0.700$; $n=1167$; $p<0.05$), as well as between HOTS and enjoyment ($r=0.690$; $n=1167$; $p<0.05$). Subsequently, the output also shows a positive and moderate relationship between HOTS and value ($r=0.590$; $n=1167$; $p<0.05$). As a whole, students who rate high in the mastery of higher order thinking skills tend to rate high also in the application of affective domain.

Table 3
Correlations output between HOTS and affective domain

		HOTS	enjoyment	motivation	value
HOTS	Pearson Correlation	1			
	Sig. (2-tailed)				
	N	1167			
Enjoyment	Pearson Correlation	.690**	1		
	Sig. (2-tailed)	.000			
	N	1167	1167		
Motivation	Pearson Correlation	.700**	.868**	1	
	Sig. (2-tailed)	.000	.000		
	N	1167	1167	1167	
Value	Pearson Correlation	.590**	.754**	.739**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	1167	1167	1167	

**. Correlation is significant at the 0.01 level (2-tailed).

The "Enter" method via multiple regression analysis is used whereby all independent variables (motivation, value, enjoyment) are put into regression equation concurrently to determine the significant predictors of the dependent variable namely the mastery on HOTS. The model summary (Table 4) shows all the independent variables correlate moderately with the dependent variable, the mastery on HOTS. The R Square of 0.521 shows the contribution of the combined independent variables to the variance in the dependent variable. Motivation, value and enjoyment together predict 52.1% of the variance in the mastery on HOTS.

Table 4
Model summary of the effect between HOTS and affective domain

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.721[a]	.521	.519	.670

a. Predictors: (Constant), value, motivation, enjoyment
b. Dependent Variable: HOTS

The ANOVA table (Table 5) shows the linear relationship ($p<0.05$) between mastery on HOTS and the 3 independent variables (motivation, value, enjoyment). As illustrated in Table 6, through the collinearity statistics, VIF values is less than 10, hence there is no presence of multicollinearity. The coefficients table (Table 6) shows $p<0.05$ for value, enjoyment and motivation. The mastery on HOTS was significantly predicted by value, enjoyment and motivation. Motivation was found to be the strongest predictor ($B=0.396$, $p<0.05$) in the students' mastery on HOTS. On the other hand, for every one unit increase in enjoyment rating, the mastery on HOTS rating will increase by 0.30 unit ($p<0.05$). As for value, for every one unit increase in value rating, the mastery on HOTS rating will increase by 0.091 unit ($p<0.05$). The relationship is illustrated through the regression equation

HOTS = 0.760 + 0.302 enjoyment + 0.396 motivation + 0.091 value

Table 5
Analysis of Variance (ANOVA)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	567.499	3	189.166	420.855	.000[b]
	Residual	522.747	1163	.449		
	Total	1090.246	1166			

a. Dependent Variable: HOTS
b. Predictors: (Constant), value, motivation, enjoyment

Table 6
Coefficients

Model		Unstandardized		Standardized			95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	.760	.108		7.036	.000	.548	.971		
	enjoyment	.302	.044	.296	6.811	.000	.215	.389	.219	4.566
	motivation	.396	.044	.379	8.949	.000	.309	.482	.230	4.340
	value	.091	.033	.088	2.737	.006	.026	.156	.402	2.486

Conclusion

The research findings showed that there is positive significant relationship between the mastery of higher order thinking skills and the application of affective domain. Students who rate high in the mastery of higher order thinking skills tend to rate high also in the application of affective domain. The finding is found parallel to Woolnough (2001) who reported that the affective domain is as important as the cognitive because students were unlikely to develop a "sense of personal achievement" unless teachers arouse students' interest and commitment, enthusiasm and perseverance, and creativity and intuition. Besides that, this finding is also evidenced by Black (2007) that higher order thinking skills may develop by practicing affective behaviors at the valuing, organization, and characterization level. Development of higher order thinking skills needs practice; hard work and they do not develop independently.

The research finding is also supported by DeWitt (2017) who showed a potential for the development of an enhanced placement process incorporating both the affective and cognitive domains. To be successful, the student needs to integrate the cognitive skills with the affective skills. There is a need to develop cognitive and affective domains among students. Developing these qualities in individual can help in developing the higher mental abilities of students. To develop all these in proper proportion, it is important to integrate different methods of teaching. Self-learning and critical thinking should be encouraged in the daily teaching and learning process.

The research finding contributes to the understanding of the importance of integrating the higher order thinking skills and affective domains in education. These results may be used to guide the development of syllabus based on the significant needs of the students. The

researchers suggest that future research can look into the relationship between affective domains, other thinking skills or other skills, such as 21st century skills. As supported by Monceaux (2018); Kretchmar (2008); Shephard (2008), a lack of attention to affective issues in educational research compounds the issue as a whole. Therefore, extensive researches are greatly needed to explore the areas related to affective domains and thinking skills implicitly.

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Appendix 1: Questionnaire

Value of learning STEM and English Language

Please state (√) the level of your agreement.

Statement	Strongly	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
Learning STEM can improve my ability in problem solving.						
Knowledge in STEM is beneficial in daily life.						
I know the importance of doing well in STEM subjects.						
STEM subjects are important for me to succeed.						
Learning the English Language can improve my ability in solving Science and Mathematics problems.						
English Language is beneficial in daily life.						
I know the importance of doing well in English Language.						
English Language is important for me to succeed.						

Enjoyment in STEM and English Language learning

Please state (√) the level of your agreement.

Statement	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
I enjoy STEM classes.						
I like to solve problems in STEM.						
I prefer learning STEM to other subjects.						
I enjoy the English Language classes.						
I like to speak in English.						
I prefer learning the English Language to other subjects.						

Motivation in STEM and English Language learning

Please state (√) the level of your agreement.

Statement	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
STEM subjects are interesting for me.						
I like learning STEM subjects.						
I can overcome the challenges of learning the STEM subjects.						
English Language is interesting for me.						
I like learning the English Language.						
I can overcome the challenges of learning the English Language.						

Higher-Order Thinking Skills (HOTS)

Please state (√) the level of your agreement.

Statement	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
I can make conclusions after analyzing relevant information.						
I have my own ideas when facing a problem.						
I can solve higher-order thinking skill (HOTS) questions.						