Journal of Research, Policy & Practice of Teachers &
Teacher Education
Vol. 2, No. 2, December 2012, 12-23

Thinking skills for secondary school students in Malaysia

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The purpose of this research was to identify the level of higher order thinking skills among lower secondary students in Malaysia. A higher order thinking skills test was modified and distributed to 384 students throughout the whole country to assess their higher order thinking skills levels. The results showed that higher order thinking skills levels among the students were at very low level. The findings also revealed that there was a low positive significant relationship between the higher order thinking skills and academic result, $r = 0.468$, $p < 0.05$. In addition, the results indicated that there was a significant difference in Living Skills subject results on the higher order thinking skills. The authors proposed a new approach by using a specialised instructional module for individualised learning to deliver the thinking skills learning task.

Key words: Higher order thinking skills; Bloom's Taxonomy; Instructional module.

Introduction

Learning activities should involve explicit thinking skills. It is more convenient to categorize thinking skills based on the existing frameworks. The framework that is still considered very useful and popular among educators is Taxonomy Bloom (1956). Bloom's Taxonomy of cognitive domain is categorized into six type of thinking skills (Meyer, 1988; Som & Mohd Razali, 1998; Widad & Kandar 2006). According to Tee et al. (2009), lower order thinking skills are the level of knowledge, understanding and application, while the level of higher order thinking skills are analysis, synthesis and evaluation. However, a revised on Taxonomy Bloom had been done by Bloom's students, Anderson and Krathwohl in the year of 2001. There are some significant changes based on the revised taxonomy. There are six type of thinking skills based on the cognitive domain in the taxonomy table, namely remember, understand, apply, analysis, evaluate and create. The major differences in the updated version are in the more useful and comprehensive additions of how the taxonomy intersects and acts upon different types and levels knowledge -- factual, conceptual, procedural and metacognitive (Tee et al., 2010).

Taxonomy of Anderson and Krathwohl (2001)

Bloom's taxonomy was revised by his former students, Lorin Anderson, working with one of his partners in the original work on cognition, David Krathwohl. The group redefining Bloom's original concepts, worked from 1995-2000. The group was assembled by Anderson and Krathwohl and included people with expertise in the areas of cognitive psychology, curriculum and instruction, and educational testing, measurement, and assessment (Tee et al., 2010). The revised taxonomy lays out components systematically and the cognitive processes can be easily documented and tracked by the users. This feature also makes the teaching and learning thinking skills process easier and clearer. Table 1 shows the cognitive process dimension.

Table 1. The Cognitive process dimension

Categories & cognitive processes	Alternative names	Definitions and examples
1. Remember –	Retrieve relevant knowledge from long-term memory	
1.1 Recognizing	Identifying	Locating knowledge in long-term memory that is consistent with presented material (e.g., Recognize the dates of important events in U. S. history.)
1.2 Recalling	Retrieving	Retrieving relevant knowledge from long-term memory (e.g., Recall the dates of important events in U. S. history.)
2. Understand –	Construct meaning from instructional messages, including oral, written, and graphic communication.	
2.1 Interpreting	Clarifying, paraphrasing, representing, Translating	Changing from one form of representation (e.g., numerical) to another (e.g., verbal) (e.g., Paraphrase important speeches and documents.)
2.2 Exemplifying	Illustrating, Instantiating	Finding a specific example of illustration of a concept or principle (e.g., Give examples of various artistic painting styles).
2.3 Classifying	Categorizing, Subsuming Generalizing distinguishing, focusing, selecting	Determining that something belongs to a category (e.g., concept of principle) (e.g., Classify observed or described cases of mental disorders).
2.4 Summarizing	Abstracting, Generalizing distinguishing, focusing, selecting	Abstracting a general theme or major point(s) (e.g., Write a short summary of the events portrayed on a videotape).
2.5 Inferring	Concluding, extrapolating, interpolating, Predicting	Drawing a logical conclusion from presented information (e.g., In learning a foreign language, infer grammatical principles from examples).
2.6 Comparing	Contrasting, mapping, Matching	Detecting correspondences between two ideas, objects, and the like (e.g., Compare historical events to contemporary situations).
2.7 Explaining	Constructing models	Constructing a cause-and-effect model of a system (e.g., Explain the causes of important 18th-century events in France).

3.	Apply	–	Carry out or use a procedure in a given situation	
3.1	Executing		Carrying out	Applying a procedure to a familiar task (e.g., Divide one whole number by another whole number, both with multiple digits).
3.2	Implementing		Using	Applying a procedure to an unfamiliar task (e.g., Use Newton's Second Law in situations in which it is appropriate.)
4.	Analyze	–	Break into its constituent parts and determine how the parts relate to one another and to an overall structure and purpose.	
4.1	Differentiating		Discriminating, distinguishing, focusing, selecting	Distinguishing relevant from irrelevant parts or important from unimportant parts of presented material (e.g., Distinguish between relevant and irrelevant numbers in a mathematical word problem).
4.2	Organizing		Finding coherence, integrating, outlining, parsing, structuring	Determining how elements fit or function within a structure (e.g., Structure evidence in a historical description into evidence for and against a particular historical explanation).
4.3	Attributing		Deconstructing	Determine a point of view, bias, values, or intent underlying presented material (e.g., Determine the point of view of the author of an essay in terms of his or her political perspective).
5.	Evaluate	–	Make judgments based on criteria and standards	
5.1	Checking		Coordinating, detecting, monitoring, testing	Detecting inconsistencies or fallacies within a process or product; determining whether a process or product has internal consistency; detecting the effectiveness of a procedure as it is being implemented (e.g., Determine if a scientist's conclusions follow from observed data).
5.2	Critiquing		Judging	Detecting inconsistencies between a product and external criteria, determining whether a product has external consistency; detecting the appropriateness of a procedure for a give problem (e.g., Judge which of two methods is the best way to solve a given problem.)
6.	Create	–	Put elements together to form a coherent or functional whole, reorganize elements into new pattern or structure.	
6.1	Generating		Hypothesizing	Coming up with alternative hypothesis based on criteria (e.g., Generate hypothesis to account for an observed phenomenon).
6.2	Planning		Designing	Devising a procedure for accomplishing some task (e.g., Plan a research paper on a given historical topic).
6.3	Producing		Constructing	Inventing a product (e.g., Build habitats for a specific purpose).

Purpose of the study

In recent years there has been much research into ways of developing children's thinking and learning skills (Arthur, Grainger & Wray, 2006). Thinking skills can be enhanced in an early year's classroom. Therefore, teachers should identify their students' thinking skills level before implementing any teaching or learning approaches to improve their ability to think and learn. Thus, the purpose of this study is to analyse the level of higher

order thinking skills among Malaysian lower secondary students in Living Skills subject. The higher order thinking skills test (SEA test) was modified and distributed to 384 students throughout the whole country to access the higher order thinking skills level. Specifically, the research questions for this study are:

1. What are the levels of higher order thinking skills among lower secondary students?
2. Is there any significant relationship between the higher order thinking skills and gender, location of school and Living Skills subject results?
3. Is there any significant difference in gender, location of school and Living Skills subject results on the higher order thinking skills?

Methodology

This is a survey study using the SEA test (X-form) developed by a team of specialists in educational measurement and evaluation; Callahan, Covert, Aylesworth and Vanco (1988). The test was developed based on 21 objectives in the upper three levels of Bloom's taxonomy of educational objectives; the instrument covers a broad scope of instructional areas. It had been field tested five times over a two year period and revised to ensure maximum clarity of directions and questions. The SEA test (X-form) was translated into Malay language and some items were modified to suit the local culture.

The target population for this study was the lower secondary Form One students in Malaysia that are taking Living Skills as one of the core subject in the curriculum. The total population of lower secondary Form One students in Malaysia is 509618 as of 2009 (estimated); there are 13 states and three federal territories in Malaysia. From a total of 13 states and three federal territories, total population of the Form One students are shown in Table 2.

Table 2. Population of lower secondary form one students in Malaysia as in 2009 (estimation)

STATES/ *FEDERAL TERRITORY	**NUMBER OF STUDENTS**
PERAK	45147
SELANGOR	87627
PAHANG	28007
KELANTAN	37097
JOHOR	62232
KEDAH	40393
*WP LABUAN	1220
MELAKA	15154
NEGERI SEMBILAN	19636
PULAU PINANG	26360
PERLIS	4622
TERENGGANU	23971
*WP KUALA LUMPUR	24927
SABAH	46056
SARAWAK	46147
*WP PUTRAJAYA	1022
TOTAL	**509618**

(Source: Educational Planning and Research Division, Ministry of Education Malaysia)

The Sample

Sudman (1976) suggests that for regional surveys, a sample size of 200 to 500 is typical. Krejcie & Morgan (1970) on the other hand, suggest that sample sizes should be based on population sizes. Their numbers are based on a formula developed by the United States Office of Education. As population size increases, sample size also increases but sample size becomes a decreasing percentage as population size increases. Based on the *Table for Determining Sample Size from a Given Population* by Krejcie and Morgan (1970), the proposed total number of sample (S) is 382 if the population (N) is 750,000. On the other hand, N = 1,000,000, S = 384. Thus, in this study, a total of 384 samples were selected as the respondents.

The Proportionate Cluster Sampling

The proportionate cluster sampling is used for the purpose of this study. Among the reasons to use the proportionate cluster sampling include :(i) selecting all individual members of the population in Malaysian lower secondary Form One students is not only impractical but also expensive. Instead, groups or clusters of members have been selected for the sample (Wiersma, 2000); (ii) the population members are naturally grouped in units that can be used conveniently as clusters. Before selecting the sample, all population members were identified according to their clusters (or zones) in Malaysia, due to cost and time constraints. The 13 states and three federal territories are shown in Table 3. It is not necessary that all clusters have the same number of population members (Wiersma, 2000). (iii)The lowest cost per sample especially with geographic cluster makes it the most preferred option. Based on Barnet (1974), the random sampling technique is used for every remaining states and federal territories in their respective zones has the equal chance of being chosen.

Table 3. Proportionate cluster sampling (states and federal territories) of lower secondary form one students in Malaysia

ZONE	STATE/ *FEDERAL TERRITORY	TOTAL POPULATION	TOTAL SAMPLES
North	KEDAH	40393	30
	PULAU PINANG	26360	20
	PERLIS	4622	3
East	KELANTAN	37097	28
	TERENGGANU	23971	18
	PAHANG	28007	21
Central	SELANGOR	87627	66
	PERAK	45147	34
	*WP KUALA LUMPUR	24927	19
	*WP PUTRAJAYA	1022	1
South	MELAKA	15154	11
	NEGERI SEMBILAN	19636	15
	JOHOR	62232	47
Sabah and Sarawak	SABAH	46056	35
	SARAWAK	46147	35
	*WP LABUAN	1220	1
TOTAL		**509618**	**384**

(Source: Educational Planning and Research Division, Ministry of Education Malaysia)

Reliability and Validity

Two essential characteristics of measurement that must be considered in establishing the appropriateness and usefulness of measurement instruments were reliability and validity (Wiersma, 2000). Reliability is the extent to which a measuring device was consistent in meeting whatever it measured. It is a measure that indicates the extent to which it was without bias (error free) and hence ensured consistent measurement across time and across various items in the instrument. Reliability indicated the stability and consistency with which the instrument measured the concept and helped to assess the "goodness" of a measure. Reliability coefficient can take on values from 0 to 1.0. In educational measurement, it was desirable to obtain high reliability coefficient, although coefficients of 1.0 were very rare indeed (Wiersma, 2000). Validity is the extent to which an instrument measured what it intended to measure (Ary, Jacob & Razavieh 1996, Tuckman 1999 and Nueman 2000). Based on feedbacks from six panels, items in the test were reworded and retranslated to improve its validity. The test was pilot tested to confirm the reliability of the test and to achieve the desired objective of this study.

Pilot Testing

The test was distributed to 38 lower secondary Form One students from a secondary school in Melaka. The SEA test (X-form) has multiple and short-answer questions. Table 4 shows the reliability values for each construct for objective questions, short-answer questions and overall questions. KR-20 reliability test results indicated that the reliability value for all constructs (analysis, evaluation and synthesis) for objective questions, short-answer questions and overall questions were above .60. On the other hand, KR-20 reliability test results also revealed that the reliability value for objective questions, short-answer questions and overall questions were .80 and above. This has clearly indicated that the test is reliable. According to Konting (1998), he stated that reliability coefficient that is more than .60 is considered as usable.

Table 4. KR-20 reliability test results

Objective (37 items)	
Construct	KR20
Analysis	.67
Evaluation	.61
Synthesis	.71
Overall	.82

Short-answer (26 items)	
Construct	KR20
Analysis	.79
Evaluation	.87
Synthesis	.64
Overall	.82

All items (objective + short-answer) 63 items	
Construct	KR20
Analysis	.62
Evaluation	.66
Synthesis	.66
Overall	.80

Data Collection

Test questions were mailed to teachers at each states and federal territories. At the same time, some of the test questions were given by hand to teachers. Purpose and format of the SEA test (X-form) and administration directions were given through phone and face-to-face to teachers before the test being held at school classroom. Respondents were given 2 hours time to answer the test in an examination environment setting. All responses were mailed back to the researcher after the test ended.

Data Analysis

The SPSS for Windows (version 11.5) is used to measure (frequency, percentages, Pearson-r and ANOVA) in the research questions as shown in Table 5.

Table 5. Summary of research questions and statistical techniques used in the study

	Research Questions (RQ)	Statistical Techniques
RQ1	What are the levels of higher order thinking skills among lower secondary students?	Percentages and frequencies
RQ2	Is there any significant relationship between the higher order thinking skills and gender?	Eta
	Is there any significant relationship between the higher order thinking skills and location of school?	Eta
	Is there any significant relationship between the higher order thinking skills and Living Skills subject results?	Pearson - r
RQ3	Is there any significant difference in gender, location of school and Living Skills subject results on the higher order thinking skills	UNIVARIAT 3 way-ANOVA

Findings and Discussions

Findings used both descriptive and inferential statistics as analytical tools. All inferential statistics in this study were evaluated using the probability level $p < .05$. Parametric statistical techniques were used in the inferential statistics. Table 6 shows the score range and categorization of higher order thinking skills.

Table 6. Score range and categorization of higher order thinking skills

SCORE RANGE	LEVEL
0 – 42	Very low
43 – 52	Low
53 – 62	Moderate
63 – 72	High
73 – 100	Very high

Levels of Higher Order Thinking Skills

Table 7 shows that all three higher order thinking skills levels among the students were at very low level (analysis = 27.34%, synthesis = 28.64% and evaluation = 30.31%). The age and schooling level at the beginning of secondary school maybe are among the

reasons why the student are at the very low level of higher order thinking skills. Somehow, the data showed the level of evaluation is higher than analysis and create. This showed that most probably students are exposed to more evaluation questioning based on assignment, homework and examination when they were in elementary school. On the whole, however the thinking skills levels of the students were at very low level. Immediate actions or interventions must be taken to overcome this alarming matter.

Table 7. Levels of higher order thinking skills

Thinking Skills	Score (%)	Level
Analysis	27.34	Very Low
Evaluation	30.31	Very Low
Synthesis	28.64	Very Low
Avarage	28.76	Very Low

Table 8 shows the detail responses for three levels of higher order thinking skills levels.

Table 8. Responses for three levels of higher order thinking skills levels

Analysis			Evaluation			Synthesis		
Item	Response		Item	Response		Item	Response	
	Correct	Wrong		Correct	Wrong		Correct	Wrong
9	110 (28.6%)	274 (71.4%)	3	157 (40.9%)	227 (59.1%)	1	273 (71.7%)	111 (28.9%)
10	57 (14.8%)	327 (82.5%)	4	88 (22.9%)	296 (77.1%)	2	203 (52.9%)	181 (47.1%)
33	162 (42.2%)	222 (57.8%)	5	150 (39.1%)	234 (60.9%)	19	86 (22.4%)	298 (77.6%)
34	161 (41.9%)	223 (58.1%)	6	145 (37.8%)	239 (62.2%)	20	142 (37.0%)	242 (63.0%)
35	244 (63.5%)	140 (36.5%)	7	92 (24.0%)	292 (76.0%)	21	224 (58.3%)	160 (41.7%)
38	97 (25.3%)	287 (74.7%)	8	159 (41.4%)	225 (58.6%)	22	129 (33.6%)	255 (66.4%)
39	103 (26.8%)	281 (73.2%)	11	144 (37.5%)	240 (62.5%)	36	101 (26.3%)	283 (73.7%)
46	47 (12.2%)	337 (87.8%)	12	137 (35.7%)	247 (64.3%)	37	113 (29.4%)	271 (70.6%)
47	103 (26.8%)	280 (72.9%)	13	156 (46.0%)	228 (59.4%)	17	48 (12.5%)	336 (87.5%)
48	12 (3.1%)	372 (96.9%)	14	126 (32.8%)	258 (67.2%)	18	40 (10.4%)	344 (89.6%)
49	61 (15.9%)	323 (84.1%)	15	181 (47.1%)	203 (52.9%)	27	98 (25.5%)	286 (74.5%)
	105 (27.34%)	279 (72.66%)	16	91 (23.7%)	293 (76.3%)	28	28 (7.3%)	356 (92.7%)
			23	142 (37.0%)	242 (63.0%)	29	51 (13.3%)	333 (86.7%)
			24	58 (15.1%)	326 (84.9%)	30	47 (12.2%)	337 (87.8%)
			25	72 (18.8%)	312 (81.3%)	31a	129 (33.6%)	255 (66.4%)
			26	126 (32.8%)	258 (67.2%)	31b	78 (20.3%)	306 (79.7%)
			40	139 (36.2%)	245 (63.8%)	32a	123 (32.0%)	261 (68.0%)

	41	74 (19.3%)	310 (80.7%)	32b	62 (16.1%)	322 (83.9%)
	42	68 (17.7%)	316 (82.3%)		110 (28.64%)	274 (71.35%)
	43	129 (33.6%)	255 (66.4%)			
	44	118 (30.7%)	266 (69.3%)			
	45	116 (30.2%)	268 (69.8%)			
	50A1	106 (27.6%)	278 (72.4%)			
	50A2	89 (23.2%)	295 (76.8%)			
	50A3	96 (25.0%)	288 (75.0%)			
	50B	74 (19.3%)	310 (80.7%)			
	51A1	134 (34.9%)	247 (64.3%)			
	51A2	117 (30.5%)	267 (69.5%)			
	51A3	124 (32.3%)	260 (67.7%)			
	51A3	124 (32.3%)	260 (67.7%)			
	51B	104 (27.1%)	280 (72.9%)			
	52A1	113 (29.4%)	271 (70.6%)			
	52A2	110 (28.6%)	274 (71.4%)			
	52A3	105 (27.3%)	279 (72.7%)			
	52B	94 (24.5%)	290 (75.5%)			
		116 (30.31%)	268 (69.79%)			

Relationship between the Higher Order Thinking Skills and Gender, Location of Schools and Living Skills Subject Results

Table 9 shows that for the sample of this research (n = 384), the coefficient correlation between Higher Order Thinking Skills and Gender (r = .013) is almost non existence, Location of Schools (r = .598), while Living Skills Subject Results (r = .468) is positively moderate. This result indicates that the rural-urban gap in education exists. Appropriate strategies and approaches on teaching and learning thinking skills should be implemented to avoid unfavorable educational outcomes for both rural and urban schools.

Table 9. Relationship between the higher order thinking skills and gender, location of school and living skills subject results

Higher Order Thinking Skills		
	Gender	
	Eta	.013
	Location of School	
	Eta	.598
	Living Skills Subject Results	
	Pearson - r	.468

Table 10 shows that there is no significant difference in gender between male and female on the higher order thinking skills. On the other hand, there is a significant difference in location of school between rural and urban on the higher order thinking skills. Furthermore, for the sample of this research (n = 384), mean score for higher order thinking skills for excellent category in Living Skills subject results is higher (M = 27.68, SD = 7.57, n = 72) compare to distinction category (M = 16.81, SD = 3.82, n = 72), good category (M = 17.58, SD = 8.87, n = 130), minimum achievement (M = 14.27, SD = 9.58, n = 77) and below minimum achievement category (M = 15.27, SD = 8.86, n = 33).

The higher order thinking skills between these five categories of Living Skills subject results were significantly difference $F(4, 379) = 31.04$, $p < .05$. Tukey LSD test shows that significant differences occur between excellent category with all other categories and good category with minimum achievement category, $p < .05$. Due to the significant different between location of schools and Living Skills subject results, we propose that different teaching strategies should be applied on these matter. Appropriate teaching strategies and learning environments are able to facilitate the students' growth in learning thinking skills. Lessons should be specifically designed for students with different level of achievements.

Table 10. Descriptive statistics and Anova: Living skills subject results

Dependent variable: Thinking Skills	F	p
Gender	.145	.703
Location of school	136.897	.000
Living Skills subject results	21.309	.000

Suggestions

Thinking skills approach must not only specify what is to be taught but also how it is taught. Teachers should help the students to recognize the importance of developing more complex ways of thinking. At the same time, allowing the students with sufficient time and practice to experience success in new ways of thinking. Thus, using self-instructional modules can be an alternative approach and make significant contributions. Moreover, modules are self-paced and they can cater to an extent for individual differences in the learner's abilities, interest and degrees of application. Furthermore, modules are largely self-instructional, specific basic study programmes can be run either

as a pre-requisites as part of a total structure programme of technical and vocational education.

Modules are able to support the students in their efforts through encouragement and constructive feedback. Therefore, a Self-Instructional Module is important here as to help every single student to study on their own pace (Meyer, 1988). In line with this approach, basically the proposed self-instructional module on thinking skills must consist of *Input*, *Process* and *Output* cycle. The *Input* covers the thinking skills content based on Anderson and Krathwohl Taxonomy; *Process* with activities to engage the students with content wise and *Output*, the students must be able to self assess their mastery level of the module through a clear and efficient interpretation method on the task within the module. Furthermore, the module should be able to challenge students to think more deeply and widely and in more systematic and sustained ways. On the whole, however the effectiveness of this new approach should be tested with true or quasi-experimental designs.

Conclusion

The levels of higher order thinking skills among lower secondary students are at very low level. Beside that, there was no significant relationship between the higher order thinking skills and gender ($p > .05$). In contrast, there was a moderate positive significant relationship between the higher order thinking skills and location of school ($r = .579$, $p < .05$) and a low positive significant relationship between the higher order thinking skills and Living Skills subject results, $r = .468$, $p < .05$). The results also indicated that there was no significant difference in gender between male and female on the higher order thinking skills. On the other hand, there was a significant difference in location of school between rural and urban on the higher order thinking skills and findings also showed that there was a significant difference in Living Skills subject results on the higher order thinking skills. We are confident that students should learn the six thinking skills and later follow by the thinking tool – Buzan mind mapping. Beside that, the convenient way to apply the thinking tool – Buzan mind mapping is to encourage the students to take notes (Tee et al., 2012) in class or at home by referring to text book.

Acknowledgements

The authors would like to thank the Ministry of Higher Education, Malaysia for supporting this research under the Fundamental Research Grant Scheme (FRGS).

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