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Grades 1-12 Thai Students' Learning Styles according to Kolb's Model

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Abstract

This survey research aims to explore grades 1-12 students' learning styles according to Kolb's model. The data was collected from 9,600 students in 120 schools, which located in 20 provinces in six regions of Thailand. The Learning Styles Questionnaire (LSQ) adapted from Kolb's model of learning styles were sent to the sample by post and 77.5% of them were returned. The respondents were 7,444 students (59.3% female, 40.7% male) aged from 7 to 19 years old. In data analysis, the respondents' preferred learning styles were categorized into: Concrete Experience (CE), Reflective Observation (RO), Abstract Conceptualization (AC) and Active Experiment (AE). These learning styles were calculated for mean and standard deviation. The relationships between the respondents' learning styles and their genders, grade levels, school sizes and regions were examined by using the One-way Analysis of Variance and Sheffe multiple comparisons. After that, the combination of learning styles' scores was plotted and interpreted into four types of learners including Diverging, Accommodating, Assimilating and Converging and counted for their frequencies. The results revealed that the students' learning styles were significantly different regarding their genders, grade levels, school sizes and regions. That is, the female students, the grade level 1 students and the students from large-size schools significantly had mean scores in CE, RO, AC and AE higher than the male students, the students in other grade levels and the students from small-size and medium-size schools, respectively. However, the regions that schools located did not show a strong pattern of relationship with students' learning styles. In addition, most of the students preferred to be the Diverging learners, followed by the Accommodating, Assimilating and Converging learners. The implications from these findings were also discussed.

Keywords: Kolb, learning style, grades 1-12 student, learning reform, Thailand

1. Introduction

The national education reform had been initiated in Thailand since 1999 by the proclamation of the National Education Act B.E. 2542 (Office of the National Education Commission, 1999). This reform led to the change of old national basic education curriculum to the new one, i.e., the Basic Education Curriculum B.E. 2544 (Ministry of Education, 2001). One main emphasis of this new curriculum placed on the change of teaching and learning approach from the teacher-centered to the student-centered approaches. In the student-centered approach, teachers are generally regarded as a learning facilitator rather than a knowledge provider and students are regarded as an active learner rather than a passive learner. However, the results from this wave of education reform were not satisfied because Thai students showed their learning achievement in particular to thinking ability and eager to learn lower than expected level (Office of the Education Council, 2005). Chareonwongsak (2005) asserted that Thai students did not attain quality thinking skills especially for the group who did not learn with the student-centered approach.

The student-centered approach is firmly based on constructivism, which is one modern philosophy of learning. The basic concept of constructivism is that learners themselves construct their knowledge by linking their prior knowledge and experience with new ones. In constructivism, teachers are urged with the question as "How can I teach you if I don't know how you learn?" to place more emphasis on their students than teachers themselves and apply the student-centered approach. In constructivist classrooms, teachers strongly concern about their students' individual backgrounds (Colins, 2002; Donovan & Bransford, 2005). The backgrounds of individual

students are also highlighted in the Basic Education Curriculum B.E. 2544.

Education management emphasizes the importance of knowledge, thought, capability, morality, learning processes and social responsibility. The aims are to foster the well balanced development of each individual as learner is the most important. Everyone is capable of learning and self-development, *learners shall be encouraged to develop themselves in line with their natural inclinations, and to fully realize their own potential*. (p. 3, emphases by author)

The new curriculum clearly mentions that teachers must conduct learning activities to suit students' individual differences (Ministry of Education, 2001). However, many teachers perceive student individual differences in term of student learning achievement such as high, medium and low learning achievement. Other dimensions are rarely taken into account such as students' learning styles.

According to constructivism and student-centered approach, knowing students' learning styles is very important because it allow teachers to find out the most appropriate learning activities to suit their students with different learning styles. There are many studies about learning styles of students in an undergraduate level (Bumrungsri, 1982; Kitiyanusan, 2006; Kupkarnjanakul, 1982; Promsiri, 1992; Srisuay, 1984; Yanthip, 1985). There are few studies about learning styles in secondary level (grades 7-12) (Lertphop, 1992; Ratanawarawan, 1991) and there is no study in a primary level (grades 1-6). Consequently, this study aimed to explore grades 1-12 students' learning styles in order to help Thai teachers design or select learning activities that are suitable for students' individual differences regarding learning styles.

One favorite model of learning styles is Kolb's model. In 1984, David Kolb had published his experiential learning theory (ELT) and subsequently created the learning styles inventory (LSI). Kolb stated, ideally, individuals learn with a continuum learning cycle of experiencing, reflecting, thinking, and acting. That is, immediate or concrete experiences lead individuals to observations and reflections. These reflections are then assimilated (absorbed and translated) into abstract concepts with implications for action. Individuals can actively test and experiment with such abstract concepts, which in turn enables them to create new experiences. According to Kolb, there are four learning styles: Concrete Experience (CE), Reflective Observation (RO), Abstract Conceptualization (AC), and Active Experimentation (AE). As Kolb stated, although these learning styles are in the continuum, individuals tend to rely on one learning style above the others.

For CE learning style, individuals tend to use a receptive, experience based approach to learning. They are not primarily interested in theory; instead, they like to treat each case as unique and learn best from specific examples. In learning, they are more oriented towards peers than to authority and learn best from discussion and feedback with peers. They preferred learning by labs, field work, videos, or observations.

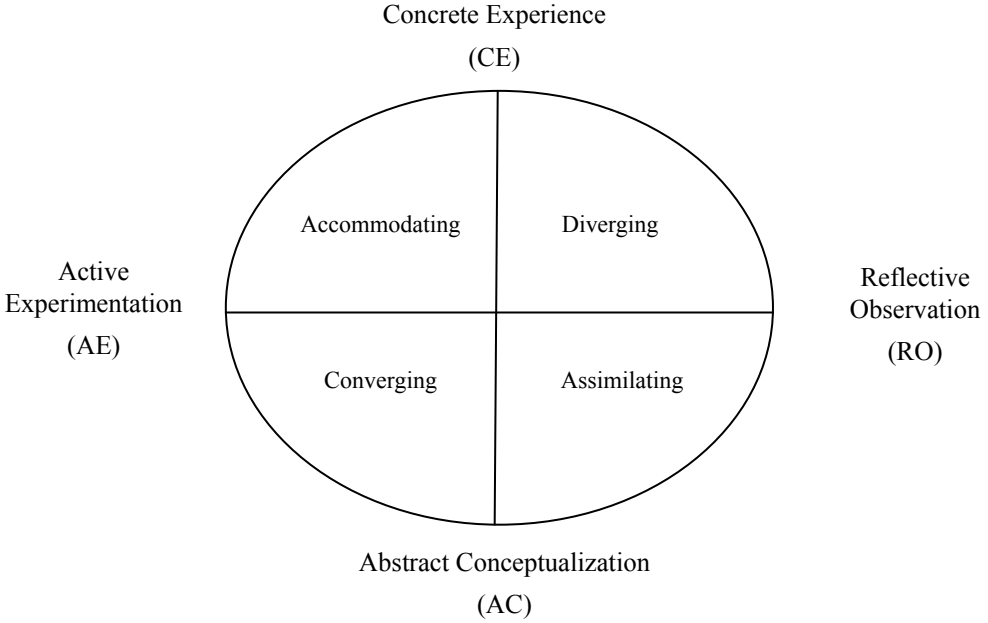

Figure 1. Kolb's model of learning styles

For RO learning style, individuals tend to use a tentative, impartial and reflective approach to learning. They rely

on careful observation of others and/or like to develop observations about their own experience. They preferred learning by self-reflection exercises, journals, or brainstorming.

For AC learning style, individuals tend to use an analytical, conceptual approach to learning. They learn best from authority-directed learning situations that emphasize theory such as lectures and reading papers. They do not benefit from unstructured discovery type learning approaches.

For AE learning style, individuals tend to use an active, doing approach to learning that relies heavily on experimentation. They learn best when they can engage in projects, homework, or small group discussion.

In addition, the combination of two preferred learning styles leads to four types of learners: Diverging (CE/RO), Assimilating (AC/RO), Converging (AC/AE) and Accommodating (CE/AE) as Figure 1.

For Accommodators, the dominant learning abilities are CE and AE. The greatest strength of Accommodators is doing things and involving them in the experience. They tend to solve problems in an intuitive, trial-and-error manner, relying often on other people's information rather than on their own analytic ability or logical analysis. These learners are good with complexity and are able to see relationships among aspects of a system. A variety of methods are suitable for Accommodators as encouraging independent discovery or active participation in the learning process. In formal learning situations, Accommodators prefer to work with others to get assignments done, to set goals, to do field work, and to test out different approaches to completing a project.

For Assimilators, the dominant learning abilities are AC and RO. Assimilators prefer to understand a wide range of information and put it into concise, logical form. These people require good clear explanation rather than practical opportunity. They are good at creating abstract concepts or theoretical models with less interested in people. They like accurate, organized delivery of information and tend to respect the knowledge of the expert. They like to get the right answer to the problem and are not comfortable in randomly exploring a system. Instructional methods that suit Assimilators include: lecture, followed by demonstration or exploration of a subject in a lab, or a prepared tutorial with exact answers. Generally, Assimilators emphasize logical soundness of the theory than its practical value. In formal learning situations, Assimilators prefer readings, lectures, exploring analytical models, and having time to think things through.

For Convergers, the dominant learning abilities are AC and AE. They prefer to find practical uses of ideas and therories and are motivated to discover the relevancy or 'how' of a situation. Convergers have the ability to solve problems and make decisions based on finding solutions to questions or problems. Convergers prefer to deal with technical tasks and problems rather than with social issues and interpersonal issues. In formal learning situations, Convergers prefer to experiment with new ideas, simulations, laboratory assignments, and practical applications.

For Divergers, the dominant learning abilities are CE and RO. Divergers' greatest strength lies in imaginative ability. They are very good at viewing concrete situations from different points of view. Divergers prefer to have information presented to them in a detailed, systematic, reasoned manner. They perform better in situations that call for generation of ideas. Divergers have broad cultural interests and like to gather information. They prefer to work in groups, listening with an open mind to different points of view and receiving personalized feedback. Instructional methods that suit Divergers are lecture, hands-on exploration, brainstorming, or simulation.

As mentioned earlier, knowing students' learning styles is very important for teachers to create learning activities to suit their students' preferred learning styles. However, in Thailand, there were few studies explored grades 7-12 students' learning styles and no study explored grades 1-6 students' learning styles. So, these are a gap that this study wants to fulfill.

1.1 Research Objectives

The objectives of this study are: a) to explore grades 1-12 Thai students' learning styles, and b) to examine the relationship between the students' learning styles and their genders, grade levels, school sizes and regions.

2. Method

2.1 Sample

This study was a survey research. The sample of this study was grades 1-12 students, which were divided into four grade levels: Grade Level 1 (grades 1-3), Grade Level 2 (grades 4-6), Grade Level 3 (grades 7-9) and Grade Level 4 (grades 10-12). The sample was derived from the multi-stage cluster sampling. First, 20 provinces were randomed from the total of 76 provinces in six regions of Thailand. Second, in each province, one education area office was randomed; therefore, there were 20 education area offices attended this study. Third, in each education area office, six schools were randomed: two from a small-size school, two from a medium-size school and two

from a big-size school. Fourth, in each school, 40 students from each grade levels were randomed; therefore, there were 160 students per school. The total number of students in a sample was 9,600 students. The questionnaire was sent to the sample by post and 7,444 questionnaires were returned; so, the return rate was 77.5%. The sample allocated by regions and provinces can be shown as Table 1.

Table 1. The sample allocated by regions and provinces

Region	Province	Frequency	%
North	Phayao	351	4.7
	Chiang Mai	470	6.3
South	Phuket	430	5.8
	Trang	468	6.3
	Chumphon	445	6.0
	Songkhla	481	6.5
Central	Pisanulok	476	6.4
	Saraburi	462	6.2
	Bangkok	351	4.7
	Nakhon Pathom	444	6.0
	Nonthaburi	428	5.7
	Samut Songkhram	491	6.6
Northeast	Khon Kaen	377	5.1
	Ubon Ratchathani	295	4.0
	Surin	306	4.1
	Si Sa Ket	411	5.5
	Mahasarakham	449	6.0
West	Ratchaburi	150	2.0
East	Chanthaburi	80	1.1
	Trat	79	1.1
Total		7,444	100.0

There were female respondents more than male respondents. The ratio of female and male respondents was about 6:4.

Table 2. The sample allocated by genders (n = 7,370*)

Gender	Frequency	%
Male	2,998	40.7
Female	4,372	59.3
Total	7,444	100.0

*Note: This number was not equal the sample (n = 7,444) because of missing data.

Table 3. The sample allocated by grade levels (n = 7,289)

Grade level	Frequency	%
1	1,590	21.8
2	1,775	24.4
3	2,068	28.4
4	1,856	25.5
Total	7,444	100.0

The distribution of respondents according by their grade levels can be shown as Table 3. The percentage of students from grade level 1 was lowest because in some small-size schools there were students in each class less than 40.

A majority of the respondents came from a medium-size school, followed by a large-size and small-size schools.

Table 4. The sample allocated by school sizes (n = 7,443)

School size	Frequency	%
Small*	1,903	25.6
Medium	2,902	39.0
Large	2,638	35.4
Total	7,444	100.0

*Note: Small school means a school with the number of students less than 500.

Medium school means a school with the number of students between 501-1,500.

Large school means a school with the number of students more than 1,500.

2.2 Instrument Development and Data collection

The instrument used in survey is the Learning Styles Questionnaire (LSQ). Twenty items of LSQ were drawn from Kolb's (1981) Learning Style Inventory (LSI). The LSQ was tried out with 403 grades 1-12 students from two schools in Bangkok and calculated for Cronbach's alpha coefficients. Then, four items of LSQ having item-total correlation less than .35 were deleted from a pool of items. So, the total number of items in LSQ was 16 items. After deleted these items, the reliability of LSQ was higher. The reliability of final LSQ was .91. Specifically, the reliability of the CE, RO, AC and AE scales were .75, .76, .63 and. 73, respectively.

Table 5. Items of LSQ (adapted from Kolb's model of learning styles)

Scale	Item no.	Item statement
CE	1.	I like to get involved in learning activities.
	6.	In learning, I am open to new experiences.
	10.	I learn things best when I am open-minded for new ideas.
	15.	I learn best when I am confident in my ideas.
RO	3.	I study contents learned in every perspectives.
	5.	I think and consider things my teacher explained with attention.
	14.	I solve problems by thinking various solutions.
	9.	I like to take my time before acting.
AC	4.	I use my logic to understand content taught.
	7.	I conclude things leaned into concepts or principles.
	12.	In learning, I like to analyze things and break them into parts.
	16.	In learning, I like to think about things.
AE	2.	I like to try things out myself.
	8.	I learn best from try things out and practice.
	11.	In learning, I like to be active in doing things.
	13.	In learning, I am fluent in doing things.

The direction provided to all respondents was as:

Direction: The Learning Styles Questionnaire (LSQ) is a questionnaire aimed to explore your learning styles not to evaluate your learning ability, so there is no right or wrong answer. Please check (/) in the frequency matched your degree of practice, which is divided into five degrees: never, rarely, sometimes, often and regular. When you finished the questionnaire, please return to your teacher. Thank you for your cooperation.

2.3 Data Analysis

The 'never', 'rarely', 'sometimes', 'often' and 'regular' responses of the students from LSQ were scores as 1, 2, 3, 4 and 5, respectively. Then, the mean and standard deviation of score in each scales (i.e. CE, RO, AC and AE) were calculated. The relationships between students' learning styles and their genders, grade levels, school sizes and regions were examined by using the One-way Analysis of Variance (One-way ANOVA). Also, the mean difference between each pair of variables was tested by the Sheffe multiple comparisons. The statistical significance level was set at .05. After that, the respondent's combination score of two learning styles, that is, AC-CE and AE-RO, was calculated to show their preference on abstractness over concreteness (AC-CE) and action over reflection (AE-RO). These combination scores were plotted into the diagram as Figure 1 into one of four quadrants. The result was interpreted into four types of learners: Diverging, (in the CE-RO quadrant), Assimilating (in the RO-AC quadrant), Converging (in the AC-AE quadrant) and Accommodating (in the AE-CE quadrant). Finally, the frequency of each type of learners was counted.

3. Results

The results are presented into two main sections, that is, the students' learning styles and the relationships between students learning styles and their genders, grade levels, school sizes and grade levels.

3.1 Students' Learning Styles

A majority of students had the Diverging learning styles, followed by the Accommodating, Converging and Assimilating learning styles as Tables 6-10. This pattern of students' learning styles was strong across genders, grade levels, schools sizes and regions.

Table 6. Students' learning styles (n = 7,062)

Learning style	Number of respondents	%
Diverging	2,450	34.7
Accommodating	1,321	18.7
Assimilating	749	9.8
Converging	297	4.2
Cannot specify learning style	2,299	32.6
Total	7,062	100.0

Table 7. Students' learning styles allocated by genders (n = 7,006)

Learning style	Gender			
	Male		Female	
	Frequency	%	Frequency	%
Diverging	894	31.7	1,544	36.9
Accommodating	517	18.3	797	19.0
Assimilating	314	11.1	376	9.0
Converging	156	5.5	136	3.2
Cannot specify learning style	938	33.3	1,334	31.9
Total	2,819	100.0	4,187	100.0

Table 8. Students' learning styles allocated by grade levels (n = 6,932)

Learning style	Grade level							
	1		2		3		4	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Diverging	474	32.6	468	27.7	712	35.6	602	33.6
Accommodating	472	32.5	714	42.2	649	32.5	581	32.4
Assimilating	250	17.2	278	16.4	378	18.9	400	22.3
Converging	183	12.6	172	10.2	178	8.9	139	7.8
Cannot specify learning style	74	5.1	58	3.4	81	4.1	69	3.9
Total	1,453	100.0	1,690	100.0	1,998	100.0	1,791	100.0

Table 9. Students' learning styles allocated by school sizes (n = 7,061)

Learning style	School size					
	Small		Medium		Large	
	Frequency	%	Frequency	%	Frequency	%
Diverging	624	35.2	948	34.3	878	34.7
Accommodating	318	18.0	526	19.1	476	18.8
Assimilating	163	9.2	286	10.4	246	9.7
Converging	79	4.5	121	4.4	97	3.8
Cannot specify learning style	587	33.1	879	31.8	833	32.9
Total	1,771	100.0	2,760	100.0	2,530	100.0

Table 10. Students' learning styles allocated by regions (n = 7,062)

Learning style	Region											
	North		South		Central		Northeast		West		East	
	f	%	f	%	f	%	f	%	f	%	f	%
Diverging	263	33.2	656	37.8	807	32.0	652	37.9	32	21.8	40	26.5
Accommodating	182	23.0	311	17.9	485	19.3	254	14.8	58	39.5	31	20.5
Assimilating	77	9.7	140	8.1	254	10.1	194	11.3	7	4.8	23	15.2
Converging	34	4.3	60	3.5	116	4.6	74	4.3	7	4.8	6	4.0
Cannot specify learning style	236	29.8	568	32.7	856	34.0	545	31.7	43	29.3	51	33.8
Total	792	100.0	1,735	100.0	2,518	100.0	1,719	100.0	147	100.0	151	100.0

3.2 The Relationship between Students' Learning Styles and Their Genders, Grade Levels, School Sizes and Regions

The results revealed that the students' learning styles were significantly related to their genders, grade levels, schools sizes and regions.

Table 11. Relationship between students' learning styles and their genders

Learning style	Gender	Mean	S.D.	F	*p*
CE	Male	3.9297	.69711	10.773	.000*
	Female	4.0773	.65083		
RO	Male	3.7754	.71051	16.673	.000*
	Female	3.8785	.62930		
AC	Male	3.6210	.74083	14.636	.000*
	Female	3.6904	.66425		
AE	Male	3.5803	.69500	10.277	.000*
	Female	3.6468	.68253		

Note: * means the statistical difference at the .05 significant level.

Table 10 showed that the female students significantly had mean scores of all learning styles (i.e. CE, RO, AC and AE) higher than male students.

Table 12. Relationship between students' learning styles and their grade levels

Learning style	Source of Variance	Sum of Square	df	Mean of Square	F	*p*
CE	Within group	53.996	3	17.999	40.353	.000*
	Between groups	3126.243	7009	.446		
	Total	3180.240	7012			
RO	Within group	143.837	3	47.946	113.606	.000*
	Between groups	2957.622	7008	.422		
	Total	3101.458	7011			
AC	Within group	98.441	3	32.814	69.804	.000*
	Between groups	3294.346	7008	.470		
	Total	3392.787	7011			
AE	Within group	87.841	3	29.280	63.574	.000*
	Between groups	3227.683	7008	.461		
	Total	3315.523	7011			

The students' learning styles were significantly different regarding their grade levels.

Table 13. Scheffe multiple comparisons of students' learning styles and grade levels

Learning style	Grade level (I)	Grade level (J)	Mean difference (I-J)	Std. Error	*p*
CE	1	2	.20190	.02316	.000*
		3	.23164	.02265	.000*
		4	.17935	.02325	.000*
	2	1	-.20190	.02316	.000*
		3	.02974	.02197	.608
		4	-.02255	.02258	.802
	3	1	-.23164	.02265	.000*
		2	-.02974	.02197	.608
		4	-.05229	.02207	.132
	4	1	-.17935	.02325	.000*
		2	.02255	.02258	.802
		3	.05229	.02207	.132
RO	1	2	.26514	.02253	.000*
		3	.36129	.02204	.000*
		4	.36073	.02261	.000*
	2	1	-.26514	.02253	.000*
		3	.09615	.02138	.000*
		4	.09559	.02197	.000*
	3	1	-.36129	.02204	.000*
		2	-.09615	.02138	.000*
		4	-.00056	.02147	1.000
	4	1	-.36073	.02261	.000*
		2	-.09559	.02197	.000*
		3	.00056	.02147	1.000
AC	1	2	.30891	.02378	.000*
		3	.27347	.02326	.000*
		4	.26026	.02387	.000*
	2	1	-.30891	.02378	.000*

Learning style	Grade level (I)	Grade level (J)	Mean difference (I-J)	Std. Error	*p*
AE	3	3	-.03544	.02256	.481
		4	-.04866	.02319	.221
		1	-.27347	.02326	.000*
		2	.03544	.02256	.481
		4	-.01322	.02266	.952
	4	1	-.26026	.02387	.000*
		2	.04866	.02319	.221
		3	.01322	.02266	.952
	1	2	.30001	.02353	.000*
		3	.26110	.02302	.000*
		4	.20408	.02362	.000*
	2	1	-.30001	.02353	.000*
		3	-.03890	.02233	.386
		4	-.09592	.02295	.001*
	3	1	-.26110	.02302	.000*
		2	.03890	.02233	.386
		4	-.05702	.02242	.091
	4	1	-.20408	.02362	.000*
		2	.09592	.02295	.001*
		3	.05702	.02242	.091

Table 14. Students' learning style and the mean differences compared between grade levels

Learning style	Difference of mean
CE	grade level 1 > grade level 2, 3 and 4
RO	grade level 1 > grade level 2, 3 and 4*
	grade level 2 > grade level 3 and 4*
AC	grade level 1 > grade level 2, 3 and 4*
AE	grade level 1 > grade level 2, 3 and 4*
	grade level 4 > grade level 2

*Note: It shows the difference between pairs which is not arranged by degree of difference

Table 15. Relationship between student's learning styles and their school sizes

Learning style	Source of Variance	Sum of Square	df	Mean of Square	F	*p*
CE	Between Groups	198.009	2	99.005	14.001	.000*
	Within Groups	51260.558	7249	7.071		
	Total	51458.568	7251			
RO	Between Groups	167.220	2	83.610	12.034	.000*
	Within Groups	50518.373	7271	6.948		
	Total	50685.593	7273			
AC	Between Groups	247.137	2	123.569	16.089	.000*
	Within Groups	55783.186	7263	7.680		
	Total	56030.323	7265			
AE	Between Groups	365.727	2	182.863	24.653	.000*
	Within Groups	54000.313	7280	7.418		
	Total	54366.040	7282			

Table 14 asserted that the relationship between students' learning styles and their grade levels was not a strong pattern. In most of the learning styles, the grade level 1 students significantly had mean scores of CE, RO, AC and AE learning styles higher than other grade levels.

Table 15 showed that the students coming from different school sizes significantly had different learning styles. Then, Sheffe multiple comparisons were conducted and showed the results as Table 16.

Table 16. Scheffe multiple comparisons of students' learning styles and school size

Learning style	School size (I)	School size (J)	Mean difference (I-J)	Std. Error	*p*
CE	Small	Medium	-.107	.080	.409
		Large	-.398	.081	.000*
	Medium	Small	.107	.080	.409
		Large	-.292	.072	.000*
	Large	Small	.398	.081	.000*
		Medium	.292	.072	.000*
RO	Small	Medium	-.010	.079	.992
		Large	-.323	.080	.000*
	Medium	Small	.010	.079	.992
		Large	-.313	.072	.000*
	Large	Small	.323	.080	.000*
		Medium	.313	.072	.000*
AC	Small	Medium	-.138	.083	.249
		Large	-.452	.084	.000*
	Medium	Small	.138	.083	.249
		Large	-.314	.075	.000*
	Large	Small	.452	.084	.000*
		Medium	.314	.075	.000*
AE	Small	Medium	-.057	.081	.780
		Large	-.500	.083	.000*
	Medium	Small	.057	.081	.780
		Large	-.443	.074	.000*
	Large	Small	.500	.083	.000*
		Medium	.443	.074	.000*

Table 17. Students' learning styles and their school sizes

Learning style	Mean difference
CE RO AC AE	Large > Small and Medium*

*Note: It shows the difference between pairs which is not arranged by degree of difference

In overall, the students from a large-size school significantly had higher mean scores of CE, RO, AC and AE learning styles than the students from the small- and medium-size schools. Then, the One-way ANOVA of the learning styles and regions was conducted and the results were as Table 18.

Table 18. Relationship between student's learning styles and their regions

Learning style	Source of Variance	Sum of Square	df	Mean of Square	F	*p*
CE	Between Groups	705.476	5	141.095	20.147	.000*
	Within Groups	50753.968	7247	7.003		
	Total	51459.444	7252			
RO	Between Groups	844.650	5	168.930	24.632	.000*
	Within Groups	49851.976	7269	6.858		
	Total	50696.626	7274			
AC	Between Groups	617.205	5	123.441	16.174	.000*
	Within Groups	55415.791	7261	7.632		
	Total	56032.995	7266			
AE	Between Groups	181.643	5	36.329	4.880	.000*
	Within Groups	54184.628	7278	7.445		
	Total	54366.271	7283			

Table 18 showed that regions that the schools located significantly affected the differences of students' learning styles.

Table 19. Scheffe multiple comparisons of students' learning styles and region

Learning style	Region (I)	Region (J)	Mean difference (I-J)	Std. Error	*p*
CE	North	South	-.493	.112	.002*
		Central	.185	.107	.701
		Northeast	-.244	.112	.454
		West	.601	.236	.263
		East	.718	.232	.088
	South	North	.493	.112	.002
		Central	.678	.081	.000*
		Northeast	.250	.089	.162
		West	1.094	.226	.000*
		East	1.211	.222	.000*
	Central	North	-.185	.107	.701
		South	-.678	.081	.000*
		Northeast	-.428	.082	.000*
		West	.416	.223	.626
		East	.534	.219	.311
	Northeast	North	.244	.112	.454
		South	-.250	.089	.162
		Central	.428	.082	.000*
		West	.844	.226	.016
		East	.962	.222	.002*
	West	North	-.601	.236	.263
		South	-1.094	.226	.000*
		Central	-.416	.223	.626
		Northeast	-.844	.226	.016
		East	.118	.304	1.000
	East	North	-.718	.232	.088
		South	-1.211	.222	.000*

Learning style	Region (I)	Region (J)	Mean difference (I-J)	Std. Error	*p*
		Central	-.534	.219	.311
		Northeast	-.962	.222	.002*
		West	-.118	.304	1.000
RO	North	South	-.401	.111	.023
		Central	.155	.106	.828
		Northeast	-.396	.111	.027
		West	1.272	.233	.000*
		East	.561	.230	.309
	South	North	.401	.111	.023
		Central	.556	.080	.000*
		Northeast	.006	.088	1.000
		West	1.674	.223	.000*
		East	.962	.219	.002*
	Central	North	-.155	.106	.828
		South	-.556	.080	.000*
		Northeast	-.550	.081	.000*
		West	1.118	.220	.000*
		East	.406	.217	.620
	Northeast	North	.396	.111	.027
		South	-.006	.088	1.000
		Central	.550	.081	.000*
		West	1.668	.223	.000*
		East	.957	.219	.002*
	West	North	-1.272	.233	.000*
		South	-1.674	.223	.000*
		Central	-1.118	.220	.000*
		Northeast	-1.668	.223	.000*
		East	-.711	.300	.345
	East	North	-.561	.230	.309
		South	-.962	.219	.002*
		Central	-.406	.217	.620
		Northeast	-.957	.219	.002*
		West	.711	.300	.345
AC	North	South	-.497	.117	.003*
		Central	.037	.112	1.000
		Northeast	-.441	.117	.015
		West	.859	.248	.035
		East	.097	.242	.999
	South	North	.497	.117	.003*
		Central	.534	.085	.000*
		Northeast	.056	.093	.996
		West	1.356	.237	.000*
		East	.594	.231	.249
	Central	North	-.037	.112	1.000
		South	-.534	.085	.000*
		Northeast	-.478	.085	.000*
		West	.822	.234	.031
		East	.060	.228	1.000
	Northeast	North	.441	.117	.015

Learning style	Region (I)	Region (J)	Mean difference (I-J)	Std. Error	*p*
		South	-.056	.093	.996
		Central	.478	.085	.000*
		West	1.300	.237	.000*
		East	.538	.231	.364
	West	North	-.859	.248	.035
		South	-1.356	.237	.000*
		Central	-.822	.234	.031
		Northeast	-1.300	.237	.000*
		East	-.762	.318	.331
	East	North	-.097	.242	.999
		South	-.594	.231	.249
		Central	-.060	.228	1.000
		Northeast	-.538	.231	.364
		West	.762	.318	.331
AE	North	South	-.242	.116	.496
		Central	.073	.110	.994
		Northeast	-.101	.116	.979
		West	.027	.243	1.000
		East	.615	.238	.246
	South	North	.242	.116	.496
		Central	.315	.084	.015*
		Northeast	.141	.091	.793
		West	.269	.233	.931
		East	.857	.227	.014
	Central	North	-.073	.110	.994
		South	-.315	.084	.015*
		Northeast	-.174	.084	.510
		West	-.046	.230	1.000
		East	.542	.224	.322
	Northeast	North	.101	.116	.979
		South	-.141	.091	.793
		Central	.174	.084	.510
		West	.128	.233	.998
		East	.716	.227	.077
	West	North	-.027	.243	1.000
		South	-.269	.233	.931
		Central	.046	.230	1.000
		Northeast	-.128	.233	.998
		East	.588	.312	.616
	East	North	-.615	.238	.246
		South	-.857	.227	.014*
		Central	-.542	.224	.322
		Northeast	-.716	.227	.077
		West	-.588	.312	.616

Table 20. Students' learning styles and their regions

Learning style	Mean difference
CE	South > North, Central and East*
	Northeast > Central and East
RO	South and Northeast > North, Central and East
AC	South and Northeast > North and Central
AE	South > Central and East
	Northeast > East

*Note: It shows the difference between pairs which is not arranged by degree of difference

In overall, the relationship between the students' learning styles and their regions was not strong pattern when compared with the gender, grade level and school size variables. Remarkably, the students from the South and Northeast regions tended to had mean scores on CE, RO, AC and AE learning styles higher than the students from other regions.

4. Discussion

Teachers are responsible to help students develop to their own pace with their best potentiality as mentioned in Section 22 of the National Education Act B.E. 2542 of Thailand:

Education shall be based on the principle that all learners are capable of learning and self-development, and are regarded as being most important. The teaching-learning process shall aim at enabling the learners to develop themselves at their own pace and to the best of their potentiality. (Office of the National Education Commission, 1999, p. 10)

In order to help students develop with their potentiality, teachers must understand individual learners' backgrounds including students' learning styles. When teachers understand students' learning styles, they are capable in selecting or creating learning activities to suit students' preferred learning styles. In other words, teachers adjust their teaching styles to suit students' learning styles. Montgomery and Groat (1998, pp. 1-2) state the reasons why teachers should understand their students' learning styles: making teaching and learning more dialogue; responding to more diverse students; communicating clearer message; making teaching and learning more rewarding and ensuring the future of taught disciplines. According to Kolb (1985), learning styles can be divided into: Concrete Experience (CE), Reflective Observation (RO), Abstract Conceptualization (AC) and Active Experimentation (AE). The combination of these learning styles yields four types of learners: Diverging, Accommodating, Converging and Assimilating. A Diverging (experiencing and reflecting) learner can be called "the Reflector," an Accommodating (doing and experiencing) learner can be called "the Activist," a Converging (thinking and doing) learner can be called "the Pragmatist" and an Assimilating (reflection and thinking) learner can be called "the Theorist."

This survey research shows that the grades 1-12 students in Thailand significantly had different learning styles (i.e. CE, RO, AC and AE) regarding the gender, grade level, school size and region variables. That is, the female students, the grade level 1 students and the students from large-size schools significantly had mean scores in CE, RO, AC and AE higher than the male students, the students in other grade levels and the students from small-size and medium-size schools, respectively. In this study, the gender, grade level and school size variables show strong pattern of students' learning styles; while the region variable show weak pattern. The relationships of students' learning styles and their genders and grade levels are similar to Kaya, Ozabaci, and Tezel (2009) and Bumrungsri (1982), who found that students' learning styles are related to their genders. Accordingly, in designing learning activities, teachers should consider the students' genders and grade levels as important variables affecting their learning styles.

According to four types of learners in Kolb's model, most of the students in this study tend to be the Divergers, followed by the Accommodators, Assimilators and Convergers. This emerged pattern is similar to what found in Kaya, Ozabaci, and Tezel (2009) study. However, this finding is in contrast with Lertphop (1992), who found that most of the students in the Olympic Science project had the Accommodating learning style, followed by the Assimilating, Diverging and Converging learning styles. The difference of finding found in this study and Lertphop's study may come from the use of different types of sample. That is, the sample of this study is the grades 1-12 students; while the sample of Lertphop's study is the talented students. Anyway, one interesting finding is both the grades 1-12 students or the talented students prefer least in the Converging learning style. The

unpopularity of Converging learning style may be originated from the implementation of new national basic education curriculum in Thailand, that is, the 1999 Basic Education Curriculum (B.E. 2544). This new curriculum emphasizes more higher-order and critical thinking, which may subsequently enhance student's Diverging learning style.

Anyway, Kolb stated that, for all learning styles, teachers should provide students with these four kinds of activity: a) Concrete Experience-teachers require students to have practical experiences from active participation in observation, hands-on activity, collecting a variety of data from direct experience; b) Reflection-teachers require students to exchange their ideas and experiences with their peers and reflect what they have understood or learned; c) Conceptualization-teachers require students to think collaboratively with others, link different ideas emerged from the class and finally conclude all into their own concepts; and d) Application-teachers require students to apply their learned concepts into various situations. The Concrete Experience-Reflection-Conceptualization-Application learning cycle here may help teachers prepare and provide learning activities to suit four types of learners: the Diverging learner or "the Reflector," the Accommodating learner or "the Activist," the Converging learner or "the Pragmatist" and the Assimilating learner or "the Theorist."

5. Implementations

First of all, teachers should realize the importance of knowing students' learning styles. That is, learning style is appeared as one key component of student individual differences, which highly regarded by the 1999 National Education Act. Knowing students' learning styles, thus, helps teachers understand students' individual differences.

Teachers should explore students' learning styles both in individual and classroom levels. This information is useful for both students and teachers. That is, students should be informed about their preferred learning styles that might promote or hinder their learning. They can subsequently take advantages from knowing their learning styles and lead to more effective learning. In addition, teachers can use information about their students' learning styles in planning the lesson, designing learning activities, finding learning materials that are best suit each type of student learning style. However, teachers should not rely only on data from survey. Instead, they should use other data collection techniques such as interview or classroom observation to get more in-depth information about students' learning styles.

A teacher should realize the diversity of students in his or her classroom, that is, students enter the classroom with different backgrounds including learning styles. So, teachers should conduct a variety of teaching methods as many as they can to suit all kinds of student learning styles. This approach guarantees that, at least, each student in one classroom has opportunity to learn with one of his or her preferred learning styles.

Also, teachers should scrutinize students' learning styles and consider that such learning styles act as an obstacle for students in learning or not. If yes, teachers should students limit such learning styles and promote others. Importantly, teachers should encourage students to learn collaboratively with others because students have chance to help each other as well as learn from their peers' strengths, weaknesses and learning styles. This kind of leaning experience may help students develop desirable learning styles for themselves.

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