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# Critical Thinking Skills and Brain Dominance of Post-Graduate Students

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## Abstract

The objectives of this study were to investigate the post-graduate students' critical thinking skill and examine their brain dominance. The design of this study was cross sectional in nature. Both qualitative and quantitative approaches were used in this study. The total of 326 post-graduate students from YUOE and SUOE participated in this study. Most of the participants were prospective teacher educators by profession. In addition, some of them were in-service teacher trainees and some were pre-service teacher trainees. Critical Thinking Skill Test (CTST) and Brain Dominance Test (BDT) were used as the research instruments. Alpha reliability for CTST, and BDT revealed at 0.64 and 0.86, respectively. Regarding the critical thinking, 25.8% were found to be advanced skilled thinkers, 46.9% were skilled thinkers, and the rest 27.3% can be classified as unskilled thinkers. Moreover, differences in level of education were found on overall test as well as interpretation sub-scale. Concerning the brain dominance, 27.9% of post-graduate students were whole brain thinkers, whereas 65.6 % were left-brain thinkers, and the rest 6.4% were right-brain thinkers.

## Keywords:

Critical thinking skill, Brain dominance, Whole brain thinking

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## Author's Notes

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## Introduction

In this new millennium, teachers could no longer foresee exactly what kinds of knowledge and skills will assist their learners' lifespan. There are diverse kinds of challenges that teacher educators today would have to handle. Teachers should react to these challenges by encouraging students' thinking skills rather than rote memorization of facts. According to Tsui (2002), higher-order cognitive skills, such as the ability to think critically and creatively, are invaluable to students'

future; individuals should be prepared to tackle a multitude of challenges that they were likely to face in their personal lives, careers, and duties as responsible citizens. Moreover, by instilling critical thinking in students, they will become independent lifelong learners. According to Porritt (2005), education is not a matter of transmission of knowledge or concepts or ideas. To be exact, education seeks to increase the intellectual capital of this world. Therefore, brilliance thinking must be systematically cultured.

## Significance of the Study

John Dewey (1933) stated that learning to think is the central purpose of education. There is an urgent question which needs to answer: Are school administrators and teachers being prepared to think critically and to guide students how to think? Concerning this, in 1997, Kishore Mahbuni, a senior official in Singapore, posed a challenging question at a conference; Can Asians think? It was a remarkable moment of self-doubt. Asians have always been proud of how well they educate their children. Although, Asians score highest in science and mathematics in worldwide comparisons, Asian students were too busy memorizing deadening answers to learn to think. But from Tokyo to Taipei and Singapore, governments were, now, realizing that their children were so overstressed and over tested that they were ill equipped for the information age, where thinking and creativity hold a premium (Elliott et al, 1999).

In addition, Michael Scriven (1987) stated that training in critical thinking should be the primary tasks of education. Educators are not alone in recognizing the importance of critical thinking. The demands of employment in a global economy, and personal decision making in a complex and rapidly changing society require people who can reason well and make good judgments (as cited in Scriven and Paul, 1987). So, it is the clearly time for the educators in Myanmar to be aware of the need to inculcate the habit of critical thinking in every academic discipline and at every level of education.

Although several critical thinking studies have been conducted in previous years throughout the world, research related to critical thinking and brain dominance was relatively rare, especially in the field of teacher education and teacher training. The fields of neuroscience and cognitive science are helping to satisfy the fundamental curiosity about how people think and learn (Bransford et al, 2000). Educator might aware the function of the brain and its thinking process.

To fulfill this need, current study tried to identify and explore critical thinking and brain dominance of selected post-graduate students in the contexts of teacher education. Majority of post-graduate students at the two Universities of Education are in-service teachers and the rest are pre-service teachers. The rationale of this study was deeply rooted in the idea that teachers are the key change-agent in producing

a thinking generation. If teachers are going to be the mediator and change-agent in the classroom and the change element that is being concerned here is the thinking skills, it will be very important for educators to find out whether teacher trainees or teachers are adequately prepared for critical thinking skills in their profession.

## Conceptual Framework

In fact, during the last decades, many psychologists have put forward theories and definitions to explain the meaning of thinking. (Mok Soon Sang, 2003). From a neuroscience perspective, instruction and learning are very important parts of brain development and psychological development processes (Bransford et al, 2000). On the thinking front, the brain's interconnected cells allow people to speak, describe, argue, create, articulate, organize, decide, and dream (LoCicero et al, 2005). The whole concept of right and left-brain thinking was borne out of research conducted by American Nobel Prize Winner Roger Wolcott Sperry (LoCicero et al, 2005).

According to Roger W Sperry (1960), the human brain has two very different ways of thinking. Anatomically speaking, the brain is split into two halves or -- more technically -- hemispheres. These halves are commonly called the right brain and left brain, but should more correctly be termed hemispheres. Each hemisphere seems it should be completely identical to each other, but they're not really. The left side of brain actually controls the action of right side of the body and vice versa (as cited in Bransford et al, 2000).

According to Hopkins (1984), education system is mainly the region of the left hemisphere of the brain and that the functions of the right hemisphere are little understood and perhaps neglected in education system. A balanced brain makes a balanced person - combining sequential thinking with a holistic approach, or linear thinking with intuition, enables him/her to fully comprehend issues and solve problems. Whole-brained people have the best of both hemispheres. Truly critical thinkers will find ways to incorporate the talents of both brain hemispheres to maximize their personal effectiveness (Wagner, 2009). Thinking is a process of formulating knowledge and understanding which involves mental activities in the human brain (Mok Soon Sang, 2003).

Operational definition of critical thinking is described here as the ability to explain, evaluate, analyze, and interpret via logico-inferential modes of reasoning.

From the time of Socrates to contemporary concerns about the need for an educated citizenry and quality work-force, the ability to think critically and to reason well has been regarded as an important and necessary outcome of education. In this regard, during the last decades, a blossoming body of research concerning critical thinking at every level of education in every academic discipline has been accumulated.

Facione (1997) conducted a longitudinal aggregate study of undergraduate nursing programs wherein students demonstrated gains on the CCTST with each year of college. Changes were examined between freshmen and sophomores, then freshmen and juniors, then freshmen and seniors; the largest gains occurred between the freshmen and sophomore years.

## **Purpose of the Study**

The objectives of this study are to investigate the post-graduate students' critical thinking skills and examine their brain dominance.

## **Scope and Procedure**

This study was conducted at Yangon University of Education (YUOE) and Sagaing University of Education (SUOE) in Myanmar. This study aims to survey the critical thinking skills, critical thinking dispositions and brain dominance of post-graduate students. The instruments used in this study were Brain Dominance Test (BDT), and Critical Thinking Skill Test. Post-graduate students' critical thinking skills, and brain dominance were investigated across disciplinary clusters of the two Universities of Education in Myanmar. With the permission of administrative personnel of two Universities, all the post-graduate students of Doctoral program, Master program, and Post-graduate Diploma program who enrolled in 2010-2011AY were included as the sample in this study. Then, two questionnaires were administered to the participants.

## **Methodology**

Design of this study is cross sectional in nature. Both qualitative and quantitative approaches were used in this study. In addition, for purposes of empirical exploration, the ten research questions motivating this study should be expressed as follows.

### **Research Questions**

1. Is there any difference in Brain Dominance of post-graduate students from two Universities of Education?
2. Is there any difference in CTS of post-graduate students from two Universities of Education?
3. Is there any difference in CTS among post-graduate students by grade level?
4. Is there any difference in CTS among post-graduate students by discipline?
5. Is there any difference in CTS among post-graduate students by gender?

### **Sample of the Study**

Two Universities of Education such as Yangon University of Education (YIOE) and Sagaing University of Education (SIOE) were purposefully selected for this study. All students who enrolled in post-graduate classes during 2010-2011 AY at the selected Universities were included in the sample. The total of 326 post-graduate students participated in this study. Among the sample, 87 (26.7%) were drawn from Educational Administration and Supervision, 42 (12.9%) from Pedagogic Methodology, 42 (12.9%) from Educational Guidance and Counselling, 29 (8.9%) from Educational Test and Measurement, 22 (6.75%) from MA (TEFL), 14 (4.29%) from Dip. in ELTM, and 90 (27.6%) from PGDMA program.

### ***Data Collection Procedures***

With the permission of administrative personnel of two Universities of Education, two questionnaires were administered to the participants during 2010-2011 AY at two Universities of Education. Then, descriptive statistics and inferential statistics were applied to the data set by using SPSS software. Specifically, t-test, ANOVA, Post-Hoc Analysis and cross tabulation analysis were used in order to interpret and report the results.

Critical Thinking Skill Test and Brain Dominance Test (BDT) were used as the research instruments. The instrument to measure critical thinking skills of post-graduate students in this study was developed by researcher. This process was undertaken by the guidance of existing standardized critical thinking skills tests such as California Critical Thinking Skills Test (sample) (CCTST), Thinking Skill Assessment (TSA) (University of Cambridge Local Examinations Syndicate, 2007), Critical Thinking Instrumentation Manual developed by University of Florida, (Irani et. al, 2007) and Critical Thinking Test in Sociology Item Development Manual of Michigan State University, Keesler (2006). After studying the above mentioned critical thinking skills tests, researcher developed Critical Thinking Skills Test. Critical Thinking Skills Test consists of 21 items and five sub-scales such as evaluation, explanation, analysis, inference and interpretation. Critical thinking skill of post-graduate students was identified as three types such as unskilled thinker, skilled thinker, and advanced skilled thinker. Candidates who earned the scores less than 50th percentiles are identified as unskilled thinkers, the ones whose scores lie between 50th percentiles and 75th percentiles are classified as skilled thinkers, and those whose scores are greater than 75th percentiles are referred to as advanced skilled thinkers.

In addition, to assess the brain dominance of post-graduate students, Brain Dominance Test (BDT) was adapted from Hough Brain Dominance Test developed by David Hough, Missouri State University. The BDT is composed of 50 items. Brain Dominance Test is a 5 points Likert scale, with 1= never, 2=sometimes, 3=often, 4= usually, to 5=always. The BDT is composed of 50 items among them, 25 items stand for left-brain dominance and other 25 items stand for right-brain preference. In order to get the total score for left brain as well as right brain dominance, add the score for each 25 items of BDT. The lowest total score for

either hemisphere is 25 and highest possible total score is 125. After that, subtract smaller total score from greater total score of particular hemisphere either left or right to find the degree to which an individual tends to favor whether the left brain over the right brain or the right brain over the left brain. The greatest difference is 100 which indicate a strong preference on one side of brain, while the smallest degree of difference is 0 which indicates no preference or integrated mind (Hough, 1987). A person has an integrated mind can be referred to as a whole brain thinker. Such kind of person uses both sides of brain fairly. Brain Dominance Test was administered during 2010-2011 AY at two Institutes of Education. Alpha reliability for CTST, and BDT revealed at 0.64 and 0.86, respectively.

### **Results and Discussions**

After developing the instruments, differences in critical thinking skills, and differences in brain dominance of post- graduate students were examined at two Universities of Education. In addition, differences across disciplines, difference between Universities, gender related difference, differences between grade level, and differences between types of trainee were further investigated. And then, inter-correlation among critical thinking skills, and brain dominance were also explored.

#### ***Brain Dominance of Post-graduate Students***

Concerning brain dominance, 27.9% of post-graduate students were found to be whole brain thinkers, 65.6% were left-brain thinkers, and the rest 6.4% were right-brain thinkers.

Looking across the disciplines, 58.62% of students from Educational Administration and Supervision cluster can be said to be left-brain thinkers, 5.74% were right-brain thinkers, and the rest 35.6% were whole brain thinkers. Similarly, percentage of students who prefer left-brain mode of thinking from each disciplinary cluster was larger than that of whole-brain mode and right-brain mode. Again, the participant students in both Universities were provided with more learning opportunities that enable them to develop left side of the brain.

**Table 1. Mean Comparison of Post-graduate Students' Critical Thinking Skill across Discipline**

Attributes /Discipline	AS	ETM	GC	PM	ELT	DMA	F	p
The Whole Test (21items)	18.31	18.34	18.82	18.3	18.1	17.44	.731	.601
Evaluation Sub-scale (3 items)	4.8	4.8	4.7	4.5	4.5	5.1	1.85	.102
Explanation Sub-scale (4 items)	5.3	5.4	5.6	5.5	4.9	5	0.83	.529
Analysis Sub-scale (3 items)	1.25	1.35	1.44	1.56	1.55	1.23	0.81	0.51
Inference sub-scale (6 items)	5.2	5.1	5.3	5.2	5.7	5	1.72	0.12
Interpretation sub-Scale (5 items)	2.8	2.9	3	3	2.8	2.3	<b>5.6**</b>	<b>0.000</b>

\*\* The mean difference is significant at the  $P < 0.001$

AS=Educational Administration & Supervision, ETM= Educational Test& Measurement, GC= Educational Guidance & Counselling, PM=Pedagogic Methodology, ELT= English Language Teaching, DMA= Multimedia Art

Concerning gender, nearly 65% of students were found to be left brain thinkers. It can reasonably be said that both male and female were provided same learning opportunities that enable them to enrich more left hemisphere style thinking. The results evidently showed that the participant students in this study were provided with less learning opportunities that enable them to develop right side of the brain.

### **Critical Thinking Skills of Post-graduate Students**

Looking across the discipline, Table 1 shows the differences of students' response on five sub-scales and overall scale of Critical Thinking Skills Test (CTST). Despite a slight variation of mean score exists, no significant difference was found among post- graduate students' overall score as well as sub-scale score on critical thinking skill test by different discipline ( $F=0.731, p=0.601$ ). Significant difference was found only on the interpretation sub- scale of CTST ( $F=5.6, p=0.000*$ ).

In addition, to examine the highly significant differences across disciplines, Post-hoc Test was executed by Tukey HSD method and it became apparent that the mean score of Multimedia Art cluster was significantly lower than that of other clusters in interpretation sub-scale. It can reasonably be said that participant students from Multimedia Art cluster have limited ability to make explicit, through the contextual meanings of words, ideas, and events, to make a reasonable judgments (See Table 2). Concerning the across disciplinary effects on critical thinking, McDonough (1997) found that there was no disciplinary effects on critical thinking test scores.

**Table 2. Post-Hoc Analysis of Post-graduate Students' Critical Thinking Skill across Discipline by Tukey HSD Method**

Sub-scale	(I)Discipline	(J) Discipline	Mean Difference (I-J)	p
Interpretation	DMA	AS	-0.57*	.001
		ETM	-0.61*	.034
		GC	-0.73*	.001
		PM	-0.68*	.002
		ELT	-0.52	.062

\* The mean difference is significant at the 0.05 level

**Table 3. Mean Comparison of Post-graduate Students' Critical Thinking Skill by Gender**

Sub-scale	Male	Female	t	p
The Whole Test (21 items)	18.76(4.03)	18.00(4.34)	1.15	0.25
Evaluation Sub-scale (3 items)	4.8(1.5)	4.8(1.2)	0.32	0.74
Explanation Sub-scale (4 items)	5.6(2.6)	5.2(2.3)	1.11	0.26
Analysis Sub-scale (3 items)	1.5(0.6)	1.6(0.6)	-0.27	0.78
Inference sub-scale (6 items)	5.3(1.3)	5.2(1.3)	0.28	0.78
Interpretation sub-Scale (5 items)	2.9(0.9)	2.7(1.0)	1.5	0.12

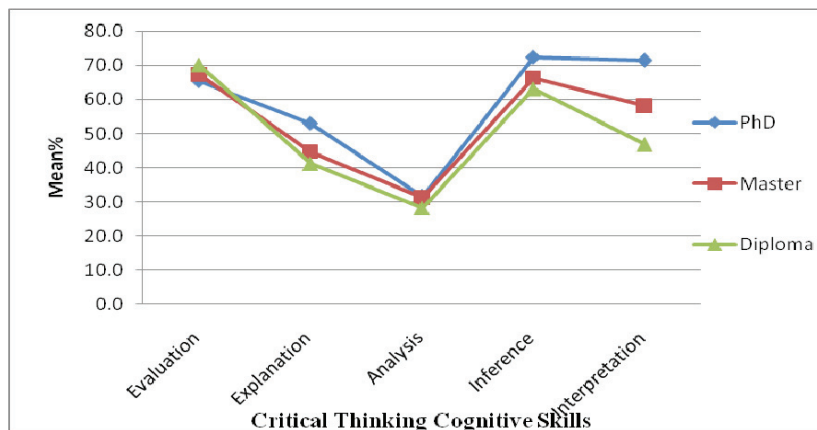
Parenthesis show the standard deviation (SD).

Looking across the overall scale and five sub-scales, gender related difference was not found in post-graduate students' critical thinking skills. It can reasonably be said that male and female participants were provided the same learning opportunities that enable to enhance their critical thinking cognitive skill.

Concerning the type of thinker, 17 out of 50 (34%) of male students and 67 out of 276 (25%) of female students can be said to be the advanced skilled thinkers whereas 23 out of 50 (46%) of male and 130 out of 276 (47%) were referred to as skilled thinkers. On the other hand, 20% of male and 28% of female were unskilled thinkers. This may be due to the fact that both male and female students in this study were provided with some degree of learning experiences and opportunities that enable them to develop the critical thinking skills.

Concerning the level of education, significant difference was found on the overall scale of CTST as well as interpretation sub-scale. Regarding the doctoral level candidates, inference skill, interpretation skill and the evaluation skills were high among five critical thinking cognitive skills. Again, doctoral level students' mean score of interpretation skill was significantly higher than that of both master level students and diploma level students whereas the doctoral level students' mean score on overall scale was significantly higher than that of diploma level students'. Similar result was found between students from master and diploma program. This may be due to the fact that doctoral level students were provided more learning opportunities and experiences in thinking concern with formulating the research hypothesis, planning and conducting various research, analyzing and interpretation of data, and making inferences than master level and diploma level students.





**Figure 1. Mean Comparisons of Critical Thinking Cognitive Skill by Level of Education**

**Table 4. ANOVA Results of Post-graduate Students' Critical Thinking Skill by Level of Education**

Attributes	PhD	Master	Diploma	F	p
The Whole Test (21 items)	20.28	18.32	17.41	3.46*	0.03
Evaluation Sub-scale (3 items)	4.57	4.72	5.06	2.78	0.06
Explanation Sub-scale (4 items)	6.35	5.37	4.95	2.73	0.06
Analysis Sub-scale (3 items)	1.65	1.64	1.55	1.51	0.22
Inference sub-scale (6 items)	5.78	5.31	5.04	2.42	0.09
Interpretation sub-Scale (5 items)	3.57	2.91	2.34	17.57**	0.000

\* The mean difference is significant at the 0.05 level.

\*\* The mean difference is significant at the 0.001 level.

Regarding the master level students and diploma level students, the mean score of master level students was significantly higher than that of diploma level students. It can reasonably be said that master level students were offered more learning activities and experiences in conducting research, analyzing and interpretation of data, making inferences and presenting the result in logical order than diploma level students.

Looking across the level of education, 42.8% of doctoral level students, 26.4% of master level students, and 22% of diploma level students can be identified as advanced skilled thinkers. In addition, proportion of skilled thinker across doctoral, master and diploma

level were 42.8%, 46.6% and 48%, respectively. The percentage of advanced skilled thinkers from doctoral level students was greater than that of master level and diploma level. Therefore, it is evident that critical thinking skills of sample students in this study become more skilful, and advanced as their education level gets higher.

Looking across the institution level, the mean scores of participant students from YUOE were greater than those of SUOE on all five sub-scales as well as overall scale of Critical Thinking Skill Test. In addition, significant differences were found on overall test and three sub-scales such as explanation, inference, and

**Table 5. Post-Hoc Analysis of Critical Thinking Skill among Level of Education by Tukey HSD Method**

Attribute	(I) Level	(J) Level	Mean Difference (I-J)	p
CTST Total	PhD	Diploma	2.87*	0.049
Interpretation Sub-scale	PhD	Diploma	1.22**	0.000
		Master	0.65*	0.034
	Master	Diploma	0.56*	0.000

**Table 6. Mean Comparison of Post-graduate Students' Critical Thinking Skill between two Universities**

Attributes	SUOE	YUOE	t	p
The Whole Test (21items)	16.8	19.4	4.74**	0.000
Evaluation Sub-scale (3 items)	4.6	4.9	1.90	0.05
Explanation Sub-scale (4 items)	4.8	5.6	2.83*	0.005
Analysis Sub-scale (3 items)	1.5	1.6	0.16	0.87
Inference sub-scale (6 items)	4.8	5.6	3.20**	0.000
Interpretation sub-Scale (5 items)	2.5	2.9	3.85**	0.000

\* The mean difference is significant at the 0.05 level.

\*\* The mean difference is significant at the 0.001 level.

interpretation. Concerning the evaluation skill, mean difference between two Universities was marginal,  $p=0.05$ . In addition, significant difference was not found to be only on the analysis skill.

It can reasonably be said that students from YUOE were provided more teaching learning activities which call for the development of critical thinkers than students from SIOE. Furthermore, post-graduate students from YUOE were offered more experiences in participating academic debate, group discussion, conducting small-scale research, projects and assignments concerned with academic writing focus on critical reasoning than that of post- graduate students from SUOE.

#### **Brain Dominance and Critical Thinking: Skill of Post-graduate Students**

Concerning the brain dominance and post-graduate students' critical thinking skill, the mean score of whole-brain thinkers was higher than that of left-brain thinkers and right-brain thinkers. In other word,

the mean score of right-brain thinkers was lower than that of whole-brain thinkers and left- brain thinkers. Although a slight variation of mean score exists, no significant difference was found among the left brain thinkers, right brain thinkers and whole brain thinkers. Whether a person is a left-brain thinker or a right-brain thinker, there is no better or winning side to be. These are two halves that make a much better whole (LoCicero et al, 2005).

#### **Conclusions and Recommendations**

Myanmar, like other countries whether developed or developing, needs citizens who can evaluate and reason well, from different perspectives, regarding global issues, cultural diversity, social conflicts, political issues, and international affair.

The results revealed that critical thinking skill of doctoral level candidates was significantly higher than that of diploma level and master level students. Again, master level students' mean score on interpretation sub-scale was significantly greater than that of diploma



**Table 7. Post-graduate Students' Critical Thinking Skills by Brain Dominance**

<b>Brain Dominance</b>	<b>N</b>	<b>Mean</b>	<b>SD</b>	<b>F</b>	<b>p</b>
<b>Right</b> Brain Thinkers	21	17.85	5.3	0.241	0.78
<b>Whole</b> Brain Thinkers	91	18.37	4.5		
<b>Left</b> Brain Thinkers	214	18.03	4.1		
Total	326	18.11	4.2		

students. Similarly, Onwuegbuzie, (2001) conducted a study which compared the critical thinking skills of Masters-level and doctoral-level students. Findings revealed that the doctoral-level students obtained statistically significantly higher overall critical thinking skills than did the Master's-level students. Results evidently show that the link between thinking and education is obvious.

Concerning the training effect, mean score of in-service teacher trainees on interpretation skill was greater than that of pre-service teacher trainee. Appropriate teaching strategies and learning environments facilitate their growth as student persistence, self-monitoring, and open-minded, flexible attitudes (King et al, n.d.).

To say exactly, one cannot learn well without thinking well. Here, no one can deny the fact that teachers play a crucial role in bringing about national development as they are responsible for producing well-qualified human resources necessary for national development. The task of teacher educators in the 21st century is not as straight forward as in the 20th century. In this new millennium, the world is changing rapidly in science and technology and the changes has the greatest influence on business, economic, educational, environmental, cultural and social trends of the future. Therefore, it is clearly the time for teacher educators to be aware that children should be provided with the learning opportunities that enable them to become thinking generation who can reasonably, wisely, confidently, and open-mindedly, face the challenges of 21<sup>st</sup> century.

Concerning the brain dominance, 65% of participants were found to be left-brain thinkers while minorities of participant students were found to be right-brain thinkers. Results evidently showed that both YUOE and SUOE geared more on left-brain modes of thinking. Concerning the brain-based learning; the brain has two quite distinct ways of processing information attributable to its two hemispheres. The complexity of the brain and the ways in which it processes information are much greater than the simplicity implied by the two hemispheres. However, an understanding of the processing modes of the two hemispheres serves as a useful starting point in understanding the nature of mental processing in learning (Atkin, 1999).

Brain-based learning has resulted from educators and researchers applying the findings of brain research to guide teaching practice. Brain- based teaching involves the implementation of carefully-designed principles with due consideration of their impact before, during, and after each lesson (Townsend, 2005)

Educators and teachers from worldwide must recognize that right hemisphere processing is as paramount importance as left hemisphere processing for learning. In practice, since meaningful learning for students is indispensable in this competitive world abundant with material and information, educators today should exert their effort to implement education system that mainly focus on developing the right hemisphere of the learners to enable them to make right decisions out of various alternatives and overcome the challenges of this complex world.

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