THE INFLUENCE OF LEARNING STYLES AND METACOGNITIVE SKILLS ON STUDENTS' CRITICAL THINKING IN THE CONTEXT OF STUDENT CREATIVITY PROGRAM

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Abstract

Improving students' critical thinking is very important in learning process because one of the goals of critical thinking is to develop students ' critical thinking in the perspective of collectable information. The approach used in this research to address the problem of critical thinking is through learning style and metacognitive skill. The Student Creativity Program is a great way to hone critical thinking at the university level. This research is intended to find out the level of metacognitive skills, learning style, and critical thinking and the influence of metacognitive skills and learning styles on critical thinking among a total of 55 students of a Korean Education Study Program at a state university in Indonesia in the context of Student Creativity Program. This research used survey to find about students' learning styles and their level of metacognitive skill. A test was also conducted to find out the level of students' critical thinking. The data were calculated by the SPSS to test the hypothesis. The research results for learning styles show that 33 (60%) of the students were in the "medium" category and 22 (40%) were in the "high" category, and there was no student categorised into the "low" category. In terms of metacognitive skills, 53 students (98.2%) were in the "high" category and 2 (1.8%) in the "medium" category, and no one was in the "low" category. All students were identified to have "high" level critical thinking. Based on the significance test, learning style had no significance influence on critical thinking; however, metacognition skills had significant influence on critical thinking.

Keywords: critical thinking; learning styles; metacognitive skills

INTRODUCTION

Critical thinking has an important role in enhancing student learning outcomes (Baker, Rudd, & Pomeroy, 2001; Noone & Hogan, 2016; Kumar & James, 2015; Song, 2016). Critical thinking is organized for the students to take responsibility for their own learning, to become active learners, and seek to enhance their own individual characteristics (Cırık, Çolak, & Rich, 2015; Marlowe & Page, 2005; Tuncel & Bahtiyar, 2015). Developing critical thinking means developing the active role of lifelong learning (Gibby, 2013), a requirement for individuals to become active members of democratic societies, and can solve the social problems they will face (Oğuz & Sariçam, 2015).

One of the problems identified in relation to the development of critical thinking is the lack of school or campus-based activity that support students' critical thinking development (Marin & Halpern, 2011).

Students who are not able to develop critical thinking will not be able to learn by using their thoughts alone; to collect, analyse, synthesise and evaluate information; to analyse the logic to solve problems; to sympathise with others; to be critical readers, authors, speakers and listeners; in addition, they will have a tendency to study on the basis of their rationale; not really display the characteristics of an educated person; and cannot really exhibit humility, integrity, courage, perseverance, and faith (Paul, 1989).

In this regard, Student Creativity Program, a program developed by the Directorate of Learning and Student Affairs under the Ministry of Research, Technology, and Higher Education can be one of the means to enhance students' critical thinking. The extracurricular nature of this program encourages students to think critically and be able to work in team and independently without the help of lecturers.

Students in team will have to create a proposal for a creative product-oriented program under a lecturer's limited supervision. The proposal submitted will compete with other proposals at the university and national levels. Most research on the program has focused on students' creative thinking, such as that by Gina, Perbawati, and Supriyanto, (2017). The critical thinking, meanwhile, has not been much discussed.

Previous research on critical thinking itself has gleaned some light into various factors affecting critical thinking. One of the most identified factors is self-control that has been studied in terms of different variables, such as gender, age, grade, ethnicity, and levels of education (Bakır, 2015; Bostic, 2010; Buluş, 2011; Dunn, Rakes, & Rakes, 2014; Fagbohungbe & Jayeoba, 2012; Loghmani, 2010; Vierra, 2014; Wood, Saylor, & Cohen, 2009). Another factor found to have some effect on critical thinking is learning styles (An, 2007; Roberts, 2003; Shin, Ha, & Kim, 2005; Torres & Cano, 1995). Some researchers have also sought to find the effects of reading and writing (Tierney, Sotter, O'Flahavan, & Mc Ginley., 1989) and cooperative learning (Nezami, Asgari, & Dinarvand, 2013) on critical thinking.

In the same note, according to Fisher, Alec, and Scriven (1997), learning styles and metacognitive skills may have influence on critical thinking. However, most research has not really probed into how a combination of the two factors affects critical thinking. Mostly focus on either the influence of metacognitive skills only (Gotoh, 2016; Halpern, 1998; Hanley, 1995; Paul, 1993; Pellegrino, 2007; Tishman, Jay, & Perkins, 1992; Tsai, 2001), or on the effect of learning styles only (Andreou, Papastavrou, & Merkouris, 2014; Wessel & Williams, 2004; Zhang & Lambert, 2008).

In addition, most of the cited research focused on nursing students or students at the primary and secondary levels. Hence, the present research would like to contribute to the existing research by investigating how both learning styles and metacognitive skills affect students' critical thinking in the context of Student Creativity Program. More specifically, this research aims to 1) describe the level of metacognitive skills, learning styles, and critical thinking of the students; and 2) determine the influence of learning styles and metacognitive skills on students' critical thinking.

CRITICAL THINKING, LEARNING, STYLES, AND METACOGNITIVE SKILLS

Critical thinking skills are included into high level thinking skills or Higher Order Thinking Skills (HOTS). HOTS are associated with the three upper levels of Bloom's taxonomy. Critical thinking particularly is defined as a thinking skill using basic thought processes to analyse arguments and give rise to insights for each meaning and interpretation, develop a pattern of cohesive and logical reasoning, understand the underlying assumption of each position, and give a presentation model that is reliable, concise and convincing (Costa, 1996).

Critical thinking is a process that aims to make rational decisions directed to decide whether to believe or do something (Ennis, 1996). It is an intellectual process with active and skilled conceptualizing, applying, analysing, synthesising, and evaluating the information collected or generated from observation, experience, reflection, reasoning, or communication, to guide our beliefs and actions (Scriven, Michael, & Paul, 1987). It can also be defined as a mental process involving operations such as deduction, induction, evaluation, classification and reasoning (Muhfahroyin, 2009).

Critical thinking indicators are divided into twelve items that are further grouped into five aspects (Ennis, 1996), as presented in Table 1:

Table 1 Critical Thinking Indicators

No.	Aspects		Indicators
1.	Giving a simple explanation	a.	Focus on question
		b.	Analyse the question
		c.	ask and answer questions about an explanation
2.	Building up the basic skills	a.	Consider whether a source is reliable or not
		b.	Observe and consider induction
3.	Deducing	a.	deduce and consider the results of the deduction
		b.	Induce and consider induction
		c.	create and determine the outcome of consideration
4.	Providing further explanation	a.	define the terms and consider a definition in three dimensions
		b.	Identify assumptions
5.	Setting the strategy and tactics	a.	Decisive action.
		b.	interact with others

Source: (Ennis, 1996)

The present study draws upon the model of critical thinking by Magno (2010) as shown in figure 1.
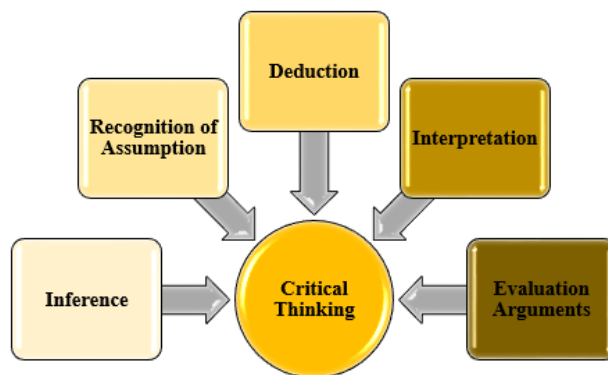
Figure 1. The Model of Critical Thinking
(Magno, 2010, p.140)

As mentioned previously, critical thinking has often been associated with learning styles. Learning styles are distinguished based on the dimensions of learning: cognitively, perceptually, and effectively, showing how to learn, understand, interact and respond to a learning environment (Hyland, 2005). Learning style is strongly linked to methods of education, specifically for the individuals. It should allow individuals to learn better. Learning style is also called cognitive strategy whose capacity directs how a person manages the internal processes that accompany the activities of learning, thinking, and remembering, capabilities that are affected by the strategy in seeking and finding new things and organizing the response. Cognitive strategies are also similar to self-management behaviours and mathemagenic activities (Gagne, 1977).

The indicators of learning style used in this research are drawn from DePorter (1999) who stated that learning style is based on how an individual receives information easily (modalities). He divided the learning styles into three types, namely: 1) visual learning style, in which learners tend to make the association with things that are already known by making mental descriptions when reading and remembering visual images that are stored in the mind that are associated with what is being studied (Olivier, Bowler, & Cosby, 1996); 2) auditory learning style, where learners tend to learn through hearing, lectures, discussions, media, audio, etc. Auditory learners will think coherently, regularly, and think in terms of words; and 3) kinaesthetic learning style, in which learners tend to speak slowly, are physical response-oriented, learn through practice, etc. (DePorter, 1999).

Some models of learning style as proposed by educational psychologists, among others, include: (1) non-linear; (2) general and special; (3) inductive and deductive; (4) analytical and synthesis; (5) analogue and digital; (6) concrete and abstract; (7) impulsive and reflective (Brown, 2009). The variables that affect a person's learning style include: (1) the elements of the environment: sound, light, draft; (2) emotions with hereditary elements: motivation, perseverance,

responsibility, structure; (3) sociological elements: elements of yourself, spouses, peers, team, adult, group of variations; (4) physiological elements of a number of perceptual elements, foodstuffs (that which is eaten), time, mobility; (5) psychological elements of global scope: analytic, cerebral hemispheres, reflective-impulsive (Dunn, Dunn, & Perrin, 2014).

Among different types of learning styles put forward by experts, the present research would only focus on three type dimension of learning styles, namely: (1) the cognitive dimension; (2) the affective dimension; and (3) the perceptual dimensions (Hyland, 2005).

Although some research has sought to seek the interrelations between learning styles and metacognitive skills, such as that by Palennari, Taiyeb, and Saenab (2018) who investigated college freshmen's metacognitive skills based on their learning style and Pedone (2008) whose research involved primary school students, not much research has really investigated the relationship between learning styles and metacognitive skills and critical thinking of university students.

Metacognition here is defined as the awareness of thinking about what is known and what is unknown (Iskandarwassid & Sunendar, 2011). In the context of learning, students learn how to learn, knowing the capabilities and modalities of learning, and knowing the best learning strategies to learn effectively.

Metacognitive and understanding are considered as the ability to monitor an individual's thoughts through the assumptions and implications in the activity. Metacognitive as the thought process of thinking (thinking about thinking) refers to a person's knowledge about any theory or process in him/herself (Lee & Baylor, 2006). On the same note, Anderson and Krathwohl (2001) defined metacognitive as knowledge about cognition; in general it is the same as awareness and knowledge about cognition of one's self.

The characteristics of metacognitive skills include: 1) strategic knowledge; (2) self-awareness; (3) awareness of the tasks; (4) knowledge of the context; (5) conditional knowledge; and (6) knowledge of the self (Fisher, 2009). Meanwhile, the indicators of student metacognitive skills are divided into eight (8) points (Schraw & Moshman, 1995), namely: 1) declarative knowledge; 2) procedural knowledge); 3) knowledge of conditionals; 4) planning; 5) information management strategy; 6) understanding of the monitoring; 7) implementation of the Strategy; 8) evaluation.

Magno (2010) further developed the metacognitive skills as displayed in Figure 2.

Figure 2. Metacognitive Skills
Magno (2010, p. 142)

The present research will draw upon these theories to seek out the relationships between learning style and metacognitive skills and critical thinking.

METHOD
This is correlational research to determine whether there is a relationship and the degree of relationship between the variables of learning style, metacognitive skills, and critical thinking.

Population and Sample
The population in this research consisted of the whole student creativity program's groups at Korean Education Study Program in a state university in West Java, Indonesia. Each of the student creativity programs consists of three students; therefore, the total number of students is divided by three. The distribution of students in the student creativity program groups based on year of enrolment can be seen in Table 2.

Table 2. The Distribution of Students in the Student Creativity Program

No.	Class	Number of Students	Number of Student Creativity Programs
1.	2015	52	17
2.	2016	75	25
3.	2017	70	23
Total		197	65

In this research, sampling was taken randomly, so that all subjects were of equal proportion. The sampling technique referenced the formulation proposed by Yamane (1973) as follows:

n = N / (N.d2 + 1)

Notes:
n   = number of samples
N   = total population
d2   = specified precision

By using the above formula, the sample can be calculated as follow:

$$= \frac{N}{N.d^2 + 1} = \frac{65}{65\,(0,05)^2 + 1} = \frac{65}{65\,(0,0025) + 1} = \frac{65}{1,1625} = 55$$

Hence, out of the 197 students, 55 were selected as the sample for the present research.

Data Collection Techniques and Tools
To collect the data in this study, the researcher conducted a survey using a questionnaire and administered a test on critical thinking.

The Questionnaire was adapted from Schraw and Dennison's (1994) Assessing Metacognitive Awareness. It was prepared with five-point Likert Scale (strongly agree, agree, not sure, disagree, strongly disagree, with a score of 5, 4, 3, 2, and 1, respectively). The questionnaire was modified based on indicators of learning styles and metacognitive skills. In total, there were 40 items in the questionnaire. More specifically, there were 11 questions related to visual learning style, 15 items pertaining auditory learning style, and 14 on kinaesthetic learning style. The questionnaire was distributed to the respondents on campus. The researchers explained to the respondents about their participation and asked their consent to participate in the survey. The results of the questionnaire were interpreted based on Mardapi's (2008) categorisation, as follows: a score ≥ 180 means high, 150-180 medium, and <15 low.

We also distributed a Likert-based questionnaire on students' metacognitive skills. Similarly, the questionnaire comprised of 40 items, distributed into eight groups of questions concerning declarative knowledge, procedural knowledge, conditional knowledge, planning, information management strategy, monitoring understanding, strategic implementation, and evaluation. The scoring is the same as that of the questionnaire for learning styles, with the same categorisation for the score results from high, medium, to low.

To assess students' critical thinking ability, we carried out a test consisting of 7 essay questions. The questions in general asked the respondents to:
  a. Formulate a Question
  b. Consider whether the source is reliable or not
  c. Create and determine the outcome of consideration
  d. Define the term and consider a definition
  e. Analyse the argument

Students' answers to the questions in the test were then calculated with no penalty. The scores were then categorized based on Suwarma's (2009) categorisation of thinking skills, as follows: 0-20% below the maximum score (very low), 20-40% (low), 40-60% (medium); 60-80% (high), and 80-100% (very high).

All of the instruments were tested for their validity and reliability by experts and using correlational coefficient test and Cronbach's alpha at the significance level of 0.05.

Significance Test

Once the data were collected, we analysed them using Multiple Linear regression aided by SPSS version 22 for Windows. The purpose of Multiple Linear regression analysis is to determine the significance of the influence between one or more free variables with one dependent variable. These relationships can be divided into the shape of the regression function as follows:

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + e$

Description: Y = critical thinking
β_0 = regression constant
β_1 = regression coefficient X 1
β_2 = regression coefficient X 2
X 1 = the learning style
X 2 = Metacognition skills
e = disturbing factor

T-test was deployed to prove the hypothesis on the influence of learning style on critical thinking skills and the influence of metacognitive skills on critical thinking. The hypotheses are as follows:

H_0: Learning styles and metacognitive skills have no significant influence on critical thinking.
H_1: Learning styles and metacognitive skills have significant influence on critical thinking.

RESULTS

Students' Learning Styles

All of the 55 participants participated in responding to the 40-item questionnaire related to learning styles with a maximum total score of 200. The results show that the highest score obtained by the students was 157 or 78.5% of the maximum score, and the lowest score was 108 or 54% of the maximum score. The number of students in the "medium" category was 33 or 60%, and 22 students or 40% were in the "high" category, and there was no student included in the "low" category.

It is interesting to note that the individual responses pertaining to learning styles reveal that most students (57%) could often learn better by looking at the attitudes, gestures, and mouth movements of teachers while teaching; write words smoothly and correctly (50.9%); and maintain a normal distance while speaking to others (60%).

On the other hand, the respondents also revealed that in learning they "never had no" interest in songs (74.5%); in other words, the majority of the respondents could learn better while listening to music or humming to some songs. This response was strengthened by their responses revealing that they very often (50.9%) preferred music to painting or sculptures.

Another interesting finding related to learning styles was that none of the respondents responded "never" to items on talking fast, easily getting their concentration disrupted by noises when learning, liking to read all types of texts, reading by themselves rather than asking their friends to read for them, liking music more than other arts, liking telling stories to others, being able to write words smoothly and correctly, learning better by listening, forgetting the lesson heard, liking standing close to others when talking, using more gestures when communicating with others, maintaining a normal distance when talking to others, learning well through action, being able to learn better if the learning is accompanied by physical activities, and being able to learn well without any aids and media.

The individual responses, hence, confirm the results of the overall assessment which showed that all of the students were in the medium and high categories in terms of learning styles, and none of them was included into the "low" category.

Students' Metacognitive Skills

The data of students' metacognitive skills were obtained from 55 participants who responded to the 40 items of the questionnaire related to metacognitive skills. With a maximum total score of 40 questions being 200, the result shows that the highest score obtained by the students was 190 or 95% and the lowest score was 112 or 56% of the maximum score. The number of students who was in the "high" category was 53 (98.2%) and 2 students (1.8%) were included into the "average" category. Similar to the learning styles, no respondents were included in the "low" category of metacognitive skills.

Further analysed, the results of the questionnaire reveal that all of the students "agreed" with all of the statements or items in the questionnaire, with a percentage of more than 50%, except for such statements as "asking other people's help when I don't understand an assignment," "often repeating a lesson by teacher to find the extent to which I understand it," "managing time as well as possible to meet the desired learning goals," "having a good command in understanding the information conveyed by both teachers and friends," and "making pictures and diagrams to help me understand a lesson." The last item received the lowest response (27.3%), while the rest of the mentioned items received more than 30% responses.

On the other hand, the items that received the highest rate of "agreed" responses—especially those scoring more than 70%—included "being able to consider which information is important and not to be learned," "deeply thinking of information received," and "knowing my own ability in doing a task assigned by the teacher."

Students' Critical Thinking Ability

Finally, the data of students' critical thinking ability were obtained from 55 participants who did an essay critical thinking test consisting of 5 items. The maximum total score for the 5 questions was 200, and the result shows that the highest score obtained was 200 or 100%, while the lowest score was 144 or 72% of the maximum score. Based on the categorisation of the scores, then it can be stated that all students (55 students or 100%) were categorised into "high" critical thinkers.

Further analysis of the results for this critical thinking test indicates that the lowest score of 25 was obtained for the item on "creating and determining the outcome of consideration", and the highest score of 45 was gained by the first item of "formulating a question". The items of "considering whether the source is reliable or not", "creating and determining the outcome of consideration", and "defining the term and considering a definition" all received the same highest score of 41; on the other hand, the last item of "analysing the argument" only reached the highest score of 36.

Significance (t-test) results
To prove the null hypothesis formulated in the study that learning styles and metacognitive skills have no influence on critical thinking, we then conducted a *t*-test. The results can be seen in Table 3.

Table 3. *t*-test results

Model	Unstand. Coefficients		Stand. Coef.	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
1 (Constant)	19.449	7.564		2.571	.013		
Learning Style	.220	.180	.163	1.222	.227	.092	10.812
Metacognitive Skills	.755	.126	.800	5.995	.000	.092	10.812

a. Dependent Variable: Critical thinking

As indicated by Table 3, based on the *t*-test results, it can be concluded that learning styles had no significant influence on critical thinking because r > 0.05 (0.227); however, metacognitive skills had significant influence on critical thinking because r < 0.05 (0.000). The hypotheses were then partially proved.

DISCUSSION
The results have shown that learning styles had no significant influence on the Korean Education students' critical thinking in their Student Creativity Program. The results were different from those of Andreou, Papastavrou, and Merkouris (2014) and Zhang and Lambert (2008) who found that learning styles to some extent determined critical thinking ability of students. However, the present results were in line with those of Wessel and Williams (2009) who discovered no relationship between learning styles and critical thinking.

The results can be partly explained by the least possibility for students under research to apply their learning styles in the context of the creativity program. In this program, students did not have any formal classroom teaching and learning. The program was part of the "extracurricular" program, meaning that students did this outside the study hours and independently with their peers in group. The role of lecturers was only at the level of supervision when necessary.

Meanwhile, the research results indicate that metacognitive skills had significant influence on the Korean Education students' critical thinking. The results are recently confirmed by Yasushi (2016) who found that metacognitive skills had strong influence on critical thinking.

The results of this research can be explained by the fact that similar to critical thinking skills, metacognitive skills are an active, persistent, and precise process concerning belief or knowledge from various perspectives of supporting reasons and further conclusions of their tendencies (Fisher, 2009). Hence, in the process of creating a creative program, students' metacognitive skills were much needed along with their critical thinking skills.

CONCLUSION
The present research has sought to investigate whether learning styles and metacognitive skills had any significant influence on the critical thinking ability of Korean Education students in the context of Student Creativity Program. The results have shown that while there was no significant influence of learning styles on critical thinking, metacognitive skills had significant influence on students' critical thinking in doing their creativity program.

The results of the research also reveal that students' critical thinking ability in the context of Student Creativity Program was in the "high" category". It means that the program can evoke and sharpen students' critical thinking ability, as it requires students to be really creative to create something in group.

The results imply that Student Creativity Program should be used as an appropriate medium to hone and cultivate students' critical thinking. In addition to the teaching and learning in the classroom, it is also important to encourage students to join the creativity program, so that they can channel their creativity while honing their critical thinking skills. However, as the present research results cannot be generalised, it is important to do more research on the same topic in different study programs and departments, and more preferably at the university level. More results would hopefully confirm the present research's claim of the importance of Student Creativity Program for cultivating critical thinking ability in students.

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