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Short communication

Cognitive Style and Creative Quality: Influence on Academic Achievement of University Students in Indonesia

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ABSTRACT

Reasoning is a process to solve the problem. This process needs cognitive functions in thinking, learning, and making decision. Cognitive style is a term to explain human natural preferences in gathering and processing information. Humans appears to reason using two cognitive processing styles; the first system is called as intuitive thinking style that is spontaneous, effortless, and without conscious search, whereas the second system is called as reflective or analytical thinking that works in a deliberate, analytical, procedural, and controllable process. In human context, sometimes people encounter difficult problem or unknown situation that have to be coped by ideas that are both novel and adaptive to the task constraints. People who solve the problem successfully are called creative. Creativity is the base to enhance competitiveness among students that might result in good academic performance. The present study examined cognitive style and creative quality in affecting academic achievement of university students in Indonesia. The result showed that students who used analytical thinking tended to have higher academic success, especially in life science majors. Moreover, it was found that students would need to materialize their creative potential to reach greater academic achievement in demanding classes; for instance, the final year of undergraduate program.

1. Introduction

Reasoning is a process to solve the problem. This process needs cognitive functions that help us to think, learn, and make decision (Sadler-Smith and Badger 1998). It exploits what already known packed with adaptable knowledge to come to conclusion that is reliable, novel, and refutable for inconsistency (Johnson-Laird 2010). However, in yielding those kind of conclusions, human reasoning has its frailties as another premises counteracts. In performing such task, human have access to two distinct cognitive styles (Kahneman and Frederick 2001; Franco and Meadows 2007; Ahmed *et al.* 2012; Stanovich and West 2000). The first style is a system that is spontaneous, associative, emotionally charged, without conscious search, and effortless (Kahneman 2003); the second system works in a deliberate, analytical, procedural, and controllable process (Alter *et al.* 2007; Sarmanny-Schuller and Kuracka 2012). The first system is called as intuitive thinking, whereas the second system is reflective, rational, or analytical

thinking styles. The first system may result in error due to aging, stressful situation, and biased premises, whereas the second system can occasionally correct the output of the first system (Alter *et al.* 2007). There is individual difference in using any of the two systems in making judgments that leads to different styles of cognitive functions in solving everyday life problem (Frederick 2005).

Cognitive style is closely related to learning activity. For instance, category learning is known as a way in assembling information to learn something. There are two kinds of category learning, that is, rule-based and information-integration tasks. Rule-based tasks have clue as indicator of the tasks; this clue then can be used to recover the rule that is easy to describe verbally. On the other hand, information-integration tasks are those in which their logical form cannot easily be extracted, so people need to integrate any knowledge they could gather to reach conclusion. Rule-based task relies on working memory, in contrast to information-integration task that relies on procedural memory (Zeithamova 2008). Zhang (2002) reported a statistically significant correlation of thinking styles in affecting grade point average of students. However, other works (Riding and Pearson 1994; Sadler-

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Smith 1997) found a low correlation between cognitive style and academic performance in terms of intelligence.

In human context, sometimes people encounter difficult problem or unknown situation that has to be coped by ideas that are both novel and adaptive to the task constraints (Goel *et al.* 2000). People who solve the problem successfully are called creative. There were many definitions of creativity varied by field. In the field of educational research, creativity refers to acquisition of knowledge and performance (Surkova 2012). Previous researches assessing the association of creativity to academic achievement (Riaz 1989) and performance in professional life (Scager *et al.* 2012) found a positive correlation between creativity scores and academic achievement, especially in the academically superior students. Moreover, creativity was the base of innovation that underlain the enhancing competitiveness among students (Chen and Chen 2012a) that might result in good academic performance.

The aim of this research is to determine cognitive style and creative quality of university students in Indonesia and examine the covariations between different cognitive styles and different creative qualities in affecting their academic achievement.

2. Materials and Methods

2.1. Time and place

The research was held on September 2013 until April 2014 in Bogor Agricultural University (IPB), Bogor and University of Indonesia (UI), Depok, West Java, Indonesia. Data were analyzed in Division of Animal Biosystematics and Ecology, Department of Biology, IPB.

2.2. Sampling

The subjects of this research were undergraduate (1–4 years of tertiary study) and graduate (more than 5 years of study) students of IPB and UI who are academically active until July 2014, had received their grade point average, and had never taken similar test. The total number of subjects used in this research is 234 individuals consisted of 133 IPB students and 101 students of UI from various majors. We specified the various majors into four groups based on an assessment system in Next Generation Science Standard adopted in the United States of America (Pellegrino *et al.* 2013); they were engineering and application sciences, life sciences (LS), physical sciences, and social sciences.

2.3. Informed consent

Subjects signed an informed consent before taking the test. Before the signing, the interviewer (NHW) stated the purpose of the research, researchers' contact address, and agreement form. After participating the test, the interviewer gave subjects a gift worth around IDR 1000.

2.4. Academic achievement

Academic achievement was described according to the latest *Indeks Prestasi Kumulatif* (IPK). In each university, IPK is calculated as the ratio of the score gotten in every subject matter weighted with the total number of class credit she/he took. The IPK scales from 0 to 4. It is assessed at the end of each semester. In both universities, it is used to determine the number of credit she/he could take in next semester and whether she/he could pass through to the higher grade relative to some threshold (UI 2004a, 2007; IPB 2013).

2.5. Cognitive style

Cognitive style was determined by using cognitive reflection test (CRT; Frederick 2005). The Indonesian version of CRT (available on request to the authors) was used to determine which cognitive style each subject adopts. The test administered directly, so the subject's

natural mindset would not be distracted. Test duration was without limit, and subjects had to do the test themselves. There were three questions and the correct answers were summed for the CRT scoring. The minimal CRT score 0 indicates that the individual is intuitive, and the maximal 3 reflective or analytic (Frederick 2005).

2.6. Creative quality

Creative personality scale (CPS) for the adjective check list (Gough 1979) is a commonly used self-report personality inventory test for creativity (Le Roux 2001). This is from Gough (1979) whom simplified the 300 words of adjective check list into 30 for which each of it have high relationship with creativity categories (Baron and Welsh 1952; Domino 1970). Present research used the Indonesian version of CPS (available on request to the authors) consists of 18 adjectives representing positive indications of creative individual and 12 negative ones. Subjects were asked to check all adjectives that they think match to them. Creative qualities were assessed by summing positive and negative checks, whereas non-checked adjectives were given zero value. Final score ranges from −12 to 18. The median score is three, so one who scores higher than three is categorized as more creative than average and one who scores lower than three is categorized as less creative (Oldham and Cummings 1996).

2.7. Statistical analysis

Statistical analysis was performed using linear model (Venables and Ripley 1999) with cognitive style and creative quality as factors that assumed to affect academic performance. It was performed in base statistical package implemented in R program version 2.11.0 (R Core Team 2014).

3. Results

3.1. IPK

The pooled mean of the students' academic achievement was 3.25 (Table 1); nevertheless, UI students had IPK significantly higher than IPB students on average, for LS and for final year (4th year of study) undergraduate. The pooled means were very much

Table 1. Means of IPK, CRT, and CPS scores

| | Pooled | IPB | UI | Differences between universities | |
				Subtraction	*p* Value[*]
IPK					
Pooled	3.25	3.19	3.34	0.146	**0.002**
Major					
EAS	3.27	3.27	3.27	0.001	0.992
SS	3.34	3.24	3.37	0.131	0.199
LS	3.20	3.16	3.42	0.254	**0.001**
PS	3.33	3.82	3.25	–	–
Year of study					
1	3.18	3.18	–	–	–
2	3.32	3.35	3.32	–	–
3	3.30	3.29	3.31	0.019	0.902
4	3.19	3.00	3.36	0.356	**0.000**
5	3.46	3.51	3.37	0.136	0.290
6	3.34	3.50	3.02	–	–
7	3.68	3.73	3.51	–	–
CRT score					
Pooled	0.85	0.49	1.34	0.848	**0.000**
CPS score					
Pooled	3.15	3.19	3.09	0.099	0.824

CPS = Creative personality scale; CRT = cognitive reflection test; EAS = engineering and application sciences; IPB = Bogor Agricultural University; IPK = *Indeks Prestasi Kumulatif*; LS = life sciences; PS = physical sciences; SS = social sciences; UI = University of Indonesia.
Endash (−) represents either minimum or no data collected.
[*] Probability that IPB-UI differences is not zero are given as bold printed.