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The Effect of Analogy Variations on Academic Writing: How Indonesian EFL Students Perform with Different Cognitive Styles

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Abstract

This study examines the effects of applying two different forms of analogy, namely written and oral analogy, while also considering learners' cognitive styles, on students learning outcomes for a research course in English as a Foreign Language. The cognitive style was used in this study as a moderator variable. This study used an experimental design with a 2x3 factorial design. Two classes of slower learners each comprised 30 students, who were assigned into three smaller groups according to their cognitive styles (i.e. field-independent, neutral, and field-dependent cognitive styles). The six groups were delivered teaching over four meetings. ANOVA was used to analyse the data and test the hypotheses. The results show that subjects given oral analogy achieved better learning outcomes than those who received written analogy. In addition, subjects with the field-independent cognitive style exhibited greater learning achievement that those with the neutral and field-dependent cognitive styles. There was no significant interaction between the different analogy types and subjects' cognitive styles in the results of the research course.

***Keywords**: analogy variation, cognitive style, slow learners, academic writing.*

Introduction

The cognitive style and analogy thinking approach in academic writing attainments are the focus of this study. The way how academic performance is developed in cognitive perspective by comparing notions that use an analogy as the main characteristics of university learning is described in this study. Girgensohn (2016, p.73) asserts university learning is usually based on research that use high level thinking order and analogy to perceive the content based on cognitive style. Characteristics of university learning include features that are similar to features of research, such as studying academic literature, developing critical questions or writing reports. Some approaches to university teaching therefore explicitly stress students' own research experiences. They use research as a tool for learning.

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Analogies according to Orgill & George (2004, p.15) is powerful teaching tools to make new material intelligible to students by comparing it to material that is already familiar. In the simplest sense, an analogy is a comparison between two domains of knowledge — one that is familiar and one that is not. The familiar domain is often referred to as the "analog" domain; the domain that needs to be learned is usually referred to as the "target" domain.

As a part of cognitive style, analogy has been specified as one strategy for organizing macro-level content theory (Reigeluth & Stein, 1983), which describes ways to organize the content of learning material. It is widely accepted that these aspects are very important and need to be integrated in any complete theory or learning model (Reigeluth & Stein, 1983 in Degeng, 1997, p. 13). This theory integrates seven components of strategy, namely (1) the elaborative sequence, (2) the sequence of learning prerequisites, (3) a summary, (4) the synthesizer, (5) an analogy, (6) cognitive strategies, and (7) learning control.

Cognitive style approaches that individuals possess habitual ways of approaching tasks and situations associated with particular patterns in cognitive processes including decision making, problem solving, perception, and attention (Bendall, Galpin, Marrow & Cassidy, 2016)). Introduced by Allport almost eight decades ago a cognitive style is defined as an individual's typical or habitual mode of problem solving, thinking, perceiving, and remembering (Allport, 1937). Cognitive style focuses on the tradition of identification of styles based on individual differences in cognitive and perceptual functioning (Grigorenko and Sternberg, 1995). Cognitive style is the relatively stable strategies, preferences and attitudes. It determines an individual's "typical modes of perceiving, remembering and problems' solving" (Messick, 1976, p. 5), the modes how learners approach, acquire, process information, and the consistent ways an individual memorises and retrieves information (Witkin & Goodenough, 1981).

The way cognitive styles are performed influences the degree of academic writing. Drawing upon the background, this study is directed by the following two research questions:

1) Do students who receive oral analogy achieve better performance on academic writing than those who receive written analogy?
2) Do students having field dependent cognitive style achieve better performance on academic writing than of students having field-independent cognitive style?

Review of Literature

Analogy

According to Gentner (1989), an analogy is a mapping of knowledge between two domains that holds among the objects in the analog domain and among the objects in the target domain. The purpose of an analogy is to transfer a system of relationships from a familiar domain to one that is less familiar (Mason & Sorzio, 1996). The strength of an analogy, therefore, lies less in the number of features the analog and target domains have in common than in the overlap of relational structure between the two domains (Gentner, 1983; Orgill & George, 2004).

Orgill & George (2004, p.15) admit analogies are mostly used to help students understand new information in terms of already familiar information and to help them relate that new information to their already existing knowledge structure. It has been argued that "knowledge is constructed in the mind of the learner" (Bodner, 1986, p. 873). As they construct knowledge, learners seek to give meaning to the information they are learning, and the comparative nature of analogies promotes such meaningful learning. "To learn meaningfully, individuals must choose to relate new knowledge to relevant concepts and propositions they already know" (Bodner, 1986, p. 877).

Scholars identify some benefits of analogy as the meaningful learning. Analogy help learners organize information or view information from a new perspective (Orgill & George, 2004, p. 16), help to arrange existing memory and prepare it for new information (Thiele & Treagust, 1991), give structure to information being learned by drawing attention to significant features of the target domain (Simons, 1984), give particular differences between the analog and target domains (Gentner & Markman, 1997). In addition, analogies can be useful to present concrete reference when students thinking about challanging, abstract information (Simons, 1984), play a motivational role in meaningful learning and help students visualize abstract concepts, orders of magnitude, or unobservable phenomena (Orgill & George, 2004, p. 17).

Poespoprodjo and Gilarso (1989, p. 185) and Copi (1982, p. 391) suggest that as a way of thinking, analogies are a comparison through similarities between concepts and other concepts in an attempt to make a difficult concept or idea become clear. Mundiri (1994, p. 139–142) explains that the analogy is sometimes called the inductive analogy, and this is the reasoning process from

one phenomenon to another similar phenomenon, concluding that what happens to the first phenomenon will occur also in the other phenomena. It is further explained that in each analogous inference, there are three elements, namely the fundamental events on which the analogy is based, the principal equation as the binder, and the three phenomena we want to analogize. However, according to Mundiri, the analogy is also used as explanation, and this is called a *declarative analogy* or *explanatory analogy*.

The use of analogies can result in better student engagement and interaction with a topic. Lemke (1990) asserts that students are three to four times more likely to pay attention to the familiar language of an analogy than to unfamiliar scientific language. The familiar language of an analogy can also give students who are unfamiliar or uncomfortable with scientific terms a way to express their understanding of and interact with a target concept.

Degeng (1997, p. 30) states that an analogy illustrates the equation between new knowledge and knowledge that is beyond the scope of what is being studied. This is very helpful in understanding knowledge that is difficult for students to learn. The closer the relationship between the new knowledge and the analogous knowledge, the more effective the analogy becomes. Wong (1993, p. 367-380) conducted research on self-formed analogies by students to understand the phenomenon of depth and facilitate the development of concepts. According to him, teaching through analogy can be done, among other ways, by (1) creating a new situation that is easily recognized by learners, (2) providing an overview of the problem in parts formed in accordance with the learners' background knowledge, and (3) giving stimulation for abstract thinking about the structure or shape being emphasized.

Furthermore, Degeng (1987, p. 77) explains that in the context of learning, analogical knowledge is similar to the knowledge of coordinates (level of knowledge), but it also goes beyond the context of the content being studied. If analogies are used in learning, then the analogical knowledge and the new knowledge being learned are linked in some respects. First, they both exist at the same level of publicity and second, they have essential similarities. Third, examples of analogical knowledge are not included in examples of new knowledge. The power of analogy to facilitate learning lies precisely in the attribution (in the form of comparison) of new knowledge to the analogous knowledge that learners already have. Such attribution helps to integrate separate knowledge structures and thus organize them into a more complete cognitive structure.

The reasoning for choosing a content-organization strategy with analogy can be explained by how analogy illustrates similarities between the new knowledge being learned and learners' existing knowledge. In short, the power of analogy in facilitating learning lies in associating the new knowledge being studied with the analogous knowledge of learners. Such an attachment helps to organize separate knowledge structures into a cognitive structure, so the learning process can be conducted in a more meaningful and easy way with greater opportunities to achieve optimal results and the expected learning achievement with analogies. According Reigeluth (1983), learning outcomes directly relate to the use of analogy. This still needs more in-depth review to obtain reliable information, however.

As with any other teaching technique, the use of analogies in a classroom can have a negative effect, even when teachers follow guidelines that have been suggested for teaching with analogies (see Zeitoun, 1984; Glynn, 1991; Treagust, 1993). For example, although both teacher and student may consider an analogy useful for learning new information, the analogy might be superfluous information if the student already has an understanding of the target concept being taught (Venville & Treagust, 1997).

Students may resort to using an analogy mechanically, without considering the information the analogy was meant to convey (Arber, 1964; Gentner & Gentner, 1983; Venville & Treagust, 1997). For example, a student may answer an exam question with an analogy (Question: "What is the function of the mitochondrion?" Answer: "The mitochondrion is the power plant of the cell."). Part of the mechanical use of analogy may be due to the students' not being willing to invest time to learn a concept if they can simply remember a familiar analogy for that concept, since familiar analogies can often provide students with correct answers to exam questions —even when those analogies are not understood (Treagust, Harrison, & Venville, 1996).

The mechanical use of an analogy may also be due to students' inability to differentiate the analogy from reality. An analogy never completely describes a target concept. Each analogy has limitations. Unfortunately, students usually do not know enough about the target concept to understand those limitations. For this reason, they may either accept the analogical explanation as a statement of reality about the target concept or incorrectly apply the analogy by taking it too far (Treagust, Harrison, & Venville, 1996).

Cognitive Style

Cognitive style is defined as an individual's typical or habitual mode of problem solving, thinking, perceiving, and remembering (Allport, 1937). The focus is the identification of styles based on individual differences in cognitive and perceptual functioning (Grigorenko and Sternberg, 1995). The cognitive style is classified based on the cognitive processes of perception, memory and thought, emphasizing subset of cognitive style into 'field dependence-field independence', two constructs basically reflect the way pattern recognition is processed and retained in memory.

The whole approach involves an individual's ability to perform perceptual analytic type tasks. In a field dependent mode, an individual's pattern recognition is strongly dominated by the holistic organization of the total perceptual field with its parts being perceived as 'fused'. In contrast, in the field independence mode, of perceiving, the individual is likely to see the parts of the field as distinct from the organized ground (Witkin et al, 1971, p. 4). The individual who performs in a relatively field-dependent way tends to follow the presented visual field structure. On the other hand, the field-independent individual tends to be able to break up a given field's organizational structure and locate a nominated structural part.

Cognitive style is an individual characteristic of learning that is often confused with learning style. The NASSP (National Association of Secondary School Principals) defines learning styles as characteristics of cognitive, affective, and physiological behaviours that show a relatively fixed indication of how learners feel, interact, and respond to their learning environment. The concept of learning style is therefore broader than cognitive style. Cognitive style reflects a relatively fixed habit of acting when a person receives, considers, and remembers information and uses it to solve problems (Keefe, 1987). Every individual therefore has his or her own unique cognitive style.

Keefe (1987, p. 7 & 16) explains that cognitive style is an innate trait associated with the reception, organization, and storing of information. This shows a relatively stable and consistent indication of how learners receive, interact, and respond to their learning environment. It is also surmised that while learning styles (which include cognitive styles) are related to intellectual ability, there are substantial differences between them. If a style describes the cognitive process for processing information, then intellectual ability refers to the content of that cognition.

Witkin, et al. (1971, p. 3) describes cognitive style as one's self-characteristic fixed way of functioning as shown in the acceptance of intellectual activity. Diptoadi (1990, p. 54), meanwhile, posits that cognitive style is a learners' relatively fixed habit of acting in considering, remembering, receiving, and processing information. In his description, Schmeck (1987, p. 327), explains that one's cognitive style has two different sides (e.g. *field dependent vs. field independent*, *holist vs. serialist*, and *global vs. analytic*). In this case, even if a person occupies a certain position on these sides, everyone has different levels. Furthermore, Witkin et al. (1977) describe four characteristics of cognitive style. Firstly, more attention is given to the form rather than the content of cognitive activity. It refers to individual differences in how learners feel, solve problems, learn, and connect with others. Secondly, cognitive style is the penetrating dimension, and it cuts across traditional boundaries used to categorize the human psyche, helping to restore the soul to its proper status as a whole. Thirdly, cognitive style is fixed, although this does not mean it cannot change. Fourthly, taking into account its value, cognitive style is bipolar. This characteristic is important for distinguishing between intellectual ability and other abilities.

Methods

Design

This research is an experimental type of research. It seeks to reveal the causal relationship between variables, where the researcher manipulates the independent variables and then observes the dependent variables to find the subsequent variations that manifest as a result. The design model employs a 2x3 factorial design involving two or more independent variables, called factors, in a single design. The cells of the design are determined by the level of the combined independent variables (Wiersma 1991, p. 115). This study examines three variables: (1) an independent variable, namely the learning strategy, which comprises learning strategies when using written analogy (WA) and oral analogy (OA); (2) a dependent variable, namely the subjects' learning outcomes (LO), specifically their understanding of the scientific concepts of academic performance; and (3) a moderator variable, namely the field-dependent (FD), neutral (N) and field-independent (FI) cognitive styles. Each variable, or more precisely factors, comprise two or three levels. The analogy factor has two levels, represented by written analogy and oral analogy. The cognitive factor, meanwhile, has three levels, namely the FD, N, and FI levels listed above.

Procedures

A total 90 students was involved in this study as sample. They were the seventh semester students of English Department in Kanjuruhan University Malang. The activities undertaken in the implementation of this study included identifying the cognitive style, applying learning strategies using written and oral analogy, and administering tests to measure the subjects' learning achievements. The test for cognitive style was administered at the first meeting after the two experimental groups were formed. The two experimental classes were then each subdivided into three groups to represent the FD, N, and FI cognitive styles. This cognitive style grouping was achieved through cognitive-style tests using the *Embedded Group Test* (GEFT) of Witkin et al. (1971).

Data Analysis Techniques

The data-collection method used in this study involved tests, namely the cognitive style test and a learning results test. This data were analysed using descriptive statistical analysis and parametric inferential statistical analysis (ANOVA) (Ary, et al., 1985; Hinkle, et al., 1988; Kerlinger, 1990; Ardhana, 1987). The descriptive analysis in this study shows the learning acquisition data for both learning methods across the various cognitive style groups.

Variant analysis intends to consider the questions and hypotheses proposed in this study. Three hypotheses are tested, each being relevant to the research variables, namely (1) the influence of the independent variable (i.e. written analogy and oral analogy) on learning outcomes, (2) the influence of the moderator variable (i.e. the FD, N, and FI cognitive styles) on learning outcomes, and (3) the interaction between the independent variable and the moderator variable and how this affects the dependent variable. A prerequisite test including a homogeneity test and normality test was also performed.

Results and Discussion

The research tested the effect of oral analogy and written analogy on subjects' learning achievements. The purpose of the analysis in this section is to determine whether applying analogy variation affects the subjects' learning achievements across different cognitive styles.

Oral and Written Analogy

Our findings evidently show that oral analogy gives better results that written analogy both for slow learners and fast learners in the academic performance and academic writing. Table 1 shows that the *F-ratio* for teaching technique is 6.326 with 2 *degrees of freedom*. The *P-value* is .002. This research uses a significance level of .05 ($\alpha = .05$). It can therefore be interpreted that there are significant differences in the mean scores for students' learning outcomes after being taught with written analogy and oral analogy.

Table 1.
Tests of Between-Subjects Effects

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	5688.285(a)	8	738.814	10.235	.000
Intercept	1167055.33	1	1278166.404	17062.092	.000
Analogy variation	853.391	2	482.195	5.326	.002
Cognitive Style	433.163	3	289.581	3.514	.028
Analogy Variation * Cognitive Style	4191.743	5	1211.861	17.660	.000
Error	18442.100	261	74.913		
Total	1203418.000	270			
Corrected Total	25251.596	255			

a R Squared = .258 (Adjusted R Squared = .235)

It can therefore be concluded that when applying different forms of analogy, there is a significantly different effect on the achievement of slower learners in understanding scientific concepts. From the analysis of estimated marginal means, as shown in Table 2, the rank of the two groups is known. The highest mean score for learning achievement was seen in the group of students that were delivered oral rather than written analogy.

Table 2.
Estimated Marginal Means of Analogy Variation

Teaching Analogy Variation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1=Oral analogy	65.700	.812	63.704	66.386
2=Oral analogy	70.173	.812	67.376	72.080

Field Dependent and Field-Independent Cognitive Style

Table 3 reveals that students' average achievement with an FI cognitive style was 69.045, while the mean for the N cognitive style group was 68.300. The mean for the FD cognitive style student group was 65.733. The best performance was therefore achieved by the FI cognitive style students, with the neutral cognitive style coming a relatively close second, and the FD cognitive style student group coming third.

Table 3.
Estimated Marginal Means of Cognitive Style

Cognitive Style	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1=Field Independent	69.045	.801	67.248	70.841
2=Neutral	68.300	.801	66.504	70.107
3 = Field Dependent	65.733	.801	64.037	67.532

The result of this study reflects the findings of Mundiri (1994), who revealed that oral analogy was more beneficial than written analogy, especially for proficient learners. Oral analogy can trigger spontaneous response, so a suggestion given with analogy can be immediately responded to by students, resulting in a quicker revision of errors. In addition, oral analogy brings the possibility for rapid clarification, because a given analogy is not always easily understood. Direct analogy therefore eliminates any lead time between needing confirmation and making a revision. Direct oral analogy therefore really can bring many advantages and be regarded as an effective teaching method. Moreover, the researcher also found four advantages to implementing direct oral analogy in teaching and learning: building a learning community in the classroom, the possibility of discussion, the building of greater accountability, and the identification of different perspectives.

As Poespoprodjo and Gilarso (1989) propose, oral analogy can build a learning community in the classroom. When students exchange and share their ideas with each other

while discussing a given analogy, the students can learn from each other and build a greater level of accountability for submitting a well-written product to the teacher. As shown in Table 2, the learning outcomes of students instructed with oral analogy was better than those taught with written analogy, although this is still better than the learning outcomes of students taught without analogy. The findings of this study confirm those of Poespoprodjo and Gilarso (1989), who propose that direct oral analogy helps students become more critical. It is also in line with the findings of Mundiri (1994), who states that oral analogy not only helps students improve their learning skills—it also enhances their critical thinking and reading while also motivating them to write.

Another advantage of applying direct oral analogy in learning concerns the comfort and ease of students in engaging in mutual criticism and reciprocating information. As proposed by Mundiri (1994), students like, and feel comfortable with, receiving analogies from their peers, indicating that it is easier to talk with friends than a teacher. To their friends, they can say whatever they want. Although this seems a psychological reason, it really can affect their learning performances. Indeed, the data expressed in Table 2 empirically shows that direct oral analogy had a positive effect on the social aspect, hence increasing students' learning performances.

Another reason for why direct oral analogy brings advantages to students, and hence significantly increases their learning performances, concerns becoming aware of errors, learning from peers, and engaging in self-reflection. These three benefits affect not only the psychological but also the empirical experiences of students. As proposed by Poespoprodjo and Gilarso (1989), oral analogy helps students to become aware of the common errors in their learning and learn from their peers' learning. It also raises the audience's level of awareness and enhances their learning quality, triggers self-reflection, and promotes interest and motivation for learning.

Direct oral analogy also reduces the teacher's workload in providing analogy. This can save the teacher time by avoiding students providing analogies based on their peers' learning products. Using direct oral analogy in teaching learning helped the researcher, as a teacher, to correct students' learning products quickly without requiring extra time and energy. Using direct oral analogy was therefore not only effective in promoting learning—it was also efficient.

In this study, the dominant analogy providers were the students, although the researcher, as a teacher, still played a big role in the learning process. Considering the teacher's reduced

workload, there was enough time to evaluate students' learning products and take stock of why students made mistakes. The researcher then discussed these mistakes with the students during the subsequent meeting in order to avoid the same mistakes recurring. William, cited by Degeng (1997), mentions that analogy without explanation or discussion from teacher to students, or between them, does not bring any significant benefits to students' learning. In this study, it was proven that students did not repeat the same mistakes, as can be seen in their post-test scores, which increased. In short, direct oral analogy was an effective method to use in teaching and learning. It not only increased the students' learning scores but also brought some advantages to the students themselves and aided the teacher in teaching.

As described previously, cognitive style is a relatively fixed habit of acting by a person when thinking, solving problems, and receiving and remembering information (Messick, in Keefe, 1987), so every individual has a unique cognitive style, which in turn influences learning outcomes. Keefe (1987, p. 7 & 16) explains that cognitive styling is an innate trait associated with receiving, organizing, and storing information. This gives a relatively stable and consistent indication of how learners receive information, interact, and respond to the learning environment. It was also pointed out that learning styles (which includes cognitive styles) are related to intellectual ability, but they are in themselves quite different. While the cognitive style describes the process for processing information, intellectual ability reflects the content of the cognition.

In this study, students with the FI cognitive style showed the greatest learning ability, thus showing they had superior cognitive characteristics. Cognition is an activity of thought, and it involves problem-solving activities. Such activity requires a response. The cognitive process model represents the internal process of the mind as a complex problem-solving activity. It is clear that students with the field-independent cognitive style can separate concepts and perceptions from the surrounding context, resulting in a clearer acceptance of information.

Students with the FI cognitive style also have the ability to see components that can be used to help solve problems quickly. They have a tendency to be able to restructure the context. They also have strong analytic abilities. They easily separate the details, something that is needed in good scientific analysis, so they achieve a very good understanding of the scientific concept.

The participants with field-dependent cognitive styles, in contrast, did not separate information from the environment. Those with the FD cognitive style rely on the field, and they have a tendency to follow the environment or context, so they experience difficulty in separating concepts or perceptions from the context. This results in an unclear reception of information. They tend to see the concept or problem as a whole, so they understand something as one big, confusing problem. They experience more challenges in understanding the scientific concept, as reflected in their lower scores for learning achievement.

Conclusion, Limitation and Implications

In summary, our findings show evidences that students who received oral analogy perform better achievement on academic writing compared to those who received written analogy. Oral analogy provides simple and practical identification because it directly relates to individual style of learning strategies. In addition, students with field-independent cognitive style tend to achieve better outcomes than those with a field-dependent cognitive style. It indicates that self-reliance students will work better in academic writing than those who are dependent. This finding however, promotes limitation in that the academic writing is not assessed using complex traits of indicators, and the learning strategies involving the cognitive styles used by the students are not elaborated in details in accordance with the cognitive style taxonomy. To this end, future researchers are suggested to consider analogy and cognitive style of learning as the primary entry points when researching academic performance. Specifically, oral analogy is suggested to use at enhancing students' understanding of scientific concepts when they have the field-independent cognitive style. Written analogy is not recommended for students with this cognitive style. Teaching with written analogy is more suited to learners with field-dependent or neutral cognitive styles.

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