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Comparison of the Efficacy of Intuitive and Analytical Thinking in College Students' Class Performance

대학생들의 학업 수행에 미치는 직관적 및 분석적 사고의 효과 비교

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Abstract : The present study applied cognitive continuum theory to university environment in order to demonstrate that students' cognitive modes move along the continuum to be adaptive to the certain situation. This study also compared students' cognitive modes and the generally required modes in the university. The results showed that the students used corresponding cognitive modes to each subject even though they had different cognitive styles in general. It means that the students are adaptive to various tasks. And, the comparisons of the students' cognitive modes with the required modes in the university showed that the university tended to induce the students to use analytical cognitive modes. Therefore, the university faculty should be aware that they usually induce the analytical modes, and that they need to use various kinds of cognitive modes in order for the students to have adaptability and flexibility. However, the study did not demonstrate that the students would perform better when they fitted their cognitive modes into each subject.

Key words : Cognitive continuum theory, adaptability, expertise, cognitive modes

요약 : 본 연구는 인지 연속선 이론(Cognitive Continuum Theory)을 대학 교육 환경에 적용하여 학생들이 대학 내에서 개설된 각 과목을 수강할 때, 그에 요구되는 인지 모드를 사용하는가를 알아보고자 하는 것이었다. 또한 대학 교육이 전반적으로 요구하는 인지 모드와 학생들의 전반적인 인지 모드를 비교해 보았다. 실험 결과, 학생들은 실제 자신들의 평상시 인지 양식과 관계없이 각 과목에서 요구하는 인지 모드를 수업 중에 사용하는 것으로 나타났다. 이는 학생들이 상황에 맞는 적응력을 가지고 있다고 볼 수 있겠다. 한편, 대학에서 전반적으로 학생들에게 분석적인 인지 모드를 사용하도록 유도하는 것으로 나타났다. 대학 교육이 학생들의 적응력과 융통성을 증진시키기 위해서는 교육을 담당한 교수진들이 다양한 인지 모드를 사용하는 것이 필요할 것이다. 하지만 학생들이 각 과목에서 요구되는 인지 모드를 사용하였을 때 높은 수행력을 보일 것이라는 예측은 이 실험을 통해 증명할 수 없었다.

주제어 : 인지 연속선 이론, 적응력, 전문성, 인지 모드

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1. Introduction

Two forms of cognition—intuition and analysis—have been traditionally distinguished. However, the traditional dichotomy of intuitive and analytical thinking seems to be invalid nowadays. Because, human beings are mostly adaptive to various kinds of tasks so that they can change cognitive modes from intuition to analysis and vice versa[11, 12]. As Hammond et al. asserted[6], the cognitive continuum should replace the dichotomy, that is, we should admit that people use cognitive modes on the cognitive continuum between intuition and analysis depending on the situations. Modern society requires not a single cognitive mode but a mixture of intuition and analysis in human judgment and decision-making, that is, people need to adjust their cognitive modes into the task properties[1, 9].

However, traditional theories asserted a dichotomy between intuition and analysis so that a person would have either intuition or analysis in judgment and decision-making. In addition, many researchers have talked about the importance and superiority of each extreme cognitive mode so that analytical cognition had been likely to be relatively superior because the definition of analytical cognition was quite clear in comparison with intuition. In research field of expertise, Hayes [8] said that achievement of expertise required at least ten years of diligent practice. So such extended practice may lead to reduction in cognitive flexibility or to rigidity in thinking and acting[5]. The above assertion was not considered much about cognitive flexibility and adaptability of expertise. Therefore, emphasizing only one type of cognitive form may obstruct the adaptation of cognition and it leads a person to use the cognition emphasized even in different situations.

Hammond[7] asserted against the traditional view of cognition that human cognition would move along the cognitive continuum between intuition and analysis, as it would correspond to cognition that the tasks induced, and that there was no superiority of intuition and analysis. This assertion was similar to the concept of expert flexibility, as a part of expertise, mentioned by Feltovich et al. [3, 4, 5] because the Cognitive Continuum Theory(CCT) rejected the traditional dichotomy and introduced a cognitive continuum and quasi-rationality as a compromise so that the theory emphasized the adaptation to required cognitive modes that the various tasks or situations induced, and the flexibility of expertise was also related to the adaptation to various kinds of situations and conditions.

Individuals may have their own cognitive styles in usual situations but they would perhaps try to use cognitive modes required in certain circumstances even though the required modes are different from the individuals' cognitive styles. The reason why these kinds of efforts for the individuals to try to change their cognitive styles were needed was that correspondence of cognition used by individuals and required cognitive modes could lead the individuals to perform better[6]. Of course, other individual differences such as gender or personality may have influence on the cognitive flexibility and adaptability, but in this particular research, individual differences of how they think and what they have interest in were considered.

This study accepted the concept of CCT because the modern society tends to require the concept of quasirationality[7] and flexibility in many ways

so that we want to investigate whether or not the education at university follows that kind of concept demanded in complex and real world. Moreover, we examined whether or not the students actually used corresponding cognitive modes, which were required in each class and whether the students performed better when the cognition used by them matched with the required cognitive mode in the class.

1.1 Cognitive continuum theory (CCT)

In the previous research, many researchers thought that good intuition was the mark of expertise, but the definition of intuition in comparison with analysis was obscure, which made it a controversial issue in human judgment. Simon[10] mentioned, "It is a fallacy to contrast analytic and intuitive styles of management…. Behaving like a manager means having command of the whole range of management skills and applying them as they become appropriate". This concept supports the suggestion that experts should have quasirationality in a cognitive continuum depending on tasks or situations.

Cognitive continuum theory (CCT) is an adaptive theory of human judgment that focuses on the dynamic relationship of the organism- environment interaction. The theory includes both intuitive and analytical cognition while it also focuses on the environmental interaction as well[2]. CCT made lots of contributions to the study of human judgment in terms of the definition of intuition, quasirationality, and analysis. CCT offers the description of both intuitive cognition and analytical cognition: intuitive cognition processes information rapidly, requires low cognitive effort, and logical rules are unavailable; analytical cognition processes information slowly, requires high cognitive effort, and logical rules are available. The theory defines quasirationality as having both intuition and analysis, being located between intuition and analysis on a cognitive continuum as common sense lies between them [6, 7]. CCT also offers the task continuum for tasks inducing intuition and analysis, that is, cognition induced by each task is on the continuum like cognition on the cognitive continuum.

Tasks inducing quasirationality is located on the central region of the continuum, having both characteristics of intuition and analysis. It means that cognition which a person uses is related to a certain task which induce a specific cognition and that having quasirationality is beneficial because everyday work is more or less both intuitive and analytical, that is, a mixture of intuition and analysis is needed. In fact, quasiraionality has many advantages such as potential for compromise between intuition and analysis[7], which offers the advantage of avoidance of catastrophe. Therefore, the experts should have adaptability to maintain quasirationality a balance between intuition and analysis. In this regard, CCT does not posit superiority of intuition or of analysis.

In addition, CCT predicts that if the cognitive mode matches the task demands, the person would have high task achievement so that she or he would be less likely to change the strategies or cognitive modes[2]. From this view, we suggested that if people have corresponding cognitive modes to task characteristics, they would perform best.

1.2 Present study

As mentioned above, I rejected the traditional dichotomy of intuition and analysis and considered the concept of cognitive continuum theory [7] to examine the educational environment in the university. After all, I investigated how the students' usually thought in everyday work and which cognitive activity was usually induced in the university. In addition, I found which condition (in terms of the relations between the cognition used in the classes and the subject properties) was the best for the students to perform. Therefore, I suggested that the students' cognitive modes moved along the cognitive continuum depending on the subject properties and that when the subject properties matched the cognitive modes used by the students, the students' performance (scores in the classes) were the best, as CCT asserted.

1.2.1 Hypotheses

Hypothesis I. Students' usual thinking styles in everyday life will be different from the students' cognitive mode in the university, that is, the usually required cognitive modes in the university will be more analytical.

Hypothesis II. Subject properties will induce corresponding cognitive properties, that is, the subject properties will induce the students to use corresponding cognitive modes. (Intuition-inducing subjects will induce the students to use intuition while analysis-inducing subjects will induce the students to use analysis.)

Hypothesis III. When cognitive modes used by students match with subject properties, the students will perform better in terms of GPA (Grade Point Average), that is, the students' performances (GPA in each subject) will be better when the students use corresponding cognitive modes.

Hypothesis IV. Cognitive modes that the subjects induce will influence on preferred cognitive modes of the students, that is, analysis-inducing subjects will lead the student to prefer an analytical cognitive mode to fit into the required cognitive mode.

2. Method

2.1 Participants

246 participants were students in Yonsei university who were various in age, educational background, and expertise. They got credits as participants for their classes that they took.

2.2 Design and materials

We used a survey to examine the relationship between the students' cognition and the cognitive modes induced by each subject and general education in the university. The questionnaires used in the survey can be divided into six parts. The first part was to investigate students' usual thinking styles in everyday life and had a purpose to compare these with generally required cognitive modes in the university. The second part was asking students' cognitive modes used by them in each various class and had a purpose to show the students use corresponding cognitive modes that the subjects induce, and to examine when students' cognitive modes in class matched with the induced cognitive modes in class best

performance could occur. The third part was to research students' required cognitive activities in class depends on the professors' teaching style and it had a purpose of showing the subjects induce corresponding cognitive activities. In the forth part, the questionnaires asked the students' generally required cognitive activities at school to know general educational environment in the university in which the students might tend to use analytical cognitive modes. The fifth part of the questionnaires asked the students their preferred cognitive modes in each subject to investigate which had influence on the preferred cognitive modes. The last part of the questionnaires asked the students to estimate their interest on each subject. Furthermore, the students' performances were measured by their GPAs so that if they had high GPAs, their performance would be considered as good in the classes.

2.3 Procedure

The students in the experiment session were asked to answer the questionnaire for an hour. During this time, they had to remember which subject they took in the previous semester and their GPAs. First of all, they were asked to think about what kind of cognition between intuition and analysis they usually use in everyday life, and to answer the 7-point scaled questionnaire. Moreover, the students evaluated which cognitive mode they actually used in each class and which cognitive activity was induced by the professor in each subject. They were also asked to scale the cognitive mode that they generally used in the university and to choose their preferred cognition for each subject. The questionnaires were all 7-point scaled.

3. Results

Cognitive modes required in the university tended to be analytical in comparison with students' usual cognitive modes, based on students' measurement. On 7-point scaled questionnaires, mean of cognitive modes demanded in the university($M=5.45$, $SD=.873$) was significantly different from mean of students' cognitive modes($M=4.34$, $SD=1.295$), $t(245)=11.327$, $p<.05$). This was measured by students themselves so that the result showed what the students thought about cognitive modes demanded in the university. In this scale, the bigger score implies more analytical thinking, therefore this result implies that students usually felt that the cognitive modes required in the university were close to analytical.

The students tended to use corresponding cognitive modes that were induced by subjects, regardless of their usual cognitive styles. To test this hypothesis, we divided the students into three groups based on their usual thinking style scores and two-way ANOVA was conducted. Three groups of students-analytical, quasirational, intuitive groups used cognitive modes required in each subject (analytical, quasirational, intuitive subjects), even though their usual cognitive styles were different from required cognitive modes.

As shown in the graph above, for analysis scores, there was a significant difference between subjects[$F(2, 237)=41.143$, $p<.05$]. However, there was no difference between students[$F(2, 237)=4.310$, $p>.05$], and there was no interaction between students and subjects[$F(8, 232)=.558$, $p>.05$]. In sum, the students showed high analysis

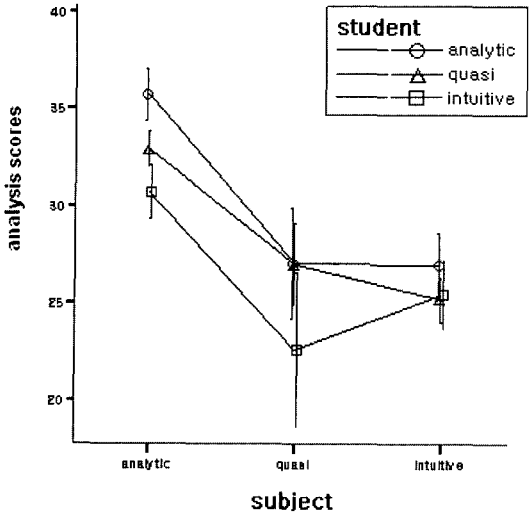

Figure 1. Analysis scores by three groups of students on each subject

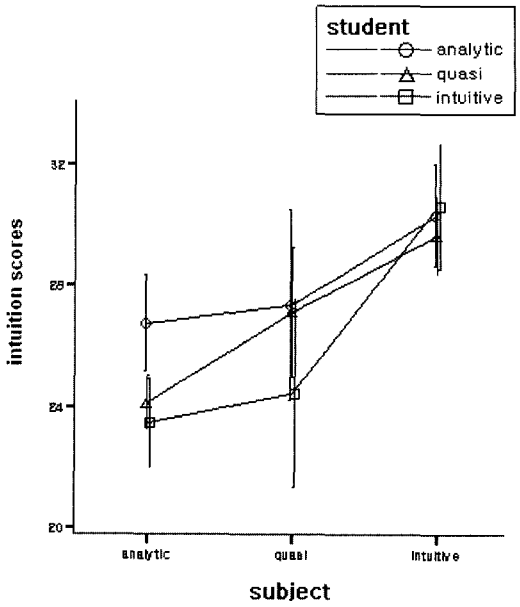

Figure 2. Intuition scores by three groups of students on each subject

scores for analytical subjects, regardless of their usual cognitive styles. The students showed the tendency that they used cognitive modes required in each subject.

In addition, for intuition scores, the similar tendency was shown (Fig. 2). The difference between subjects was significant, [$F(2, 237) = 21.806$, $p < .05$], but there was no difference between students, [$F(2, 237) = 1.503$, $p > .05$], and no interaction between subjects and students, [$F(8, 232) = .422$, $p > .05$].

After all, the students used analytical cognition for the analytical subjects, even though they had different cognitive styles; in addition, they used intuitive cognition for the intuitive subjects, even though they had opposite cognitive styles. Therefore, the hypothesis that the students would tend to use cognitive modes required in each subject regardless of their usual cognitive styles was demonstrated.

To distinguish between the matching group (when cognitive modes used for the subjects were same as cognitive modes induced in the subjects) and the non-matching group (when cognitive modes used were opposite to the required cognitive modes), 165 students were selected. However, the hypothesis that subject scores would be high when the students used corresponding cognitive modes was dismissed [$t(163) = -.264$, $p > .05$]. Although the students used corresponding cognitive modes, the students were not able to get high scores in the subjects. In addition, when the students' usual cognitive styles were same as cognitive modes induced in the subjects, the students were not able to perform better in the subject score [$t(122) = 1.941$, $p > .05$].

The students tended to prefer cognitive modes required in the subjects, regardless of their usual cognitive styles. Two-way ANOVA was conducted to test the hypothesis. According to the results (Fig. 3), there was a significant difference between subjects [$F(2, 237) = 117.661$, $p < .05$], and the

difference between students was not significant [F(2, 237)=.557, p>.05], and there was no interaction between subjects and students [F(8, 232)=.462, p>.05]. Hence, the students preferred cognitive modes that the subjects inducedthe students to use, no matter what cognitive styles the students had. The subject properties induced the students to use corresponding cognitive modes.

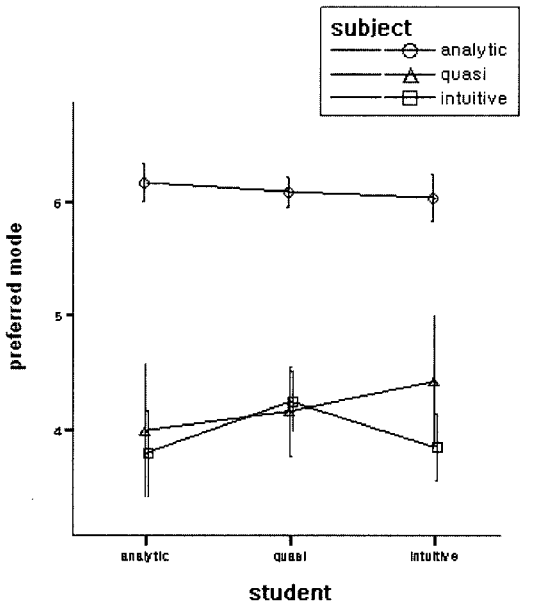

Figure 3. The cognitive modes that the students preferred to use in each subject

4. Discussion

According to the students' measurement and the analysis scores in the subjects, the university education environment tended to be analytical, as the first hypothesis expected. Except for intuitive subjects such as language and literature, most subjects in the university were close to the analytical area. It means that although the students did not use analytical cognitive modes in everyday lives, they were induced to use analytical cognitive modes in the university education environment. Therefore, the teachers need to teach the students in various kinds of ways so that the students are able to use cognitive modes flexibly, because there is needs for the students to be adaptive to various kinds of tasks in the modern society.

From these results, we could expect the possibility that the students virtually used corresponding cognitive modes to subject properties, that was, the students were able to change their cognitive modes in order to fit them to required cognitive modes in the subjects. As mentioned above, the students tended to use induced cognitive modes in the classes, even though they had opposite cognitive styles from the required cognitive modes. After all, when teachers induced certain cognitive modes in the classes, subjects required the students to use those cognitive modes, and then the students changed their cognitive modes to fit into the education environment. Analytical subjects required the students to be trained analytically in class, and intuitive subjects induced the students to be trained intuitively, no matter what the students' usual cognitive styles were. Therefore, the students' cognitive modes moved along the cognitive continuum depending on the subject properties.

The result that the students changed their cognitive modes adaptively for the subjects supports the assertion that the university education environment influences on the students' cognitive modes. If a student who had an analytical cognitive style in general were exposed to the intuitive environment, the student would try to

change his or her cognitive mode into intuitive mode to perform the task, as the results presented. It means that the students had adaptability for various tasks, and the adaptability was necessary for people to perform the multi-task that required different cognitive modes at the same time. Hence, the education circumstances need to induce various cognitive modes in order for the students to be trained to improve their adaptability.

Whether or not the cognitive modes, which the students used in the class, matched with the subject properties, the scores that the students got from the class did not have significant relationship with cognitive modes. Although the students tended to use corresponding cognitive modes to the subject properties, they did not get high scores when they fitted their cognitive modes into required modes. Whether or not the cognitive modes matched with the subject properties might not be the only cause that the students performed better. Namely, other factors such as students' background knowledge, interests, motivation, and so on were able to influence the students' performance.

However, from the tendency that the students tried to match their cognitive modes with required cognitive modes in a class, we could expect that the students would think that it was adequate to match their cognitive modes with required modes in a class and feel comfortable when they fitted modes into the task properties. The investigation of the students' preference supported the expectation mentioned above. The result showed that the students preferred to use corresponding cognitive modes to the subject properties. It means that the students thought that they needed to use required cognitive modes in classes.

Therefore, the experiment demonstrated that the students' cognitive modes moved along the cognitive continuum according to the cognitive modes induced by the subject properties, and that the university education environment was close to the analytical field. From these results, I suggest that the university education need to train the students in various ways in order for the students to improve their adaptability in modern society.

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