

Laotian Visualization Ability for Architecture

Somchith Sitthivan¹, Vira Anolac², Abe Hirokazu³

¹*Department of Architectural Engineering, Graduate School of Engineering
Osaka University, Suita, Osaka 565-0871, Japan
email: sitthivanh@hotmail.com*

²*Department of Architecture, National University of Laos
13 south road Km5, Vientiane Laos
email: virabp3@hotmail.com*

³*Cybermedia Center, Osaka University
Suita, Osaka 565-0871, Japan
email: abe@cmc.osaka-u.ac.jp*

Abstract. This paper aims to evaluate the Laotian visualization ability for the architectural space. PIT [1] and MCT [8] were applied to 176 Laotian students at the National University of Laos. The results were as follows:

The spatial ability (MCT) of Laotian students is lower than that of Japanese students in the fundamental course at Osaka University. But the visualization ability (PIT) of Laotian students of the architectural course is not lower than that of Japanese students in the fundamental course of Osaka University. Furthermore it turned out that for both the above mentioned Laotian and Japanese students it is more difficult to visualize the exterior space than the interior. And for all students it is more difficult to visualize the space which is open over two floors than that enclosed within one floor.

Key Words: Lao P.D.R., visualization ability, PIT, MCT

MSC 2000: 51N05

1. Introduction

Lao People's Democratic Republic (referred to as Lao P.D.R.) is a landlocked country, with an area of 236,800 km² and a population estimate of 5,525,900 inhabitants, and with a density of 23.3 persons per km² [3]. Since the economical opening policy in Laos, the development of the city area and the preservation districts (listed into World Heritage) have been advancing rapidly. Therefore the Lao P.D.R. government and UNESCO had established the regulation

for preservation. However, the violation of the regulations concerning architecture has been increasing [6]. There are various reasons for this violation including social factors, economical factors, educational factors and the ability of Laotian.

This paper aims to evaluate the Laotian visualization ability for the architectural space. P. PHONETHIP [5] had researched on the *spatial ability* in Lao P.D.R. by applying the *Mental Cutting Test* [8] (referred to as MCT). This research did not test the *visualization ability for architectural space*. For measuring this ability the authors of [1] developed the *Plan Interpretation Test* (referred to as PIT). Therefore as the first step MCT and PIT were applied to students at the National University of Laos (referred to as NUOL).

2. Experimental Method

For evaluating the Laotian visualization ability of architectural space and the spatial ability, PIT and MCT are administered by 176 Laotian students at NUOL in January 2004.

2.1. Tests

PIT is an objective test to identify for a given photograph the point and direction of sight in given floor plans. Fig. 1 shows a sample problem of PIT. Each problem contains photos and floor plans with numbered arrows. The arrows on the floor plan indicate possible points and directions of sight. The students are asked to figure out the correct solution among five options out of nine numbered arrows on the corresponding floor plans.

For each building displayed in PIT there are two photos with an interior viewpoint and one from exterior. One interior photo shows the space enclosed by one floor, the other shows simultaneously two or more floors.

MCT is an objective test, where subjects are asked to determine the correct cutting view from a given pictorial view of the object and the cutting plane [8]. MCT has become the most widely used measure of spatial ability [7]. The standard MCT contains 25 problems, and as each correct solution gives one point, the perfect score is 25. Sample problems from standard MCT are shown in Fig. 2.

PIT and MCT were translated into Lao language by the authors. The buildings in PIT remained — we used the original figure of PIT. These tests consisted of 11 and 6 pages, respectively, including an instruction page of each test. PIT and MCT were applied under the same conditions as in Japan. The time limits of the tests (PIT and MCT) are 25 and 20 minutes, respectively.

Table 1: The groups of subjects

	FCS1-L	FCS2-L	AECS1	<i>Total</i>					
PIT	75 persons	76 persons	25 persons	176 persons					
MCT	75 persons	76 persons	–	151 persons					
Note: <table style="display: inline-table; vertical-align: middle; border: none;"> <tr> <td style="padding-right: 10px;">FCS1-L = fundamental course students</td> <td rowspan="3" style="font-size: 3em; vertical-align: middle;">}</td> <td rowspan="3" style="vertical-align: middle;">National University of Laos</td> </tr> <tr> <td>FCS2-L = fundamental course students</td> </tr> <tr> <td>AECS1 = architectural course students</td> </tr> </table>					FCS1-L = fundamental course students	}	National University of Laos	FCS2-L = fundamental course students	AECS1 = architectural course students
FCS1-L = fundamental course students	}	National University of Laos							
FCS2-L = fundamental course students									
AECS1 = architectural course students									

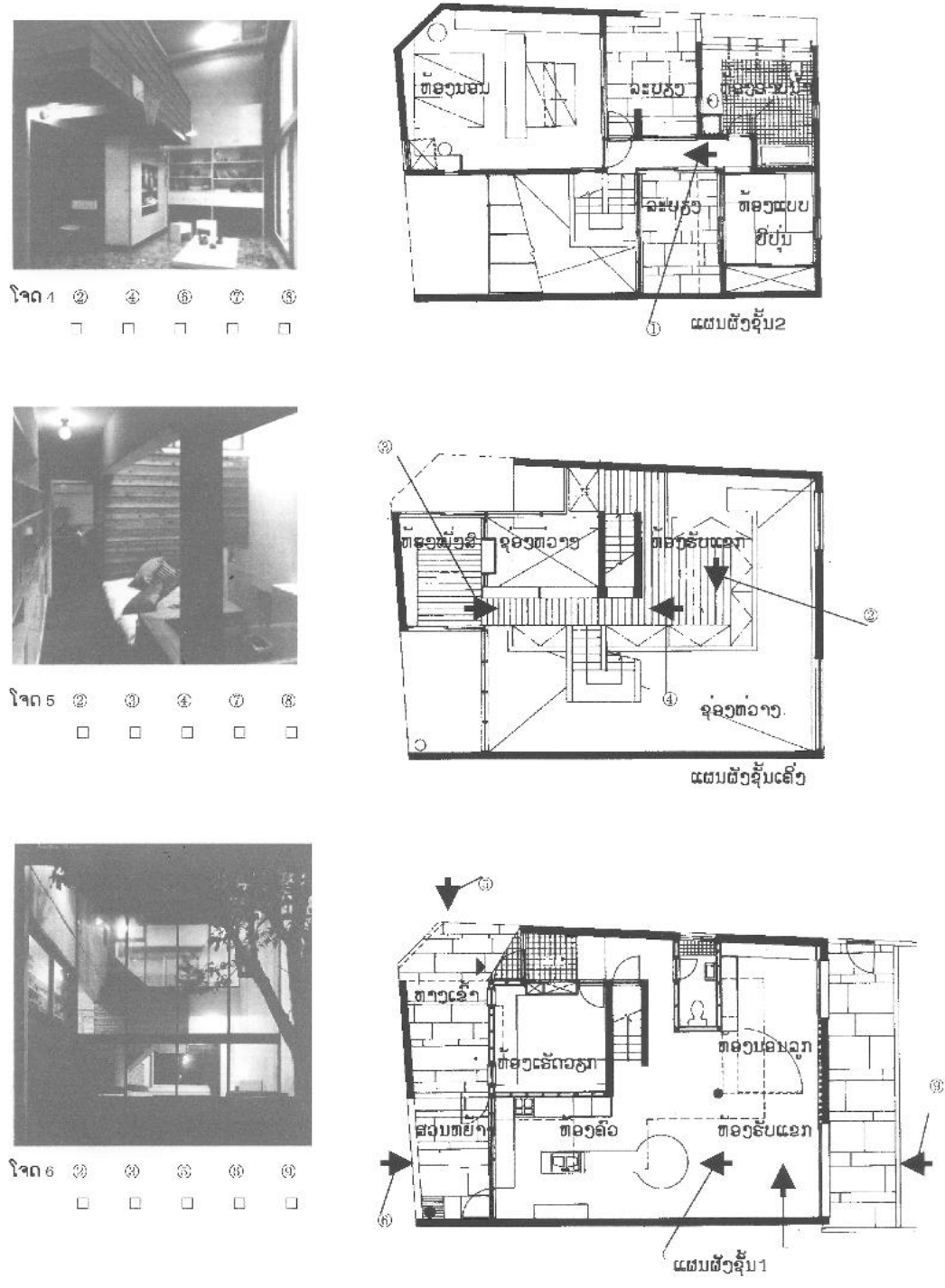


Figure 1: Sample problems of the Plan Interpretation Test (PIT)

2.2. Subjects

PIT and MCT were administered by Laotian students at NUOL. The Lao P.D.R. government had established NUOL in June 1995, merging ten existing higher education institutions and a center of agriculture [4]. In January 2004 this has still been the only one university in Lao. The aim of the foundation of the NUOL was to rationalize the higher education of Lao

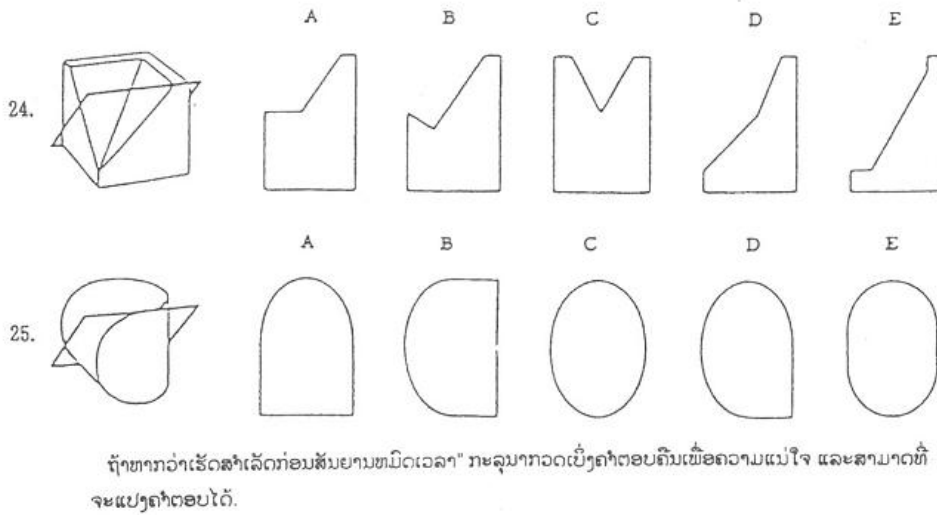


Figure 2: Sample problems of the Mental Cutting Test (MCT)

P.D.R., making it more efficient in its task of training the human resources for the country.

NUOL consists of 10 faculties: the faculty of Science, Education, Social Science, Philology, Economics & Management, Engineering & Architecture, Forestry, Agriculture, Medical Science, and Law & Public Administration [4].

Table 1 shows the groups of subjects in our experiment. There were 3 groups: The 1st group is formed from 75 freshmen of the fundamental course (referred to as FCS1-L), who are going to study an economy course at the Department of Economy. The 2nd group consists of 76 sophomores of the fundamental course (referred to as FCS2-L), who are going to be students of the Faculty of Engineering. 25 students of the architectural course make the 3rd group (referred to as AECS1); these students are instructed for a professional architectural education at the Department of Architecture.

In our experiment, only MCT was not applied to AECS1. Most of the subjects were male, not female. Therefore, we statistically analyzed the data without distinguishing gender groups.

3. Results and discussion

3.1. The result of MCT

Table. 2 shows the average score (%) of MCT and the level of significant difference between the average score of each group. The average score of FCS1-L is lower than that of FCS2-L, and there is a significant difference between the average scores of FCS1-L and FCS2-L ($P < 0.01$). Therefore, the spatial ability of MCT of the Laotian students, who are going to take an economy course, is lower than that of Laotian students who are going to take an engineering course.

For comparison the previous studies' data were carried out. Table 3 shows the average score (%) of MCT in four countries [1, 2, 9]. As shown in this table, the average scores are 76.80% (FCS1-J), 86.00% (UT), 45.60% (OWU), 62.00% (CUT), 66.80% (UKL), 62.80% (MTU1), and 54.32% (MTU2). Hence, the average score of MCT in FCS1-L is the lowest among them. The average scores of FCS2-L and MTU2 are similar.

Table 2: Results of MCT

	FCS1-L	FCS2-L
<i>Average (%)</i>	36.05	50.47
FCS1-L	–	[**]
FCS2-L	14.42	–
Note: FCS1-L = fundamental course students (freshmen) FCS2-L = fundamental course students (sophomores)		
} National University of Laos		

Note: The lower lines show the differential score between the groups and the result of the t-test.

[**] $P < 0.01$ there is a significant difference between the average score of the groups

Table 3: Average score (%) of MCT in other countries

<i>Country</i>	<i>Japan</i>	<i>Japan</i>	<i>Japan</i>	<i>Poland</i>	<i>Germany</i>	<i>America</i>	<i>America</i>
<i>University</i>	FCS1-J	UT	OWU	CUT	UKL	MTU1	MTU2
<i>Average Score (%)</i>	76.80	86.00	45.60	62.00	66.80	62.80	54.32
Note: FCS1-J = Osaka University (Japan) [1] UT = University of Tokyo (Japan) [2] OWU = Otsuma Women's University (Japan) [9] CUT = Cracow University of Technology (Poland) [2] UKL = University of Kaiserslautern (Germany) [2] MTU(1) = (Mechanical) Michigan Technological University (USA) [2] MTU(2) = (Civil & Eng) Michigan Technological University (USA)[2]							

Table 4: The groups of subjects (data of previous studies)

		FCS-L	AECS2	FCS1-J	<i>Total</i>
MCT	<i>Average Score (%)</i>	29.23	54.00	76.80	–
	<i>no. of students</i>	125	122	253	500
PIT	<i>Average Score (%)</i>	–	–	80.01	–
	<i>no. of students</i>	–	–	253	253
Note: FCS-L = fundamental course students, National University of Laos [5] AECS2 = architectural course students, National University of Laos [5] FCS1-J = fundamental course students, Osaka University, Japan [1]					

Table 4 shows the subjects of previous studies' data at NUOL and Osaka University [1, 5]. The students in the fundamental course of NUOL are 125 freshmen (referred to as FCS-L). The students in the architectural course of NUOL are 122 sophomores (referred to as AECS2) [5]. These subjects performed MCT but not PIT. The students in the fundamental course of Osaka University (Japan) are 253 freshmen (referred to as FCS1-J) [1]. They performed MCT and PIT.

As shown in Tables 2 and 4, the lowest and highest of average score (%) of Laotian students for MCT are 29.23% ~ 54.00% (previous study [5]) and 36.05% ~ 50.47% (this study). In the range of the scores of Laotian students, both results do not differ too much.

Therefore, it can be judged that this experimental approach didn't have a remarkable difference to the previous one. The data of this experiment will be analyzed statistically as follows:

3.2. The result of PIT

Table 5: Average score (%) of PIT

	FCS1-J	AECS1	FCS1-L	FCS2-L
<i>Average Score (%)</i>	80.01	80.80	43.91	54.74
FCS1-J	–	[N]	[**]	[**]
AECS1	0.79	–	[**]	[**]
FCS1-L	36.10	36.89	–	[**]
FCS2-L	25.27	26.06	10.83	–
Note: FCS1-J = fundamental course students, Osaka University, Japan [1] AECS1 = architectural course students, National University of Laos FCS1-L = fundamental course students, National University of Laos FCS2-L = fundamental course students, National University of Laos				

Note: The lower lines show the differential score between the groups and the result of the t-test.

[**] $P < 0.01$ there is a significant difference between the average score of the groups,

[N] There is no significant difference ($P > 0.05$) between average score of the groups.

Table 5 shows the average score (%) of PIT and the level of significant difference between the average scores of the groups. As shown in this table, there is no significant difference between the average scores of FCS1-J and AECS1 ($P > 0.05$). The average score of AECS1 is higher than that of FCS1-L and FCS2-L, and the difference between the average scores of AECS1 and of FCS1-L, FCS2-L is significant ($P < 0.01$).

Therefore, the visualization ability for the architectural space of Laotian students in the architectural course is higher than that of Laotian freshmen and sophomores in the fundamental course. And the visualization ability of Laotian students in the architectural course is similar to that of Japanese students in the fundamental course of Osaka University, though Laotian students were not familiar with the Japanese buildings presented in PIT.

3.3. Correlation of PIT and MCT

Figs. 3 and 4 show the distribution of the results of PIT and MCT. The correlation coefficients between both tests in the groups of FCS2-L and FCS1-L are 0.3316 and 0.3949, respectively. The result of PIT in FCS1-L is slightly correlated to that of MCT, but no-significant correlation between both tests has not been identified ($P < 0.01$). In the previous study [1] the correlation between both tests (PIT & MCT) was 0.3413. And the results of both studies are not very different.

Therefore, it can be judged that our experimental approach didn't bring about a re-

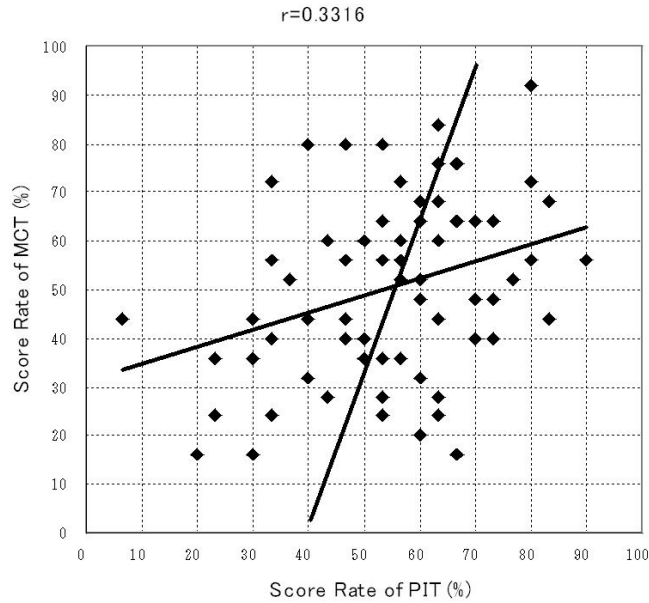


Figure 3: Correlation of PIT with MCT in FCS2-L

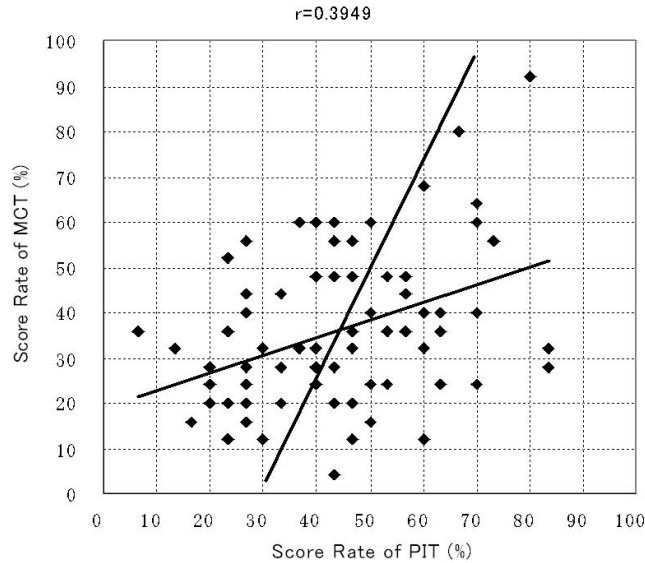


Figure 4: Correlation of PIT with MCT in FCS1-L

Table 6: Average score (%) of interior problems and exterior problems

FCS1-L		
	<i>interior</i>	<i>exterior</i>
<i>Average Score (%)</i>	42.27	47.20
<i>interior</i>	–	[N]
<i>exterior</i>	4.93	–
FCS2-L		
	<i>interior</i>	<i>exterior</i>
<i>Average Score (%)</i>	53.29	57.63
<i>interior</i>	–	[N]
<i>exterior</i>	4.34	–
AECS1		
	<i>interior</i>	<i>exterior</i>
<i>Average Score (%)</i>	86.60	69.20
<i>interior</i>	–	[**]
<i>exterior</i>	17.40	–
FCS1-J		
	<i>interior</i>	<i>exterior</i>
<i>Average Score (%)</i>	83.50	73.04
<i>interior</i>	–	[**]
<i>exterior</i>	10.46	–

Note: The lower lines show the differential score between the groups and the result of the t-test.

[**] $P < 0.01$ there is a significant difference between the average score of the groups,

[N] There is no significant difference ($P > 0.05$) between average score of the groups.

markable difference to the previous approach. The data of our experiment will be analyzed statistically as follows:

3.4. Visualization ability on interior and exterior problems in PIT

Table 6 shows the average score (%) of interior and exterior problems of PIT in each group. As shown in this table, there is no significant difference between the average scores of interior and exterior problems in FCS2-L and FCS1-L ($P > 0.05$). Otherwise the average score of interior problems is higher than that of exterior problems in AECS1 and FCS1-J, and there is a significant difference between the average scores of interior and exterior problems ($P < 0.01$).

For Laotian students of the fundamental course the visualization ability on the interior and exterior space is not different. However, for Laotian students in the architectural course and for Japanese students in the fundamental course it is more difficult to visualize the exterior space than the interior.

Table 7: Average Score (%) of one-floor problems and two-floors problems

FCS1-L		
	<i>one floor</i>	<i>two floors</i>
<i>Average Score (%)</i>	52.13	32.40
<i>one floor</i>	–	[**]
<i>two floors</i>	19.73	–
FCS2-L		
	<i>one floor</i>	<i>two floors</i>
<i>Average Score (%)</i>	63.68	42.89
<i>one floor</i>	–	[**]
<i>two floors</i>	20.79	–
AECS1		
	<i>one floor</i>	<i>two floors</i>
<i>Average Score (%)</i>	92.40	80.80
<i>one floor</i>	–	[**]
<i>two floors</i>	11.60	–
FCS1-J		
	<i>one floor</i>	<i>two floors</i>
<i>Average Score (%)</i>	90.24	76.76
<i>one floor</i>	–	[**]
<i>two floors</i>	13.48	–

Note: The lower lines show the differential score between the groups and the result of the t-test.

[**] $P < 0.01$ there is a significant difference between the average score of the groups,

[N] There is no significant difference ($P > 0.05$) between average score of the groups.

3.5. Visualization ability on one-floor and two-floor problems in PIT

Table 7 shows the average score (%) of one-floor and two-floor problems of PIT in each group. As shown in this table, the average score of one-floor problems is higher than that of two-floor problems in FCS2-L, FCS1-L, AECS1, and FCS1-J, and there is a significant difference between these two types of problems ($P < 0.01$). For all students in Lao and Japan it is more difficult to visualize the space open for two floors than that enclosed in one floor.

4. Conclusion

For Laotians the visualization ability for the architectural space and the spatial ability are analyzed by applying MCT and PIT to students at NUOL. The result are as follows:

- (1) The *spatial ability* (MCT) of Laotian students who are going to take an economy course is lower than that of Laotian students of an engineering course. Moreover, the spatial ability (MCT) of all Laotian students is lower than that of Japanese students in the fundamental course of Osaka University.
- (2) The *visualization ability* (PIT) of Laotian students in an architectural course is higher

than that of Laotian freshmen and sophomores in the fundamental course, and it is similar to that of Japanese students in the fundamental course of Osaka University.

- (3) For Laotian students in the architectural course as well as for Japanese students in the fundamental course it is more difficult to visualize the space of exterior than that of interior. For Laotian students of the fundamental course the visualization ability on the interior and the exterior space is similar. For all students it is more difficult to visualize the space open for two floors than that enclosed in one floor.

In this paper, the visualization ability and the spatial ability of Laotian students were tested. The spatial ability (MCT) of Laotian students is lower than that of Japanese students in the fundamental course of Osaka University, while the visualization ability (PIT) of Laotian students in the architectural course is not lower than that of Japanese students in the fundamental course of Osaka University. It showed that Laotian students except those of the architectural course are not familiar with architectural drawings and they do not understand the correspondence between architectural drawings and the architectural space. The Japanese students are more familiar with architectural drawings — even when they were not instructed by a professional architectural education.

However, after this experiment had been administered by students of the National University of Laos, we will apply it to the ordinary people in Lao P.D.R.. And we will also investigate the educational curriculum of each class.

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