The Effects of Environment and Living Behavior on Learning Efficiency in Educational Settings

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ABSTRACT

In recent years, emphasis has been placed on improving workplace productivity. Workplace productivity is defined as "results of workplace activities for investment". The investments mean indoor environment equipment costs, maintenance costs, and equipment costs. On the other hand, the workplace activities required mean understanding knowledge and information and using them correctly, and realizing new ideas and them. Also, it is expected that the Learning efficiency would be improved by improving the thermal environment of the education site.
The purpose of this study is to find the relation between indoor environment and Learning efficiency.
Questionnaires and measurements of the indoor environment were conducted at the educational site. The target classroom was set to 105 ㎡ and air conditioning was set to 26 ℃. From the questionnaire results, most of the students were satisfied with sound, light and wind environment. However, there were many complaints about the air environment and the thermal environment.

As a result, the environment of the classroom was totally satisfied. As the measurement results, the room temperature was from 26.3 ° C to 26.7 ° C. PMV calculation was performed based on the measurement results. The result of PMV calculation was 0.52 at a certain point. It was close to the comfortable range. Other points were 0.8 or more. They were more than the comfortable range. The result of the PMV calculation showed that it was a little uncomfortable overall. Therefore, a comfortable indoor environment can be created by improving the indoor thermal environment and air environment. It is thought that these can be made with the introduction of air conditioning and appropriate ventilation. In addition, it is expected to improve Learning efficiency by creating a comfortable indoor environment.

INTRODUCTION

Currently, smart wellness offices taken into account workplace productivity have been increasing attention in Japan. Smart wellness offices are offices that can improve the environment to promote the health of workers and workplace productivity. The urgent issue is to supply the offices that reduce working hours and improve workplace productivity to increase competitiveness with countries around the world.

From April 1, 2018, some of the school environmental health standards in Japan were revised to maintain student health. The temperature standard before the revision was 10 ℃ or more and 30 ℃ or less. After the revision, the temperature standard became 17 ℃ or higher and 28 ℃ or lower due to recent global warming. In addition, the law was amended to reduce fatigue and maintain a natural posture by using desks and chairs suitable for students.

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In addition, the importance of indoor ventilation has been stressed due to the influence of the new coronavirus that has spread rapidly in recent years. However, the inflow of inferior outside air and noise due to ventilation may have adverse effects in educational settings. For this reason, air conditioning and heating systems are essential to ensure an appropriate indoor environment.

It is thought that there is a relationship between good indoor environments and learning efficiency in the educational site Also, it is thought that life behavior and learning efficiency are related. In this study, in order to improve the indoor environment at the educational site, the indoor environment of a classroom was measured and questionnaires were conducted for students and staff. In addition, focusing on students, life behavior such as use of smartphones, exercises and meals to improve learning efficiency.

1 Measurement and questionnaire at a certain high school

1.1 Measurement

Environmental measurements of temperature, wind speed and humidity were performed in a multipurpose large classroom at the high school. Fig.1 shows the measurement points. 8 desks in the classroom were measured with students sitting. The date is July 11 in 2019, the time is 11:30AM. Inside the classroom, two store air conditioners were installed behind the classroom. The set temperature for cooling was 26℃. The doors and windows were closed. The weather on the actual measurement day was fine, the temperature was 27.9 ℃, and the wind speed was 3.2m / s (west-southwest).

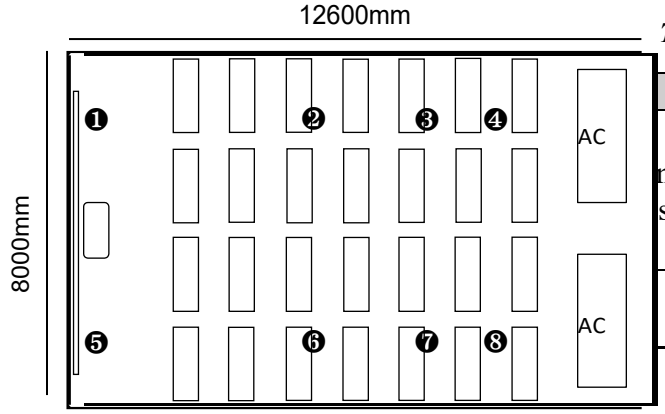


***Figure 1**: Target Classroom*

***Table 1**: Questions*

Questions	Details
nvironmental satisfaction	Factors of satisfaction and dissatisfaction with each environment (heat, air, wind, sound, light)
Living behavior	Use of smartphone, exercise, meal, break

1.2 Questionnaire

A questionnaire about environmental satisfaction and living behavior were conducted in a multipurpose large classroom for 75 students in the high school. The date was the same as the measurement. Table 1 shows the outline of the questionnaire. There were 35 multiple choice questions. The contents of the question were that the degree of satisfaction with the environmental elements in theclassroom and the life behavior affect the learning efficiency.

・Environmental element : temperature, air, wind, sound, light, space

・Life behavior : use of smartphone, exercise, eating, break

The questionnaire time limit is 15 minutes. At the end of the questionnaire, simple calculations
were performed in one minute as a learning evaluation. The students were divided into three groups in scoring order. Students Group A students scored 81 or more, group B students scored between 61 and 80, and group C students scored less than 60.

2 Results

2.1 Measurement results

Table2 shows the PMV calculation results based on the measurement results. The amount of clothing is 0.6clo and the metabolism is 1.1met. At each point, the temperature was between 26.3℃ and 26.7℃, the wind speed was between 0.05m/s

and 0.19m/s, and the humidity was between 77.0% and 80.0%. As a result, PMV was in the range of 0.52 to 0.90, and PPD was 10.7% to 22.2%. Some students were dissatisfied in a slightly warm environment. Since the wind speed at Point 4 is high, it is probable that there was direct wind from the air conditioner. Therefore, the temperature at point 4 was low and it was close to the range of comfort.

***Table 2**: Results*

	perature (℃)	MRT (℃)	Wind speed (m/s)	Humidity (%)	Clothes (clo)	Metabolic rate(met)	PMV	PPD (%)
1	26.6	26.6	0.10	79	0.6	1.1	0.80	18.7
2	26.7	26.7	0.05	79	0.6	1.1	0.90	22.2
3	26.6	26.6	0.09	80	0.6	1.1	0.84	19.9
4	26.3	26.3	0.19	79	0.6	1.1	0.52	10.7
5	26.6	26.6	0.13	78	0.6	1.1	0.73	16.3
6	26.6	26.6	0.12	77	0.6	1.1	0.74	16.7
7	26.6	26.6	0.07	77	0.6	1.1	0.85	20.3
8	26.6	26.6	0.11	77	0.6	1.1	0.76	17.2

2.3 Questionnaire results

Fig.2 shows the results of each environmental satisfaction. Approximate half of the studentsanswered that they were satisfied with the wind, sound environment and light environment. The studentswho complained were 19.7% in the wind environment, 9.1% in the sound environment, and 13.9% inthe light environment. Some students answered that the air environment and thermal environment weresatisfactory. Approximately 40% of the students answered that they were satisfied because airconditioning was effective in the air environment and thermal environment. However, 32.6% of thestudents who dissatisfied had air environment and 38.3% had thermal environment. This is probablybecause the distance between the students was short and the ventilation in the classroom was notperformed properly when the questionnaire was conducted. It is thought that these can be improved bylowering the set temperature of the air conditioner or properly performing ventilation. However, if the set temperature of the air conditioner is lowered, some students who are satisfied may feel dissatisfied.Fig.3 shows the study efficiency after a break and after a nap. According to the results, about 75% of the students who answered that they studied after a break and after a nap answered “concentrate”. Inaddition, 15.5% of students who answered that they did “NOT concentrate” were 4.4% after a break, compared with 15.5% after a nap. This is thought to be because the longer the nap time, the longer it takes to get up and cool down. From these, it is thought that a moderate break or nap has a good effecton learning.

Fig.4 shows the study efficiency after exercise and physical education. In addition, Fig. 5 shows the results of classification of study after physical education, and Fig.6 shows a result of classification of result after exercise. The term after exercise here refers to club activities, club activities outside, bicycles or walks to and from school. From Fig.4, 53.0% of the students studying after physical education said that more than half of the students answered that they did “NOT concentrate”. From Fig.5, many students who answered that the study after physical education did “NOT concentrate” in all groups were observed. In addition, the higher the grades, the higher the number of students who answered that their studies after physical education did “NOT concentrate”. Although after exercise studies are not after physical education, about 40% of the students answered that they did “NOT concentrate”. In addition, the number of students who answered that their post-exercise study was “concentrate” was almost half, down 16.2% from 29.4% after physical education.From Fig.6, it was found that in all groups, the number of students who answered that their study was "concentrate" was about half that after physical education. In addition, a large number of students in any group answered that they did “neither” after exercise. It is probable that the light exercises such as cycling and walking when going to and from school. From these facts, it is probable that studying after physical education or exercise has little effect on studying if exercise is low-intensity. However, high-intensity exercise may adversely affect subsequent studies.

Fig.7 shows the study efficiency on an empty stomach or a full stomach. Fig.7 shows that studying is relatively easier on an empty stomach. Fig. 8 shows the results of classification of study on an empty stomach and full stomach. Group A was more likely than the other groups to say that they were able to study more on a full stomach or an empty stomach, while Group B was less likely to say that they were able to study more on a full stomach or an empty stomach. In Group C, 29.2% were "empty" and 12.5% were "full," a difference of more than double.

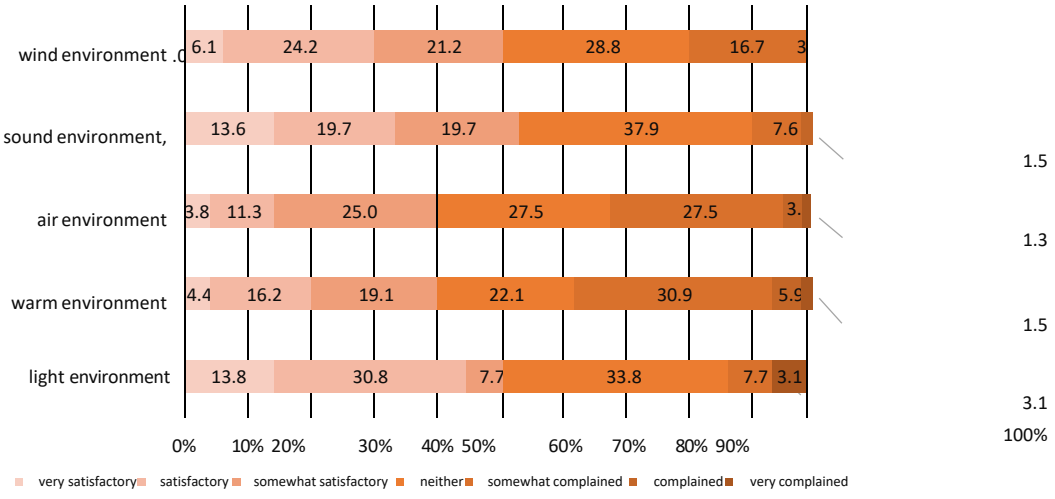
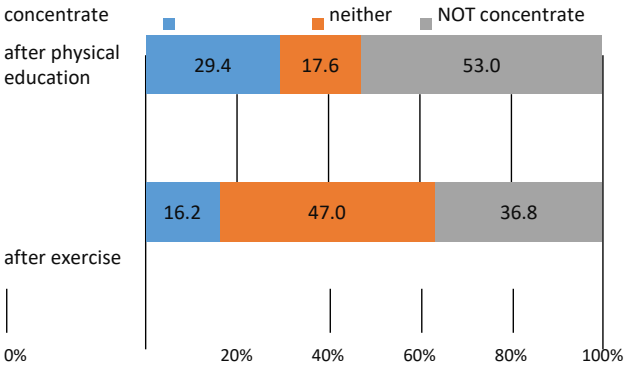


***Figure 2**: results of each environmental satisfaction*



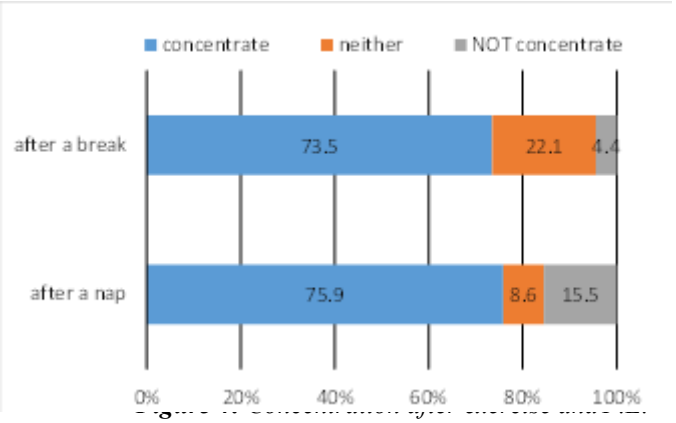


***Figure 3**: Concentration after a break or after a nap*

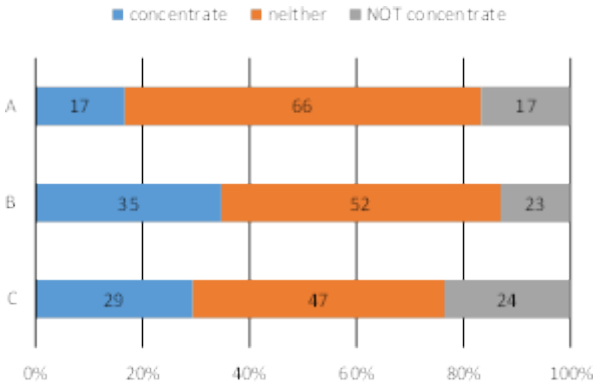


***Figure 5**: Group concentration P.E.*

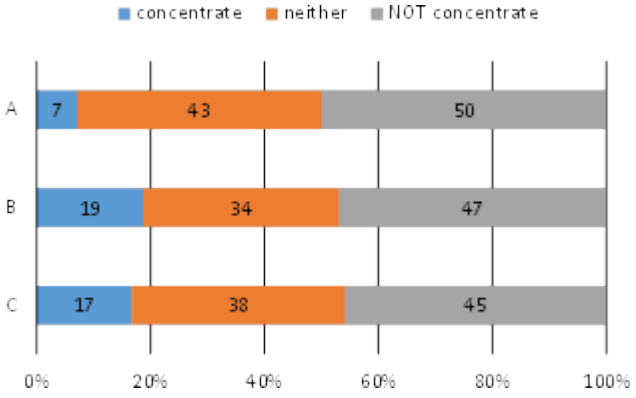


***Figure 6**: Group concentration after exercise*

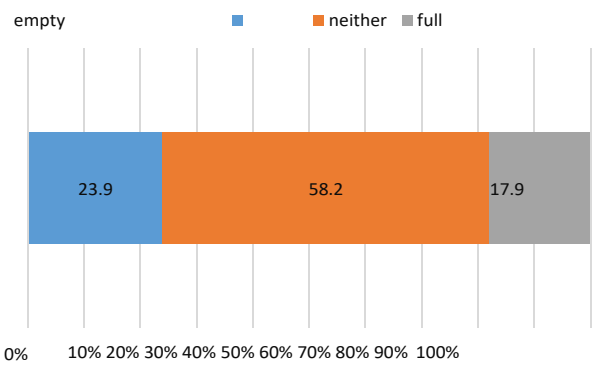


***Figure 7**: Concentration empty stomach*

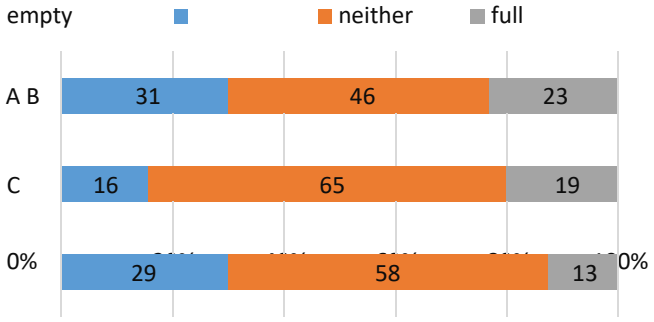


***Figure 8**: Group Concentration empty stomach or a full stomach. or a full stomach.*

CONCLUSION

The results obtained from the questionnaire survey results on the relationship between the effects of environment and living behavior and learning efficiency in educational settings and the results of actual environmental surveys are shown below.

1) From the measurement results of the thermal environment, the PMV of the target room was 0.52 ~ 0.90. Factors of dissatisfaction at this time are many reports of temperature and air environment. These may be improved by reviewing the set temperature of the air conditioner or by ventilation.

2) Individuals' living behavior is thought to have a significant effect on learning efficiency. In particular, many report that napping leads to improvement in learning efficiency.

3) From the results of the easy calculation, students who got high score answered "NOT concentrate" after high intensity exercise. In particular, the higher the correct answer rate of the easy calculation, the greater the tendency.

4) It was found that indoor environment and living behavior affected learning efficiency. Improving environmental dissatisfaction and taking appropriate living behaviors can be expected to improve environmental satisfaction and learning efficiency.

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