

# The Effectiveness of Sleep Behavioral Change Courses and Healthy Promotion Cloud System on Vocational High School Students' Sleep Hygiene

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**Abstract**—The purpose of this study was to apply behavioral change courses and healthy promotion cloud system (HPCS) learning strategies to achieve and goals for vocational high school students to self-regulate their sleep hygiene. A pretest and posttest quasi-experimental design was used for this study. Independent variable is the behavioral change courses and HPCS and it was divided into three levels: a. Control Group; b. Experiment Group One – joining the HPCS with mobile health recording device; and c. Experiment Group Two – participating in sleep behavioral change courses and HPCS with mobile health recording device. Dependent variable is students' sleep hygiene: excessive daytime sleepiness and insomnia. The results show that after having behavioral change courses, Experiment Group Two has improved more than the other two groups on excessive daytime sleepiness and insomnia.

**Index Terms**—Behavioral change, healthy promotion cloud system, sleep hygiene.

## I. INTRODUCTION

The educational system in Taiwan has long been criticized for placing excessive pressure on students from the entrance exam for their next educational level. According to the investigation made by Taiwan Society of Sleep Medicine on 600 senior students of junior and senior high school from the northern, middle and southern Taiwan. These examinees sleep averagely only for 6.4 hours during school days with 10 % of them sleep less than five hours. This investigation indicates that only 34% of the examinees considered themselves having adequate sleep. The National Sleep Foundation in the United States suggests 8.5 to 9.5 hours of sleep for adolescents from the age of 10 to 17. If this standard is used, Taiwanese examinees are short for 2.1 hours of sleep with the average sleep hour of 6.4.

One of the sleeping obstacles is day-night reversal, often found in adolescents who stayed up and get up late. For their sleeping biological clock has been postponed, it is easy for them have insomnia once their life style cannot match with their biological clock. Moreover, the biological clock is mainly controlled by the Melatonin made by our body, for those who stay up and wake up late, the peak of producing Melatonin will be many hour later than ordinary people, and cause their sleepiness during daytime.

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Sleep inadequacy has gained more emphasis recently. The Centers for Disease Control and Prevention (CDC) released their findings in 2011, indicating that about two third of the senior high school students have inadequate sleep hours. Compared to adolescents who have adequate sleep, it is easier for them to drink alcohol, smoke, and consider about suicide. This is the first investigation on sleep hygiene and delinquency. It is suggested that adolescent sleep inadequacy is now an urgent problem. However, the current courses are mostly on knowledge level with very little input on improving students' sleep hygiene. It is obvious that adolescent sleep hygiene has not yet been emphasized.

With the development of technology and for solving the problems of sleep inadequacy among adolescents, we use the healthy promotion cloud system (HPCS). The characteristics of HPCS were the wearable inertial signal sensors that could record users' biophysical signals. Participants are required to wear a mobile health recording device in order to record students' sleep status in the HPCS. This system includes teaching materials for one of the behavioral courses with elements of "game" and "community". The games can enhance the function of community, and the community can keep users' motivation to play games. Most importantly, users can exchange important game information in community, and that gives them a sense of belonging which is the main motivation for them to keep playing the game [1]. In order to keep students' learning motivation and not to have the problem of addiction, the cloud game in the current study was designed as following: the game information and progress will be stored in the information cloud, students do not need to be online to play the game. The mobile health recording device developed for the cloud community games in this study would record and upload users' behavior in the real world. The data will be processed and analyzed and presented in the online virtual game context. Thus, it avoids to be separated from the real world and keep the advantage of combining recreation and education as online learning games.

Prior studies on cloud community games have not combined with any behavioral change courses. It is therefore the aim of the current study to use the advantage of combining behavioral change courses and cloud community games to promote vocational high school students' self-regulated health management on sleep hygiene (excessive daytime sleepiness and insomnia). The research questions are as follows:

- 1) Is there any difference in **excessive daytime sleepiness** on vocational high school students with different level

of sleep behavioral change courses and healthy promotion cloud system?

- 2) Is there any difference in **insomnia** on vocational high school students with different level of sleep behavioral change courses and healthy promotion cloud system?

## II. METHOD

The independent variable in the current study is the three different level of self-regulated health management. Control group was a class with general courses, while students in experiment group one (E1) joining the healthy promotion cloud system (HPCS) with mobile health recording device, and experiment group two (E2) participated in both the HPCS and sleep behavioral change courses. Dependent variables are excessive daytime sleepiness and insomnia. The research design and frame are shown as Table I and Fig. 1.

TABLE I: RESEARCH DESIGN AND RESEARCH FRAME

GROUP	PRE-TEST	PROGRAM	POSTTEST
CONTROL GROUP	O <sub>1</sub>	X <sub>1</sub>	O <sub>2</sub>
EXPERIMENT GROUP 1 (E1)	O <sub>1</sub>	X <sub>2</sub>	O <sub>2</sub>
EXPERIMENT GROUP 2 (E2)	O <sub>1</sub>	X <sub>3</sub>	O <sub>2</sub>

X<sub>1</sub> : GENERAL COURSES

X<sub>2</sub> : HPCS

X<sub>3</sub> : HPCS + SLEEP BEHAVIORAL CHANGE COURSES

O<sub>1</sub> : SCALES FOR EXCESSIVE DAYTIME SLEEPINESS AND INSOMNIA

O<sub>2</sub> : SCALES FOR EXCESSIVE DAYTIME SLEEPINESS AND INSOMNIA

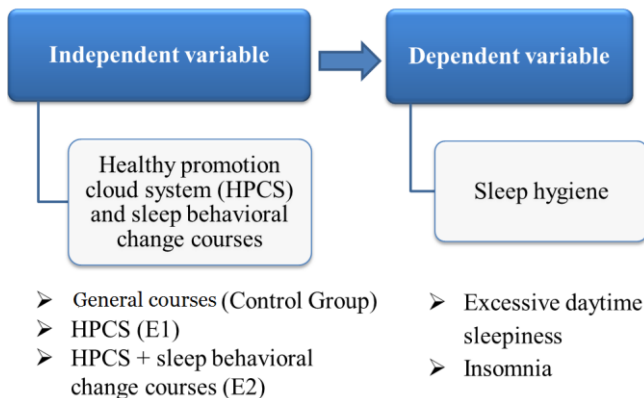


Fig. 1. Research frame of self-regulated health management on sleep behavior

### A. Participants

Three classes (50 students from each class) from one vocational high school in southern Taiwan. The class with general courses was the control group (C), and one class joined the HPCS with mobile health recording device was experiment group one (E1), and the other class participated both in HPCS and sleep behavioral change course was experiment group two (E2).

### B. Experiment Course Content and Procedure

The study adopted the “behavioral contract” on participants. The contract was developed by Premack [2] who summarized the opinions of Kazdin [3], Patterson, Reid and Dishion [4]. The advantages of behavioral contract are: promoting sense of participation of both sides, reducing

students’ antipathy towards implementing the contract, the contract is flexible, the rules of games are clear, and promoting interaction between students. The syllabus for experiment group two is shown in Table II.

TABLE II: SYLLABUS FOR EXPERIMENT GROUP TWO

WEEK	TEACHING APPROACH	COURSE CONTENT FOR SLEEP MANAGEMENT
1	LECTURE	KNOWLEDGE RELATED SLEEP
2		INTRODUCTION OF GOAL SETTING
3	BEHAVIORAL CHANGE STRATEGIES	TECHNIQUES OF COGNITIVE CHANGES
4		TECHNIQUES OF BEHAVIORAL CHANGES
5		DECISION-MAKING BALANCING
6		WONDERLAND IN TAIWAN, LET’S ZZZ: WARM-UP 1
7	COMMUNITY GAMES	WONDERLAND IN TAIWAN, LET’S ZZZ: GAME1
8		WONDERLAND IN TAIWAN, LET’S ZZZ: GAME2
9		WONDERLAND IN TAIWAN, LET’S ZZZ: GAME3
10	STUDENTS’ PRESENTATION	REVIEW OF THE COURSE

The study measured the assisting instrument (i.e., Mobile health records) for sleep quality. The instrument was developed by the Electronic Engineering of the National Cheng Kung University in Taiwan. The record overcame the problem of prior instruments about sleep quality that has difficulty for being carried. The new developed instrument can provide instant and appropriate analysis and feedback of physiological signals, to enhance students’ motivation of developing their habits for regular sleep and increasing their sleep time. In the other way, the study combined the functions of community website and game (i.e., Sleepwalk Taiwan Let’s ZZZ game), to promote students’ sense of involvement and motivation.

The healthy promotion cloud system in the study included a mobile health record and a website of “health habits”. Students could check their records for sleep including time for bed and being awake, total sleep time, and sleep efficiency through the system on the iCloud and use the content of the course related to sleep behavioral change strategy (e.g., online discussion, community game).

The community game in the study aimed to promote individuals to develop habits for sufficient physical activities in their life through passing the games for learning knowledge of sleep, answering tests for sleep and using gold coins as rewards, cards and properties in playing the game. Students were divided into groups and had to select a mascot for their group. The rules of the game were about the range of the move on a Taiwan map as a group, in which the group received a move when every group member uploaded their information to the website every day. The group could receive an additional move when there was one group member who slept between 7 and 9 hours.

### C. Instruments

The researchers employed two scales in the study: 1) Epworth Sleepiness Scale and 2) Chinese version of the Athens Insomnia Scale.

### 1) Sleepiness scale

The study was employed with the Epworth Sleepiness Scale [5], [6] to examine students' sleep quality. The scale was used to allow the participants to measure their frequency of doze-off during the day at home and school. The scale was followed by a 4-level Likert Scale. The value of Cronbachs'  $\alpha$  for the scale is 0.81, and its test-retest reliability is between 0.22 and 0.86. The values of validity and reliability of the scale indicate that it can be used to examine students' sleep behavior.

### 2) Insomnia scale

The study was employed with the Chinese version of the Athens Insomnia Scale [7] to examine students' insomnia condition. The 4-level Likert scale examined the participants' degree of insomnia within a month including 5 items measuring symptoms at night and 3 items measuring symptoms during the day. The scale was followed by a 4-level Likert Scale ranging from 0 to 3. High score indicates a critical condition of insomnia. The value of Cronbachs'  $\alpha$  without each item for the scale is between 0.79 and 0.85, and its test-retest reliability is 0.86. The values of validity and reliability of the scale indicates that it can be used to examine students' sleep behavior.

## III. RESULTS

SPSS 17.0 was used for the statistical analysis. First year senior high school students did the pre-test at the beginning of their first semester, and after the experiments, the control group and experiment groups did the posttests with different scales. One-way MANCOVA was used to analyze the scales of excessive daytime sleepiness and insomnia. Use the pre-tests as the covariate to exclude its influence on posttests, and to test the change of sleep strategies on sleep hygiene, the results are shown below.

### A. Excessive Daytime Sleepiness

All of the posttests on excessive daytime sleepiness of the three classes are lower than pre-tests ( $F(1, 128)=35.30, 40.58, 51.99, p=0.00$ ) after the different level of behavioral change courses and healthy promotion cloud system, which means that all of the three classes have improved on excessive daytime sleepiness. More importantly, E2 has improved the most out of these three groups ( $F(2, 127)=3.68, p=0.02$ ).

### B. Insomnia

All of the posttests on insomnia of the three classes are lower than pre-tests ( $F(1, 127)=22.78, 40.52, 52.11, p=0.00$ ) after the different level of behavioral change courses and healthy promotion cloud system, which means that all of the three classes have improved on insomnia. More importantly, E2 has improved the most out of these three groups  $F(2,$

$127)=4.84, p=0.01$ ).

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