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Smart Phone Application Program Development for Self-directed Learning and Attention Training

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The purpose of this study is to analyze the correlation between a learner's attention and self-directed learning ability, personality, and intelligence in order to develop an attention training smart phone application for improving the learner's ability to focus. Research subjects were high school students in Gyunggido and Jeonlabukdo, and their attention, personality, intelligence, and self-directed learning ability were tested. The inter-variable correlation was analyzed by the SPSS 17.0 statistics program. The results were as follows: a learner's attention was significantly correlated with diligence in personality, arithmetic ability, and number concept for intelligence and test-taking skills; for class concentration, problem solving skills in self-directed learning ability was significant. Based on this analysis, the research developed an attention training smart phone application in order to improve a learner's ability to focus. The program developed from this research serves to provide a scholastic motivation in two areas; it has a vitalizing function which relieves the learner from anxiety that comes from working towards a goal, and a directional function that leads the learner in the right direction in terms of his behavior and response.

Keywords: self-directed learning, smart phone, application, attention

Introduction

Recent technologies of computer application and increased Internet use have made changes in nearly every aspect of the society. Particularly in the area of education, efforts to increase the use of distance learning with the help of the Internet and computers as well as customized learning, which considers individual learner's characteristics, have been increasing. In addition, in terms of educational media, researchers have performed various studies on the wide use of the Internet and multimedia in order to maximize educational effects. These changes have served as stepping-stones from face-to-face education to distance education.

However, the universalization of mechanical culture, through computers, TVs, digital cameras, game consoles, etc., along with increases in nuclear families and working couples, have reduced opportunities for human-to-human communication and increased communication through machines. These changes have led to attention deficits and lack of empathy among the children. An increasing number of students suffer from attention deficits and distractedness, which is causing major problems at schools.

One critical factor in determining the success or failure of a task is the performer's ability to focus and pay attention. This greatly influences learning conditions. The amount of hours the student stayed focused, instead of the amount of hours the student spent studying, determined scholastic achievement (Yoon, 2009).

For these reasons, this complicated modern society has a greater need for individuals with the ability to select stimulations and skills necessary for completing a task, as well as to improve their ability to stay focused. Various researchers have shown a static correlation between an individual's ability to focus and academic performance (Cho, 2009; Kim, 1989; Seo, 2003; Yoo, 2006). However, most of these researchers relied on psychological tests that measure the individual's concentration in order to explicate the correlation between concentration and academic performance. Thus, in Korea, insufficient research has been done on the relationship between concentration and many other individual attributes of students, such as personality, intelligence, and self-directed learning ability.

Meanwhile, smart phones are attracting huge attention, as they combine the convenience of a mobile phone with the benefits of other hand-held devices, such as PDAs. Smart phones are creating a social sensation because they go beyond the limitations of previous handheld devices.

Thus, a timely discussion on the use of the smart phone as a new form of educational tool is needed. This discussion should also address the applicability of previous teaching methodologies, utilized in previous computer-based online learning tools, to smart phone applications, and the possibility of developing a new educational program.

Based on the needs mentioned above, this study examines the correlation between the learners' attention and their personality, intelligence, and self-directed learning ability, in order to develop a concentration-training smart phone application program that can improve a learner's ability to concentrate.

The application program developed through this research has two main functions: a motivational function and a directional function. The motivational function decreases the learner's anxiety, which comes with having to attain a scholastic goal and to find new motivations and energy to take necessary actions. The directional function leads a learner in the path of a correct behavior or reaction. Both serve to increase the learner's motive to study.

Theory

Teaching Methodology Planning for Program Development

Self-directed learning strategy. Choi and Kim (2010) stated that the different levels of attention determine a person's overall academic performance. The ability to pay attention to what one is learning is critical for one's academic career. The following are attributes that can improve an individual's concentration.

First, a strong curiosity (internal motivation) on a material one needs to focus on determines one's ability to maintain concentration in class. That is, in order to improve and have better concentration, a student must realize that class materials are important. Those who excel at managing their ability to concentrate will also do well at continuously maintaining their motivation.

Secondly, a small amount of tension is beneficial. A student can make good use of the "last minute effect" (as the exam date approaches, the student's concentration increases). This differs from cramming. The student must set up a systematic plan in order to maintain the tension even when the exam day is far in the future.

Thirdly, keeping a good physical and mental condition is crucial; taking breaks when tired or feeling too stressed can help the student regain physical and psychological strengths.

Fourthly, the student should set aside short time units in the study plan. This is a basic principle for increasing one's attention level. A person's normal attention span is not very long. However, with prefrontal lobe training, an individual can perform many tasks without even realizing.

Self-motivating strategy through sense of self-efficacy. The belief in one's ability to realize one's academic goals plays a very important role in continuously inducing a student's learning behavior.

Bandura (1986) emphasized the importance of self-efficacy, stating that a person with a strong faith in their own ability thinks, feels, and acts differently from someone who has self-doubts. An individual gradually and incrementally acquires and develops self-efficacy through learning experiences and education. Self-efficacy acquired in such a way becomes a key factor in affecting the individual's personal development and growth.

Harter (1985) claimed that the experiences a child goes through during the early years of schooling have a phenomenal impact on the child's development. Moreover, when a learner has firm belief in their academic self-efficacy, they invariably do better at goal-setting, showing tenacity and effort, choosing the right behaviors, and changing their mental and emotional response and attention.

Visualization strategy. Efforts to provide objective analysis of emotional aspects will help marketers understand customers' demands in the era of emotional marketing; when this analysis is applied to a product's design, it will lead to improvements in design competitiveness Korean Color Emotion Index Development Research (IRI Inc. 1997).

In view of this, our research used the following methodology to develop an attention training program.

First, in order to develop a learner's advanced thinking skills and problem-solving abilities through improving attention, maximizing efficiency, and solving a problem on one's own, this study applied the self-directed learning SMMIS model to the program.

Secondly, in the program, learners can check their own progress, improve their self-efficacy, and become motivated to participate in other learning experiences through different levels of training.

Thirdly, considering the color stimulation's impact on emotions and brain waves, we dropped the color red, which usually causes excitement or nervousness. Therefore, we used blue, yellow, and green as the main colors for inducing feelings of happiness, joy, and relaxation.

Methods

Our research subjects were high school students. We measured each student's personality, intelligence, and self-directed learning ability. After administering the attention measuring test to the students, we correlated the results with each student's personality, intelligence, and self-directed learning ability (cf. Figure 1).

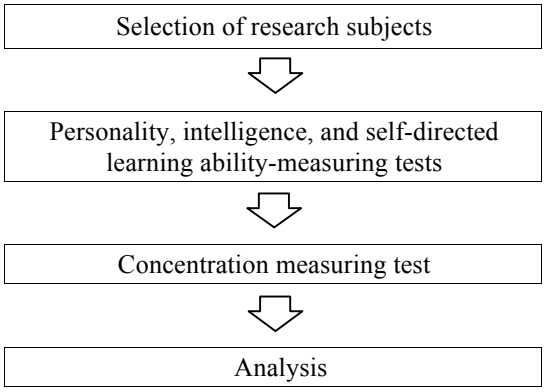


Figure 1. Research design and process

Subjects

The subjects of this research were 106 high school students, comprised of 51 students from High School A in Gyunggido and 55 students from High School B in Jeonlabukdo.

Test Tools

Personality, intelligence, and self-directed learning ability tests. In order to measure personality, intelligence, and self-directed learning ability, this study used the 3Q Comprehensive Assessment, which was developed by the Korean Aptitude Evaluation Service. This assessment is administered in elementary, middle, and high schools throughout the country. The test is comprised of four categories: personality, intelligence, aptitude, and self-directed learning ability.

The 3Q Comprehensive Assessment is an online test lasting 70 minutes. The results are analyzed and stored in a computer, and can be retrieved at any time after taking the exam.

Attention Measurement Test

Selective concentration test. Gibson (1969) stated that things in the world possess different attributes, such as shapes, colors, and sizes; and when individuals recognize these differences, they only focus on a few selected attributes among the many useful characteristics.

Selective attention means the ability to pay one's first attention to a related stimulus (Douglas, 1983). Selective attention is affected by age and state of mental acuity. In an average child, selective attention continues to develop between the ages of 3 to 12. This development occurs due to the enlargement of the child's attentional ability, task strategizing ability, and self-restraint.

The distractor task is the task most commonly used to measure selective attention, which uses a variety of stimuli-visual and auditory stimulation along with letters, numbers, and shapes. When the

researcher presents two competing stimuli to the subject simultaneously, the researcher can measure the subject's ability to quickly ignore the distractor and pay selective attention to the target task (Bae, Lee, & Ban, 2005).

This study developed and used the following test tool (shown in Figure 2) in order to measure selective attention.

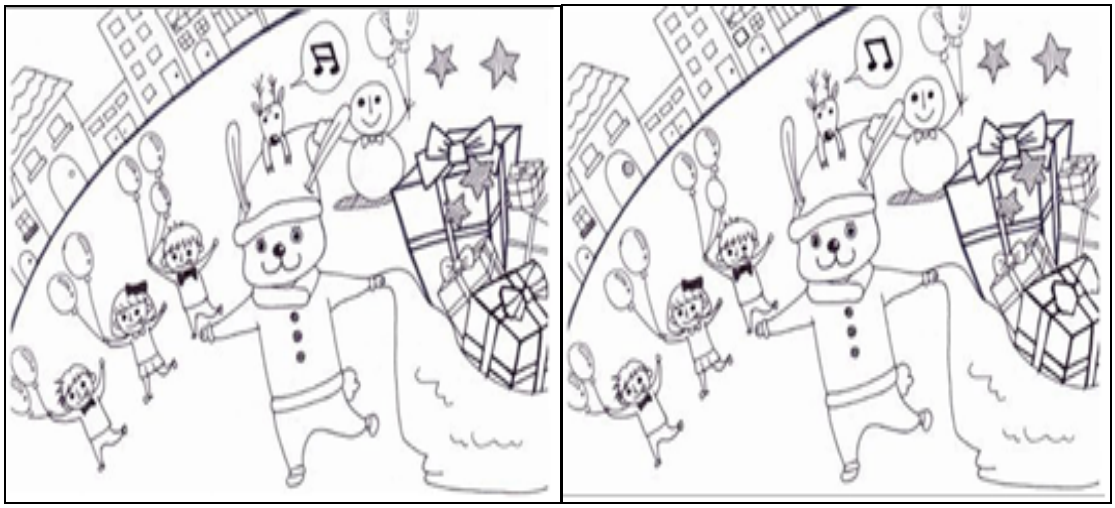


Figure 2. Selective Attention Testing Tool

The test taker had to look at the picture on the left for 10 seconds and then find the differences between the two pictures while only looking at the picture on the right. We repeated the test five times for each subject and counted the number of correct responses.

Focused attention test. Humans have limited data processing ability, and in order to complete a given task satisfactorily, they should select only the most appropriate data. This ability to select the type of data is referred to as focused attention. Researchers are examining focused attention in the areas of visual and auditory perceptions.

Focused attention is strongly related to distraction. Inappropriate stimuli during the performance of a task can disturb humans' selective perception. A person has many different types of automatic attention responses, and these can get in the way of concentration and performance. Some of these responses are innate, natural, and necessary phenomena from a biological viewpoint. When there is a threatening stimulus, such as a loud boom or a sudden movement on the periphery of one' vision, it will always bring about responses directed toward the source of the stimulus. This is an instinctive mechanism and is controlled by the superior colliculus. A visual substructure of the superior colliculus controls the eyes' saccadic movement toward the peripheral visual stimulus.

Buchtel and Butter (1998) proved that the prefrontal lobe plays an essential role in controlling saccadic movement in response to an unexpected visual stimulation. This means the prefrontal lobe plays a vital role in maintaining one's concentration in the face of visual distraction. Automatic response tendencies can manifest due to learning or conditioning. For example, humans cannot avoid hearing the phone ringing or their names being called. In experimental psychology, researchers use a distractor to measure focused attention. That is, the experiment gives the subject an inappropriate stimulus while the subject is focusing on a given task. One well-known method for such testing is the dichotic listing task. This method has the subject listen to two different recorded messages, but with instructions to focus only on one.

In this study, a test was developed by using a picture (shown in Figure 3) in order to test focused attention. This test involves finding one different figure among a group of otherwise-identical figures, with a 30-second time limit. The number of correct responses is recorded.

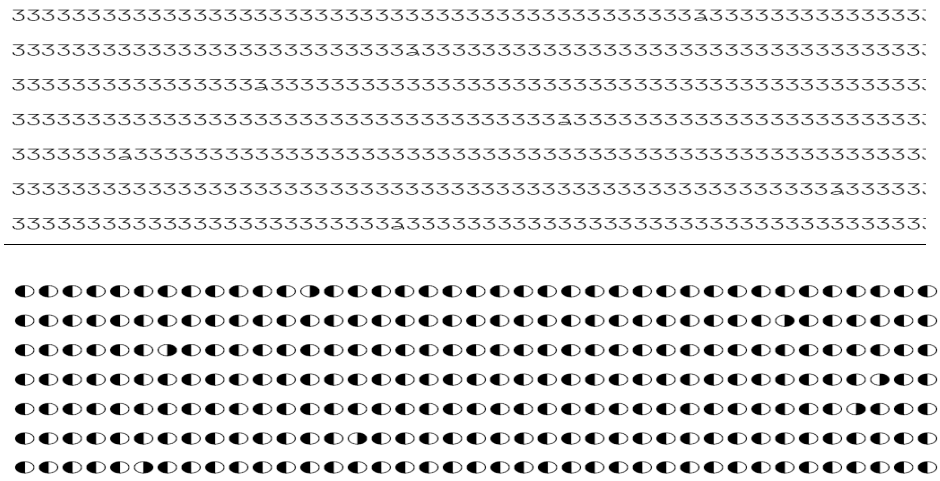


Figure 3. Focused Attention Testing Tool

Data Analysis

The collected data was analyzed using the SPSS Win 17.0 statistics package. The analytical methods we applied in this research were technical statistics (frequency, percentage, average, and standard deviation), t-test, one-way analysis of variance (ANOVA), and correlation analysis. The statistical significance level was set at 95%.

Results

Correlation Between a Learner's Attention and His Personality, Intelligence, and Self-Directed Learning Ability

We performed correlation analyses to measure the correlations between a learner's attention and personality, intelligence, and self-directed learning ability. Table 1 shows these results.

Table 1. *Correlation Between a Learner's Attention and His Personality, Intelligence, and Self-Directed Learning Ability*

Classification	test1	test2	Personality							
			emotion	sentiment	diligence	responsibility	Cooperation	Autonomy	Observance	Leadership
Selective attention	1	.137	-.151	-.059	-.030	-.032	-.024	.110	.071	-.035
Focused attention	.137	1	.074	.000	.219*	-.022	.015	.187	-.014	.156

Intelligence						Self-directed learning ability					
Linguistic Ability	Language Comprehension	Space Awareness	Structure Awareness	Calculation	Number Sense	Time Management	Test Taking	In-class Concentration	Self-management	Information Processing	Task Completion
.181	.104	-.010	.122	.209*	.260**	.068	.200*	.121	.092	.178	.217*
.147	.146	.179	.070	.240*	.208*	.176	.160	.204*	.169	.136	.189

*p < .05, **p < .01

According to the results, selective attention correlated significantly with Calculation ($r = .209$, $p < .05$) and Number sense ($r = .260$, $p < .01$) in the area of intelligence. We found statistically significant correlations with self-directed learning ability, as well as in Test Taking ($r = .200$, $p < .05$) and Task Completion ($r = .217$, $p < .05$).

In addition, focused attention had a statistically significant correlation with Diligence ($r = .219$, $p < .05$) in the area of personality, and with Calculation ($r = .240$, $p < .05$) and number sense ($r = .208$, $p < .05$) in the area of intelligence. Furthermore, in the area of self-directed learning ability, we found a significant correlation with In-class Concentration ($r = .204$, $p < .05$).

These results are in line with Hyunjoo Yoon's (2009) research: students who participated in attention training programs showed significant increases in learning attitudes, attention-paying behaviors, learning technique adaptation behaviors, and self-guided learning behaviors than students who did not participate in the programs. The difference was especially significant regarding academic performance.

Development of Attention Training Smart Phone Application

Visual Attention Training Application

This program aims to improve a user's visual attention. Using the visual data from textbooks, the students can benefit from this application by learning and remembering the data in their textbooks. In addition, its 3D screen and moving magnifying glass require continuous attention and memory and great activity in the brain and visual nerves. The user can improve their visual attention ability through using this application (cf. Table 2).

Table 2. *Visual Attention Training Application*

Application Screen			
Explanation	• The doughnuts fall randomly in the screen. Among them, the user has to click on the doughnut that correctly fits the category before the doughnuts disappear into the water at the bottom of the screen.	• Two covered, identical photos or pictures appear, and two magnifying glasses move around in the screen to partially show the hidden pictures. The user has to find the differences between the two pictures.	• Using illustrations from the textbooks, the screen shows the original picture first and then, if the user clicks on the NEXT button, it shows the same picture with a few changes. The user earns points by clicking on the changed parts of the picture. • Using the street view, users go through a route that they are supposed to follow. If users can follow the exact same route from the start, they earn points.

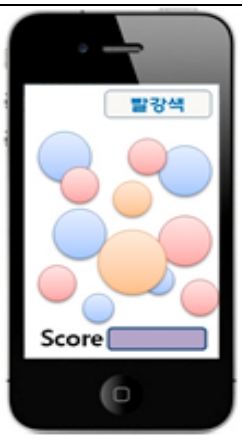
Auditory Attention Training Application

In this program, the user must solve problems by only listening to recordings. As the user can only rely on their listening skills to find the answer, the application can aid the user to develop auditory attention and memory, as the user must instantly memorize the spoken words (cf. Table 3).

Table 3. *Auditory Attention Training Application Plan*

Application Screen		
Explanation	• The user listens carefully to a recording, memorizes the words heard, and quickly clicks on the words on the screen. • When the voice reads out Rabbit, Key, Car, etc., the user listens, remembers the words, and clicks on the sentences containing the words	• The user listens to a voice reading the text and clicks on the parts that are read incorrectly. Texts are given in Korean or English. • The user cannot just click the wrong parts but must also correct them. • To prepare the user for school listening comprehension tests, in both Korean and English, the texts are categorized into difficulty levels for elementary, middle, and high school curricula. • When students repeat this training, they will subliminally ingrain the textbook materials into their memories and increase their understanding of the school materials.

Table 4. *Behavior-Response Restraint Training Application Plan*

Application Screen			
Explanation	• Animal figures move around the piano keys. When a word appears, the user clicks on the corresponding animal. After clicking on several animals, the user unwittingly completes a song. The clicked tunes are saved and can be played again.	• The bubbles' colors change continuously, and the word at the top denotes a color. The user pops the bubbles of that color.	• Using the smart phone's gravity sensor, the user moves the phone to roll the ball into the goal. When the light is blue, the ball moves in the obvious direction, but when the red light is on, the ball moves contrarily, in the opposite direction.

Behavior-Response Restraint Training Application

A behavior-response restraint, that is not working appropriately, causes short-lived resolutions: following a friend's lead in crossing the street without looking at the traffic light, acting without thinking, impulse buying, bothering others by thoughtless behavior, having poor academic performance due to being easily distracted, and inability to recognize mathematical symbols correctly (cf. Table 4).

Conclusion

This study analyzes the correlation between learners' attention and their personality, intelligence, and self-directed learning ability. We found that selective attention had a statistically significant correlation with intelligence (calculation and number sense) and self-directed learning ability (test taking and task completion). In addition, we saw a statistically significant correlation between a learner's focused attention and their personality (diligence), intelligence (calculation and number sense), and self-directed learning ability (in-class concentration).

The mobile environment does not place time or place constraints on a learner's participation. This means that the learner can learn and use the mobile application whenever and wherever desired. This is especially suitable for self-directed learning experiences.

Attention training should occur as often as possible, when the learner is able to train or is in need of training. Thus, we view the development of a mobile device application program that the learner can carry at all times as necessary. For these reasons, this study developed a smart phone application for attention training in self-directed learning.

The application program developed through this research has two main functions: the motivational function and the directional function. The motivational function alleviates the learner's anxiety, which comes with having to attain a scholastic goal, and helps the learner to find new motivations and energy to take necessary actions. We expect the program to have the following effects on the learners' academic abilities.

First, the learner's attention can improve, and thus, they can maximize the effectiveness of their study efforts.

Secondly, the application will open a new chapter of interactive, personalized, and mobile education.

Thirdly, learners can improve their self-directed learning abilities through using this application.

We conducted this research in the hope that other researchers will do more systematic and diverse studies in the area of attention training. The following are some proposals for future researches on this topic.

First, this study only focused on the academic performance of high school students. Researchers need to examine other learner types.

Secondly, the application's attention-improving effects were not validated. Follow-up studies on its effects, after the application is utilized in real classrooms, are needed to add validity to the application.

Thirdly, researchers need to conduct more studies and discussions on the development of more educational applications, and make use of smart phone functions in order to maximize the educational benefits, with the support from the educational system.

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