The Research of Relationship among Smile Developing Software, Internet Addiction, and Attachment Style

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Abstract: By developing a software tool that helps students cultivate the habit of smiling, this study aims to enhance students’ interpersonal relationships and ability to interact with others and therefore effectively decrease their Internet addiction. The study participants were students from a vocational high school in Tainan, Taiwan. To begin with, it examined the choices of attachment styles and levels of Internet addiction among high school students enrolled in a practical skills program. The students used the software tool for fourteen consecutive days and completed their smile task, which was followed by a post-test questionnaire. The result shows that for interpersonal interactions, changes in the mean values for three types of attachment styles decrease (namely anxious–preoccupied, dismissive–avoidant, and fearful–avoidant styles). In particular, the dismissive–avoidant style was reported with the most prominent change of \(-1.267\), and it was the only variable with a higher average value. This study also applied Bartholomew and Horowitz’s two-dimensional internal working model and found that the participants had demonstrated positive developments in their own self-internal modes and, in particular, others’ internal modes.

Keywords: attachment styles; Internet addiction; smile; face recognition; Agent

1. Introduction

Students often show no expression when interacting with others in their everyday lives. While there are numerous contributing factors, cell phones and Internet addiction are key hindrances, and their impact is worsening. Cell phones may prevent students from interacting with their classmates [1], and this critically affects their social interactions and their ability to learn during classes [2]. Internet addicts look forward to Internet-based rewards (e.g., escape from reality or desire) [3] and online role play as an opportunity to socialize and improve their self-esteem. However, excessive use could lead to increased dependence and consequently, negative social psychology and health problems [4–6]. Internet addiction is negatively correlated with the health-related quality of life among college students [7]. Numerous students substitute their social life on the Internet with real-life social interactions. Studies have shown that vocational school students are easily affected by Internet addiction possibly because of their wider access to the Internet [8].

Smiling can break barriers in interpersonal interactions since the mouth is at the center of one’s facial expressions [9]. Thus, a smile can effectively enhance interpersonal relationships, which in turn boosts students’ self-confidence. Psychologists and educators have highlighted the negative effects of the Internet, and that these effects are gradually intensifying [10,11]. Thus, decreasing Internet usage can improve students’ real-life interpersonal interactions by relatively extending their socialization time. This study aims to integrate the characteristics of students who use computers
for prolonged periods in software that helps them smile more naturally, which in turn, can decrease Internet addiction, enhance socialization skills, improve interpersonal relationships, and help break down barriers. The study aims to address the following research questions:

1. What attachment style do vocational school students demonstrate?
2. Can smile-developing software help improve students’ choice of attachment styles and decrease their Internet addiction?
3. To what extent are vocational school students addicted to the Internet?

2. Literature Review

2.1. Attachment Style

Bowlby [12] defines the relationship between infants and caretaker as attachment and highlights that infants need to develop safe attachment with the caretaker. If the interaction between both is positive, the caretaker responds positively to the infant’s needs, which in turn, affects how the infant perceives the world and their self-worth. The interpersonal values formed under such conditions affect future interpersonal interactions, and this is defined as attachment style. In the field of interpersonal relationship, attachment styles can form individuals’ internal working models, which are regarded by most researchers as a personality trait with a result indicating that significant differences exist in intimate romantic relationships, social interactions, and even cognitive information processing among adults with different attachment styles.

Applying Bowlby’s theory, Ainsworth et al. [13] examine an infant’s reaction to strange environments and divides attachment between an infant and caretaker into three categories: secure, anxious/ambivalent, and insecure–avoidant attachments. Bartholomew and Horowitz [14] further divide Bowlby’s second-degree internal working model into a self-internal model and other internal model, and accordingly, develop four categories of adult attachments: secure, anxious–preoccupied, dismissive–avoidant, and fearful–avoidant (see Table 1).

| Other’s Internal Model (Give Others Recognition) | Self-Internal Model (Self Recognition) |
|-----------------------------------------------|---------------------------------------|
| Positive                                      | Secure                                |
| Negative                                      | Dismissing                            |
|                                              | Preoccupied                           |
|                                              | Fearful                               |

In sum, attachment is an innate instinct developed after prolonged interactions between, for example, an infant and a caretaker [15]. Bowlby further believes that human beings instinctively seek help and belongingness. In the case of adults, Bowlby [16] uses the term ubiquity to express cognition, that is, communication with caregivers.

This research applies the attachment style scale developed by Wang et al. [17] on the basis of Bartholomew and Horowitz’s [14] adult attachment theory. The scale comprises four subscales (secure, anxious–preoccupied, dismissive–avoidant, and fearful–avoidant) and 24 questions, the responses to which are rated on a Likert scale.

2.2. Internet Addiction

The Internet, with its universality, has changed the modes of interpersonal interaction. Meeting new friends through the Internet rather than in real life [18] is currently the most popular form of interpersonal relationship, which has the interactive characteristics that can help individuals maintain their existing relationships and develop new relationships without face-to-face interactions. The term Internet addiction (IA) was originally used by American psychiatrist and clinical psychopharmacologist Dr. Ivan Goldberg, M.D., to describe abnormal addictive behaviors caused by increased Internet
addiction. It generally refers to an overuse of the computer that affects everyday routines [19]. Internet addicts may present the core symptoms of addiction that were also found in substance abusers, such as dependence, intolerance, and interpersonal conflict [20,21].

In the modern world, IA has become the root cause of many problems [22]; it lowers well-being and life satisfaction, and it increases the tendency of loneliness and depression [23]. IA is defined as morbid Internet usage that damages interpersonal relationships at school and work as well as with the family and has detrimental effects on mental health [24,25]. Studies have highlighted the lack of concentration is an important indicator of high school students’ Internet addiction irrespective of gender [26,27]. IA is regarded as a kind of technology addiction; compared with other traditional types of addiction, IA is categorized as a non-substance addiction and therefore has been conceptualized as a behavioral addiction [28]. IA is also considered as a psychological dependence on the Internet [29,30]. There are many studies examining the factors associated with IA, one of which, assessed by Eichenberg et al. [31], indicated that there does exist a correlation among attachment styles, IA symptoms, and online relationships, and so does a positive correlation between insecure attachment styles (anxious–preoccupied and dismissive–avoidant) and pathological internet use.

2.3. Smile and Attachment Style

A smile is the most common facial expression [32], and even though smiling is simply a facial muscle movement or a physiological action, it expresses the litigant’s mental state. Facial and smile attraction are closely related; for instance, during social interactions, one often tends to focus on the speaker’s mouth and eyes [33]. Smiling as a behavioral trait encourages long-term interpersonal relationships [34,35], has a positive impact [36,37], and is a powerful social tool [38]. Social scientists have shown that smiles have a profound impact on the perception of others. In general, smiles can enhance perceived similarity and identification [36–39]. Hinsz and Tomhave [40] found that smiles are positively contagious, which allow people to generate positive feedback. Wang et al. [36] observed that the intensity of a smile can affect feelings of interpersonal relationships, especially the perception of warmth. The study by Scharlemann et al. [41] suggested that people are more likely to work with smiling people in a one-time interaction with strangers, and empirical evidence shows that smiling promotes trust. Behavior researchers suggested that attachment models may become a part of the personal general interpersonal schema, which will support social development and influence thoughts, feelings, and behaviors over a lifetime. Attachment styles have also been used to study the likelihood that the development of online relationships leads to an increase in IA [42,43]. Vrtička et al. [44] used the pseudo-social interactive system incorporating smiling and angry facial expressions to investigate how attachment styles modulate the brain’s responses to facial expressions and confirmed that social perception has a strong modulating effect; this response is not only driven by facial features but also reflects the importance of smiling expressions in social interaction. Despite no direct study on attachment styles and smiles, it is through the foregoing literatures that there is a great correlation between attachment style and IA. Signs of IA and loss of basic social skills that show up on people with different attachment styles are due to their different internal working patterns that affect their patterns and expectations of interactions with others on the Internet. Smiling is recognized as a face-to-face social skill, enabling the recipients to elicit their positive emotions to express support or approval for others, and it is an important social token [45,46]. Consequently, smiling expression is important in social interactions.

3. Research Methods

3.1. Participants

The participants in this study are 30 students (age 17–18), of which 19 are male and 11 are females, enrolled in a practical skills program in a vocational high school in Tainan, Taiwan. The program focuses on practical skills and warrants the prolonged usage of computers to practically implement
learnings obtained during the classes, which is a critical aspect accounted for in the smile-developing software. The Smile Developing Software mainly played an assistant role existing and running in the background while students used their computers. This software tool will stop once the smile task is completed and the result is recorded. The experiment was conducted on a voluntary basis with the consent from students’ parents.

3.2. Automatic Recognition System for Facial Expressions

The process used by computers to recognize facial expressions can be divided into three stages: face detection, facial feature capturing, and expression recognition. Luxand FaceSDK [47], a face recognition software, comprises a facial recognition algorithm that allows the software to recognize a participant’s face, facial expression, gender, and age using pictures and videos. Once the face has been detected, it can provide up to 66 facial characteristic points used in characteristic detection [48]. Next, the software draws a picture and processes facial coordinates for the eyes, canthus, eyebrows, mouth, nose, tip of the nose, and other features, excluding the rest [49] (see Figure 1). A matching face is sourced from the picture data base, the graphic editor automatically detects the facial characteristics, and finally, a still picture or video is generated.

![Luxand FaceSDK detects 66 facial characteristic point.](image)

The facial action coding system (FACS) developed by Ekman and Friesen [50] is a standardized description for human facial expressions. On the basis of the muscle distribution in the human face, the system determines 44 action units (AUs) related to a participant’s facial muscles. Research shows the AU descriptions and further categorizes them into upper and lower face. AUs (action units) can be used alone or in combination, and many researchers have been inspired by this work to analyze facial expressions and recognition and to understand facial expressions in 2D images and videos. The FACS (facial action coding system) provides the descriptive capabilities necessary to describe the details of facial expressions in six culturally diverse and universally accepted expressions, which are happiness, anger, surprise, sadness, disgust, and fear. Commonly occurring AUs and some of the additive and non-additive AU combinations are shown in Tables 2 and 3. The combination of AUs may be additive or non-additive. In additive combinations, each AU is independent, while in non-additive ones, the AUs modify one another. Take a non-additive combination, AU 1 + 4, as an example, which is usually found in sadness [51]. The inner portion of the brows is raised when AU 1 appears alone, but it is lowered and drawn together when AU 4 appears alone. Whey they appear at the same time, the downward movement of AU 4 will be changed. It turns out that the medial portion of the brows is raised and pulled together. This movement usually causes the brows to tilt and lead to horizontal
wrinkles in the middle of the forehead and other facial expression changes. A majority of the 44 AUs can be super positioned and combined to create 7000 variations of human facial expressions.

Table 2. Upper face action units and some combinations.

| NEUTRAL | AU 1 | AU 2 | AU 4 | AU 5 |
|---------|------|------|------|------|
| Eyes, brow, and cheek are relaxed. | Inner portion of the brows is raised. | Outer portion of the brows is raised. | Brows lowered and drawn together. | Upper eyelids are raised. |
| AU6 | AU7 | AU 1 + 2 | AU 1 + 4 | AU 4 + 5 |
| Cheeks are raised. | Lower eyelids are raised. | Inner and outer portions of the brows are raised. | Medial portion of the brows is raised and pulled together. | Brows lowered and drawn together and upper eyelids are raised. |
| AU 1 + 2 + 4 | AU 1 + 2 + 5 | AU 1 + 6 | AU 6 + 7 | AU 1 + 2 + 5 + 6 + 7 |
| Brows are pulled together and upward. | Brows and upper eyelids are raised. | Inner portion of brows and cheeks are raised. | Lower eyelids cheeks are raised. | Brows, eyelids, and cheeks are raised. |

Table 3. Lower face action units and some combinations.

| NEUTRAL | AU 9 | AU 10 | AU 12 | AU 20 |
|---------|------|------|------|------|
| Lips relaxed and closed. | The infraorbital triangle and center of the upper lip are pulled upwards. Nasal root wrinkling is present. | The infraorbital triangle is pushed upwards. Upper lip is raised. Causes angular bend in shape of upper lip Nasal root wrinkle is absent. | Lip corners are pulled obliquely. | The lips and the lower portion of the nasolabial furrow are pulled back laterally. The mouth is elongated. |
| AU 15 | AU 17 | AU 25 | AU 26 | AU 27 |
| The corners of the lips are pulled down. | The chin boss is pushed upwards. | Lips are relaxed and parted. | Lips are relaxed and parted; mandible is lowered. | Mouth stretched open and the mandible pulled downwards. |
| AU 23 + 24 | AU 9 + 17 | AU 9 + 25 | AU 9 + 17 + 23 + 24 | AU 10 + 17 |
| Lips tightened, narrowed, and pressed together. | - | - | - | - |
| AU 10 + 25 | AU 10 + 15 + 17 | AU 12 + 25 | AU 12 + 26 | AU 15 + 17 |
| AU 17 + 23 + 24 | AU 20 + 25 | - | - | - |
3.3. Smile Developing Software

This study creates smile-developing software that can be operated on Windows with the objective of all participants developing the habit of smiling, which can further reduce Internet addiction and influence the choice of attachment style. Using Luxand FaceSDK’s human facial detection library, FaceSDK provides API-usable software to detect and track facial features and outline to generate a still image or motion videos. Luxand FaceSDK begins detection with the eyeball and then progresses to other facial features. Facial expressions are typically judged by the changes in the shape and position of facial features. This study mainly focuses on smile identification and thus selects 33 facial characteristic points to extract characteristics from the facial features with more obvious changes. It can detect as many as 66 facial feature points, although this study uses 33 points. Every three points is connected by a curved line to detect emotions, as shown in Figure 2.

![Figure 2. Feature point outline map formed by connecting facial feature points.](image)

According to the codes in Ekman and Friesen’s FACS, smiling can cause a lift in the cheeks (AU6) and in the corner of the mouth (AU12). A comparison of AU6 and AU12 with the feature points identified using Luxand FaceSDK helps trace the lines from point 23 to point 3 and from point 26 to point 4, which determine if a person in the image is smiling. However, in motion images, the distance from the camera or the position of one’s face (e.g., lowering of the head) can hinder the determination of whether a participant is happy. More specifically, these factors might shorten the length of the lines, and this could result in a misjudgment. Thus, this study uses two different lines, that is, from the two canthi to the philtrum (i.e., from point 23 to point 49 and from point 26 to point 49) as the standard length (Figure 3). Estimating the ratio of the two lines and the shortened standard line can help eliminate misjudgment and confirm a happy facial expression.

\[
\text{Ratio to determine happiness} = \frac{L23, 3 + L26, 4}{L23, 49 + L26, 49}
\]  

(1)

![Figure 3. Four reference lines to determine happiness.](image)
A decrease in the above-mentioned value indicates a happy expression and thus, its reciprocal is calculated as a smile index:

$$\text{Smile Index } S_n = \frac{L_{23,49} + L_{26,49}}{L_{23,3} + L_{26,4}}. \quad (2)$$

When the smile index exceeds a smile threshold, the system highlights a participant’s emotion as happy. By doing a pilot experiment, we got 1.1 as the best threshold. The standard for the smile threshold is as follows:

$$\text{Personal Smile Threshold } S_v = \text{Personal Normal Expression Smile Index } S_0 \times 1.1. \quad (3)$$

Figure 4 is a flow chart for the system procedure. Figures 5 and 6 are images of the software detecting a smile and the lack of one.
Drawing on studies on attachment style and Internet addiction, this research posits that practicing smiling on a regular basis can help reduce Internet addiction or influence the choice of attachment style. Data for this analysis are collected using a questionnaire survey.

3.4. Research Tools

3.4.1. LeLe Smile Task

The brain’s processing of visual responses is similar to facial expressions and depends largely on the consistency of current task goals and feedback [44]. Agent LeLe has positive and negative feedback connected with the smile tasks to simulate social reward and punishment, as shown in Figure 7.

This system is mainly to help users learn to smile after they properly use their computers. It runs in background program mode and window mode. For background program mode, the system is at a rest state when Agent LeLe does not need to absorb smile energy, while for window mode, the system will recover to its window mode from the background program mode when Agent LeLe needs to absorb smile energy. The scheme is designed to allow the users to observe how they smile and whether the program detects their smiles on the one hand, and to know how the energy of the users’ smiles increase on the other hand. This system will stop once the smile task is completed and the result is recorded. The flow chart of the experiment process is shown in Figure 8.
The process description is as follows:

1. **Detect the threshold of an individual’s smile**: the user takes and analyzes 10 facial images of his/her own without making any facial expressions (normal).
2. **Set the username and start the game**: identical name as the codename on the pre- and post-test questionnaires.
3. **Give enough smile energy during the detection time**: LeLe’s health point increases by 1 point for every successful detection, with a maximum of 3 points; LeLe’s health point decreases by 1 point for every failed detection until it reaches 0 points, which means LeLe dies and the smile task fails.
4. **Upon a successful completion in getting the number of absorption times of smile energy preset for the game**, the program will display a celebration screen with music, and record the result and time spent at this time, so that the program operation of that day is then successfully completed.
5. **Once the user fails to fill up the smile energy bucket for several times and causes Lele to die**, the smile task fails, for which the result will not be recorded. The user has to replay the game until he/she passes the game so that the result will be recorded and then, the program operation of that day is then successfully completed.

### 3.4.2. Interpersonal Attachment Style Scale

Wang et al. [17] propose the interpersonal attachment style scale by referencing Bartholomew and Horowitz’s [14] assessment tool that is based on adult attachment theory. The scale is based on the “positive or negative model of self” and the “positive or negative trust in others” and divides adult attachment style into four categories: secure, anxious–preoccupied, dismissive–avoidant, and fearful–avoidant. Every subscale has six questions with a total of 24 sub-questions, the responses to which are rated on a six-point Likert scale (1: Strongly Disagree, 6: Strongly Agree). The Interpersonal Attachment Style Scale is shown in Table A1.

### 3.4.3. Internet Addiction Scale

The revised Chen Internet Addiction Scale (CIAS-R) is specifically formulated and developed for the adolescents by integrating DSM-IV codes for various addiction disorders and clinical case observations, following the conceptual model of traditional addiction diagnosis and focusing on its psychological aspects. The CIAS-R is composed of two scales, namely the Core Symptoms of Internet Addiction (IA-Sym) and the Related Problems of Internet Addiction (IA-RP), with 26 questions in total. The reliability of each factor and internal consistency coefficient for this scale fall within a reasonable, satisfactory range (Cronbach’s alpha: 0.79–0.93), rendering the scale reliable [52]. A systematic
diagnostic interview result obtained by following the Diagnostic Criteria of Internet Addiction for Adolescents indicated that its accuracy and specificity were 87.6% and 92.6%, respectively [53]: the higher the score, the more serious the IA. As the CIAS-R was formulated on a stricter basis of the diagnostic conceptual model using the Taiwanese university students as the samples, of which the analysis result after testing demonstrated that this scale has good reliability and validity [18,43,54], the CIAS-R is therefore a robust, reliable and well-structured scale that explains why it was used in this study.

The scale addresses three core symptoms of Internet addiction: compulsive Internet usage (Sym-C; questions 11, 14, 19, 20, and 22), tolerance symptoms of Internet addiction (Sym-T; questions 3, 6, 9, and 24), and withdrawal symptoms (Sym-W; questions 2, 4, 5, 10, and 16). The scale also includes two items related to interpersonal and health-related problems of Internet addiction (RP-IH; questions 7, 12, 13, 15, 17, 18, and 21) and time management problems (RP-TM; questions 1, 8, 23, 25, and 26). This research adopts a six-point Likert scale with the following response options: 1: very non-conforming, 2: quite non-conforming, 3: non-conforming, 4: fairly consistent, 5: quite consistent, and 6: very consistent. Higher points denote a stronger addiction to the Internet. Internet Addiction Scale (Chen), as shown in Table A2.

4. Data Analysis and Results

4.1. Attachment Style Scale

Table 4 presents the distribution for each style. There is an increase in the number of participants who choose the secure and anxious–preoccupied styles, but a decrease in that of participants opting for the dismissive–avoidant and fearful–avoidant styles. As shown in Table 5, the average values for anxious–preoccupied, dismissive–avoidant, and fearful–avoidant styles are lower. Further, the dismissive–avoidant style shows the largest difference (−1.26) and only the secure style reports an increase in its average value. In conclusion, using Bartholomew and Horowitz’s [14] two-dimensional internal working model, this study shows that irrespective of the model of self or trust in others, all participants report positive developments and particularly a clear improvement in trust in others in the internal working model.

| Attachment Style | Secure | Anxious–Preoccupied | Dismissive–Avoidant | Fearful–Avoidant | Total Amount |
|------------------|--------|---------------------|--------------------|-----------------|--------------|
| Before/After Test | Before | After | Before | After | Before | After | Before | After | Before | After | Amount |
|                   | 2      | 3     | 10     | 13    | 8      | 5     | 10      | 9     | 30     |
| M: male, F: female |

| Statistic of Paired Sample |
|---------------------------|
| Secure                    |
| After 17.27 30 3.676 0.671 |
| Before 17.10 30 3.800 0.694 |
| Anxious–preoccupied       |
| After 22.77 30 3.287 0.600 |
| Before 23.30 30 4.284 0.762 |
| Dismissive–avoidant       |
| After 20.47 30 5.532 1.010 |
| Before 21.73 30 5.343 0.975 |
| Fearful–avoidant          |
| After 22.07 30 4.927 0.899 |
| Before 22.40 30 4.782 0.875 |

* SD: standard deviation, SEM: standard error of mean.
Table 6 shows a strong correlation for all the paired samples, Secure ($p < 0.01$, $r = 0.541$), Anxious–preoccupied, Dismissive–avoidant, and Fearful–avoidant ($p < 0.001$, $r = 0.600$, $r = 0.722$, $r = 0.753$), indicating significant differences between the pre- and post-test. The significance threshold was set at 0.05, which is all that is required.

Table 6. Pre- and post-test on correlations for attachment style.

| Paired Sample Correlations | Amount | Correlation | Significance |
|---------------------------|--------|-------------|--------------|
| Secure After–Before       | 30     | 0.541       | 0.002 **     |
| Anxious–preoccupied After–Before | 30 | 0.600       | 0.000 ***    |
| Dismissive–avoidant After–Before | 30 | 0.722       | 0.000 ***    |
| Fearful–avoidant After–Before | 30 | 0.753       | 0.000 ***    |

** $p < 0.01$, *** $p < 0.001$.

Table 7 presents the results for the paired sample test. The four dependent relationships fail to report significant differences ($p > 0.05$): the $t$-values for anxious–preoccupied ($t = −0.834$), dismissive–avoidant ($t = −1.709$), and fearful–avoidant ($t = −0.534$) styles are negative, indicating a downward trend, while only the secure style ($t = 0.255$) reports a positive $t$-value, suggesting a positive growth.

Table 7. Pre- and post-tests for differences in detection of attachment style.

| Paired Sample Test | Pairwise Variable Difference | t | Degree of Freedom | Significance (Two-Tail) |
|--------------------|------------------------------|---|-------------------|-------------------------|
| Secure After–Before | 0.167                        | 29 | 0.801             |
| Anxious–preoccupied After–Before | −0.533 | 29 | 0.411             |
| Dismissive–avoidant After–Before | −1.267 | 29 | 0.098             |
| Fearful–avoidant After–Before | −0.333 | 29 | 0.597             |

* $p < 0.05$; * SD: standard deviation, SEM: standard error of mean, CI: confidence interval.

4.2. Internet Addiction Scale

The Internet addiction scale comprises three core symptoms of Internet addiction and two items related to Internet addiction. The original scale consists of a four-point scale with 26 questions, where 26 is the lowest score and 104 is the highest. A score of 58 and below denotes normal usage and a score greater than 64 represents a high-risk group. For the purpose of this study, the values are converted and applied to a six-point scale and accordingly, the lowest score is 26 and the highest is 156. Further, 87 indicates normal usage, and a score greater than 96 is a high-risk group. Table 8 shows that after using the smile-developing system, the values increased from 20 to 22 for normal usage increased, decreased from 6 to 3 for Internet addiction, and increased from 4 to 5 for high-risk groups.

Table 8. Pre- and post-test on distribution of change in Internet addiction.

| - | Before | After |
|---|--------|-------|
| Normal ($S < 87$) | 20 | 22 |
| Have signs of Internet Addiction ($87 \leq S < 96$) | 6 | 3 |
| High Risk ($S \geq 96$) | 4 | 5 |

Table 9 presents the results for the paired sample statistics. The post-test average score is lower than the pre-test total score (70.5 < 73.667), indicating a decline in Internet addiction. All values under 87 are considered to be safe in terms of Internet addiction.
Table 9. Pre- and post-test on statistics for Internet addiction.

| Paired Sample Statistic | Average | Number | SD * | SEM * |
|-------------------------|---------|--------|------|-------|
| Total                   |        |        |      |       |
| After                   | 70.500 | 30     | 21.210 | 3.872 |
| Before                  | 73.667 | 30     | 21.085 | 3.850 |
| Sym-C                   |        |        |      |       |
| After                   | 10.833 | 30     | 3.896 | 0.711 |
| Before                  | 10.900 | 30     | 4.213 | 0.769 |
| Sym-W                   |        |        |      |       |
| After                   | 13.233 | 30     | 5.144 | 0.939 |
| Before                  | 14.800 | 30     | 5.222 | 0.953 |
| Sym-T                   |        |        |      |       |
| After                   | 11.900 | 30     | 3.916 | 0.715 |
| Before                  | 12.767 | 30     | 3.664 | 0.669 |
| RP-IH                   |        |        |      |       |
| After                   | 19.667 | 30     | 5.441 | 0.993 |
| Before                  | 20.000 | 30     | 5.994 | 1.094 |
| RP-TM                   |        |        |      |       |
| After                   | 12.067 | 30     | 5.085 | 0.928 |
| Before                  | 12.367 | 30     | 3.943 | 0.720 |

* SD: standard deviation, SEM: standard error of mean.

Table 10 shows a close relationship among all situations as per the results for the scale related to the paired sample: Total ($p < 0.001, r = 0.855$), Sym-C ($p < 0.001, r = 0.678$), Sym-W ($p < 0.001, r = 0.920$), Sym-T ($p < 0.001, r = 0.787$), RP-IH ($p < 0.001, r = 0.734$), RP-TM ($p < 0.001, r = 0.693$). Using the paired sample verification scale, Table 11 shows a significant difference only for the “withdrawal symptoms of Internet addiction” ($p < 0.001$), and all five participants report negative $t$-values ($t = -0.112, t = -4.127, t = -1.908, t = -0.434, t = -0.446$), suggesting a decrease in addiction.

Table 10. Pre- and post-test on situations related to Internet addiction.

| Paired Sample Correlation | Number | Correlation | Significance |
|---------------------------|--------|-------------|--------------|
| Total                     |        | 0.855       | 0.000 ***    |
| Sym-C                     |        | 0.678       | 0.000 ***    |
| Sym-W                     |        | 0.920       | 0.000 ***    |
| Sym-T                     |        | 0.787       | 0.000 ***    |
| RP-IH                     |        | 0.734       | 0.000 ***    |
| RP-TM                     |        | 0.693       | 0.000 ***    |

*** $p < 0.001$.

Table 11. Pre- and post-text on differences in Internet addiction.

| Paired Sample Test | Average | SD * | SEM * | 95% Difference CI | t | Degree of Freedom | Significance (Two-Tail) |
|--------------------|---------|------|-------|-------------------|---|------------------|------------------------|
| Total After–Before | -3.167  | 11.387 | 2.079 | -7.419 to -1.523  | 29 | 0.139            |
| Sym-C After–Before | -0.067  | 3.269  | 0.597 | -1.287 to 1.154   | 29 | 0.912            |
| Sym-W After–Before | -1.567  | 2.079  | 0.380 | -2.343 to -0.790  | 29 | 0.003 ***        |
| Sym-T After–Before | -0.867  | 2.488  | 0.454 | -1.796 to -0.082  | 29 | 0.066            |
| RP-IH After–Before  | -0.333  | 4.205  | 0.768 | -1.903 to 1.237   | 29 | 0.667            |
| RP-TM After–Before  | -0.300  | 3.687  | 0.673 | -1.677 to -0.446  | 29 | 0.659            |

* $p < 0.05$, *** $p < 0.001$; * SD: standard deviation, SEM: standard error of mean, CI: confidence interval.

5. Conclusions

This research proposes smile-developing software that users can access on a computer. The software customizes time intervals and the number of times detections must be performed. In addition, users can save their scores and look up those of the top 50 users; select or turn on background music or sound effects; and modify the display size, style, and positions. The software
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aims to help users develop the habit of smiling and in a customized manner so that the process is not a burden.

5.1. What Is the Students’ Choice of Attachment Style?

A pre-test on the students’ choice of attachment style reveals that the anxious–preoccupied style has the highest average score of 23.30, followed by dismissive–avoidant (22.40), fearful–avoidant (21.73), and secure (17.10) styles.

5.2. Can Smile-Developing Software Help Improve Attachment Style?

Upon using the smile-developing software for 14 days, the number of the participants with secure and anxious–preoccupied attachment styles increases, and that of the participants with dismissive–avoidant and fearful–avoidant attachment styles decreases; it is because that the social punishment mechanism of the smile developing software makes the participants with anxious–preoccupied attachment style generate even greater anxiety, and the participants with fearful–avoidant attachment style generate avoidance and hesitation. The participants with dismissive–avoidant and fearful–avoidant attachment styles are alike in reflecting avoidance of intimacy, which leads to an increase in the number of the participants with an anxious–preoccupied attachment style, and a decrease in that of the participants with dismissive–avoidant and fearful–avoidant attachment styles, echoing the study results proposed by Vrtička et al. [44] in the sense that having a social punishment mechanism increases anxiety, while having a social reward mechanism generates avoidance of delay.

A post-test on the students of attachment style reveals scores for secure (17.27), anxious–preoccupied (22.77), dismissive–avoidant (20.47), and fearful–avoidant (22.07). The average score of the secure style increased, and the rest decreased. Although Table 7 shows no significant difference among the four categories even after using the smile-developing software for two weeks, nevertheless, the t-value for the secure style is positive, which indicates an increasing trend, whereas those for fearful–avoidant, dismissive–avoidant, and anxious–preoccupied styles are negative, suggesting a decreasing trend. Although it is not significant, the effect still presents. The main reason is that the formation of attachment style is internalized over time from childhood to adulthood. The results show that the smile-developing software can improve attachment styles.

5.3. What Is the Internet Addiction Level of Students Enrolled in the Practical Skills Program?

With the total score of 73.6667, the pre-test scores for students enrolled in the practical skills program are 10.9 for compulsive Internet usage, 14.8 for withdrawal symptoms, 12.7667 for tolerance symptoms, 20.0 for interpersonal and health-related problems, and 12.3667 for time management.

5.4. Can the Smile-Developing Software Reduce Internet Addiction?

Each participant used the smile-developing software for two weeks. For all participants, the difference in t-value is negative, indicating a declining trend. There is a significant difference in the value for withdrawal symptoms at the 0.000 level (<0.05), while that for tolerance symptom is significant at 0.066, which is also close to the significant difference.

According to the number of participants with IA from the pre- and post-tests, it is found in the distribution that the number of high-risk group participants increased from 4 to 5, which is to be further explored below. It is found in Table 12 that the IA post-test scores of No. 3, 4, 5 and 6 decreased; especially, the post-test score of No. 4 is lower than that of the high-risk group. No. 6 was still at the high-risk group, but all its post-test scores in IA items decreased. The IA post-test scores of No. 1 and 2 increased mainly in the item of time management, which may mainly be due to the system’s experiment flow mechanism requiring that the result not be recorded until the smile task is successfully passed or the user has to keep playing. According to the study by Estevez et al. [35], IA is positively correlated with the adolescents who belong to anxious–preoccupied and dismissive–avoidant attachment styles.
In this study, the fact that both the participants with anxious–preoccupied and dismissive–avoidant styles were found to decrease has justified that the system designed in this study can reduce IA.

Table 12. Pre- and post-test on distribution of change in high-risk Internet addiction.

| No. | Score | Sym-C | Sym-W | Sym-T | RP-IH | RP-TM | Change |
|-----|-------|-------|-------|-------|-------|-------|--------|
| 1   | After | 103   | 20    | 21    | 18    | 24    | 20     | Increase |
|     | Before| 93    | 21    | 20    | 15    | 23    | 14     |         |
| 2   | After | 97    | 20    | 17    | 15    | 26    | 19     | Increase |
|     | Before| 95    | 18    | 21    | 15    | 27    | 14     |         |
| 3   | After | 109   | 25    | 23    | 17    | 24    | 20     | Lower   |
|     | Before| 114   | 23    | 25    | 17    | 33    | 16     |         |
| 4   | After | 94    | 17    | 22    | 14    | 24    | 17     | Lower   |
|     | Before| 96    | 21    | 22    | 13    | 24    | 16     |         |
| 5   | After | 99    | 17    | 19    | 19    | 24    | 17     | Lower   |
|     | Before| 96    | 17    | 19    | 19    | 24    | 17     |         |
| 6   | After | 120   | 23    | 23    | 22    | 32    | 20     | Lower   |

In conclusion, following the use of the smile-developing software for two weeks, the difference in attachment was not as obvious as that in Internet addiction. Nevertheless, this study finds a decline in Internet addiction and improvement in the choice of attachment style. In the follow-up study, we will further experiment for more cycles (for example, a 2–5 cycle, which is summed up to be 4–10 weeks) to explore the influence effect. Importantly, this effect can only be sustained if individuals cultivate the habit of smiling. Thus, it is important to design software that is convenient, easy to learn, and interesting to ensure that users keep using it. The sample size, the length of system operation, and the users’ ages will be the key aspects for future studies. This study is currently designed for Asians only, and it will be extended to other ethnic groups in the future. Furthermore, a mobile application will be a suitable development in the future given the current Internet usage trends, onto which a prevention mechanism may also be added, so as to prevent the formation of IA during the users’ process of usage. This application can be used in schools to encourage interpersonal relationships and learning. Studies can also use the application as a homework assignment to complete smile development tasks on the Internet and for a certain number of hours or days to cultivate the habit of smiling. Finally, an identity recognition system is critical to prevent others from completing the tasks.

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Appendix A

Table A1. Interpersonal Attachment Style Scale.

| Items                                                                 | Descriptions                  |
|----------------------------------------------------------------------|-------------------------------|
| 1. It makes me uncomfortable to get close to people.                  | 1 2 3 4 5 6                   |
| 2. I find it very easy to get close to people.                        | 1 2 3 4 5 6                   |
| 3. Even without any close emotional ties, I still live comfortably.   | 1 2 3 4 5 6                   |
| 4. It’s very important to me to be independent and self-sufficient.   | 1 2 3 4 5 6                   |
| 5. I want emotional intimacy, but it’s hard to trust someone completely.| 1 2 3 4 5 6                   |
| 6. I worry that I’ll be vulnerable if I get too close to people.      | 1 2 3 4 5 6                   |
| 7. I will worry that people don’t want to be with me that much.       | 1 2 3 4 5 6                   |
| 8. I don’t like to depend on people.                                  | 1 2 3 4 5 6                   |
| 9. I will worry that people don’t value me as much as I value them.   | 1 2 3 4 5 6                   |
| 10. I will not worry about being alone.                               | 1 2 3 4 5 6                   |
| 11. It makes me uncomfortable when people get too close to me.        | 1 2 3 4 5 6                   |
| 12. I will worry that people don’t really like me.                    | 1 2 3 4 5 6                   |
| 13. I rarely worry that people don’t accept me.                       | 1 2 3 4 5 6                   |
| 14. I’d rather keep my distance from people to avoid disappointment.   | 1 2 3 4 5 6                   |
| 15. I will get anxious when people want to be closer to me.           | 1 2 3 4 5 6                   |
| 16. I’m not satisfied with myself.                                    | 1 2 3 4 5 6                   |
| 17. Usually I prefer to be free on my own.                            | 1 2 3 4 5 6                   |
| 18. I find myself always seeking acceptance and affirmation.          | 1 2 3 4 5 6                   |
| 19. I know my strengths and weaknesses, and I like myself.            | 1 2 3 4 5 6                   |
| 20. I often care too much about what people think of me.              | 1 2 3 4 5 6                   |
| 21. I’m comfortable with people depending on me.                      | 1 2 3 4 5 6                   |
| 22. I have no problem with living by myself.                          | 1 2 3 4 5 6                   |
| 23. Even if people don’t appreciate me, I can still be sure of my worth.| 1 2 3 4 5 6                   |
| 24. When I need a friend, I can always find one.                      | 1 2 3 4 5 6                   |

Table A2. Internet Addiction Scale (Chen).

| Items                                                                 | Descriptions                  |
|----------------------------------------------------------------------|-------------------------------|
| 1. I was told more than once that I spend too much time online.       | 1 2 3 4 5 6                   |
| 2. I feel uneasy once I stop going online for a certain period of time.| 1 2 3 4 5 6                   |
| 3. I find that I have been spending longer and longer periods of time online. | 1 2 3 4 5 6 |
| 4. I feel restless and irritable when the Internet is disconnected or unavailable. | 1 2 3 4 5 6 |
| 5. I feel energized online.                                          | 1 2 3 4 5 6                   |
| 6. I stay online for longer periods of time than intended.           | 1 2 3 4 5 6                   |
| 7. Although using the Internet has negatively affected my relationships, the amount of time I spend online has not decreased. | 1 2 3 4 5 6 |
| 8. More than once, I have slept less than four hours due to being online. | 1 2 3 4 5 6 |
| 9. I have increased substantially the amount of time I spend online.  | 1 2 3 4 5 6                   |
| 10. I feel distressed or down when I stop using the Internet for a certain period of time. | 1 2 3 4 5 6 |
| 11. I fail to control the impulse to log on.                         | 1 2 3 4 5 6                   |
| 12. I find myself going online instead of spending time with friends. | 1 2 3 4 5 6                   |
| 13. I get backaches or other physical discomfort from spending time surfing the net. | 1 2 3 4 5 6 |
| 14. Going online is the first thought I have when I wake up each morning. | 1 2 3 4 5 6 |
| 15. Going online has negatively affected my schoolwork or job performance. | 1 2 3 4 5 6 |
| 16. I feel like I am missing something if I don’t go online for a certain period of time. | 1 2 3 4 5 6 |
| 17. My interactions with family members have decreased as a result of Internet use. | 1 2 3 4 5 6 |
| 18. My recreational activities have decreased as a result of Internet use. | 1 2 3 4 5 6 |
| 19. I fail to control the impulse to go back online after logging off for other work. | 1 2 3 4 5 6 |
| 20. My life would be joyless without the Internet.                    | 1 2 3 4 5 6                   |
| 21. Surfing the Internet has negatively affected my physical health.  | 1 2 3 4 5 6                   |
| 22. I have tried to spend less time online but have been unsuccessful. | 1 2 3 4 5 6 |
| 23. I make it a habit to sleep less so that more time can be spent online. | 1 2 3 4 5 6 |
| 24. I need to spend an increasing amount of time online to achieve the same satisfaction as before. | 1 2 3 4 5 6 |
| 25. I fail to have meals on time because of using the Internet.       | 1 2 3 4 5 6                   |
| 26. I feel tired during the day because of using the Internet late at night. | 1 2 3 4 5 6 |
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