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A Study on User Behavior for Assessing Symptoms of Excessive SNS Usage

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A STUDY ON USER BEHAVIOR FOR ASSESSING SYMPTOMS OF EXCESSIVE SNS USAGE

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SEPTEMBER 2018

Declaration of Authorship

I, Ploypailin INTAPONG, declare that this thesis titled, "A study on user behavior for assessing symptoms of excessive SNS usage," and the work presented in it are my own. I confirm that:

- This work was done wholly or mainly while in candidature for a research degree at Shibaura Institute of Technology.
- Where any part of this thesis has previously been submitted for a degree or any other qualification at Shibaura Institute of Technology or any other institution, this has been clearly stated.
- Where I have consulted the published work of other, this is always clearly attributed.
- Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work.
- I have acknowledged all main sources of help.
- Where the thesis is based on work done by myself jointly with other, I have made clear exactly what was done by others and what I have contributed myself.

Signed: _____

(Ploypailin INTAPONG)

Date: _____

Abstract

In this doctoral dissertation, I study on user behavior for assessing symptoms of excessive Social Network Site (SNS) usage.

With the emergence of SNSs, their usage has become a global consumer phenomenon. People are spending unexpected and unprecedented amount of time online. Such often excessive and compulsive use has been categorized as a behavioral addiction. Understanding how users behave on SNSs creates the opportunity for assessing the symptoms of excessive SNS usage to increase the awareness of excessive SNS usage. Therefore, I set my research goals as follows: designing and implementing a data collection application, clarifying the relationship between SNS usage and SNS addiction, identifying the effective factors associated with addiction components, and assessing symptoms of excessive SNS usage.

To achieve my first research goal, I design and implement the data collection application as a tool for aggregating SNS usage data from questionnaire and SNSs. Modified Internet Addiction Test (IAT) and Bergen Facebook Addiction Scale (BFAS) were employed as a part of questionnaire to measure SNS addiction and reflect addiction components. APIs were used for directly retrieving data from SNSs.

To achieve my second research goal, the data obtained by the data collection application including web log data were statistically analyzed to find the effective factors associated with SNS. The analytic results indicated the candidate of effective factors that differentiate excessive from normal users.

To achieve my third research goal, I identified the effective factors associated with addiction components. I recruited additional participants and statistically analyzed their questionnaire and Facebook data to clarify the factors associated with addiction components, which are reflected by the question items of IAT and BFAS. The analytic results indicated the candidate of effective factors associated with each addiction component. Nevertheless, the effective factors were different for each addiction component, some were shared, and common effective factors were associated with both IAT and BFAS addiction components.

To achieve my last research goal, I proposed a new method used for assessing symptoms of excessive SNS usage. This new method is the combinations of the data collection application used for aggregating SNS usage data and the analysis methods used for identifying the effective factors associated with SNS addiction and those associated addiction components.

The method used for assessing the symptoms can be applied for developing appropriate prevention strategies for individual to increase the awareness of excessive SNS usage.

- BEING AWARE OF YOUR DUTIES AND RESPONSIBILITIES-
(My Dad)

夢は汗の中に
ความฝันต้องเกิดหยาดเหงื่อจึงได้มา

少しずつ咲いて行く花
ใช้เวลาและค่อยเป็นค่อยไป ดอกไม้จึงบาน

その努力決して裏切らない
คำว่าพยายาม ไม่เคยทำร้ายสักคนที่ตั้งใจ

夢は汗の中に
ความฝันเท่ากับหยาดเหงื่อรินรดไป

芽を出してずっと待っている
เพื่อให้เหล่าเมล็ดพันธุ์นั้นเติบโต และสูงใหญ่

いつか　きっと　願い叶うまで
และคงต้องมีสักวัน จะได้ดังใจสมปรารถนา

(初日 AKB48 | BNK48)

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Abbreviations

Ajax	=	Asynchronous JavaScript and XML
ANOVA	=	Analysis of variance
APIs	=	Application programing interfaces
ATS	=	Addictive tendencies scales
BFAS	=	Bergen Facebook addiction scale
BSMAS	=	Bergen social media addiction scale
CI	=	Confident interval
CSS	=	Cascading style sheets
df	=	Degrees of freedom
DSM-IV	=	Diagnostic and statistical manual of mental disorders, 4th edition
F	=	F-value
FDQ	=	Facebook dependence questionnaire
FK	=	Foreign key
FQL	=	Facebook query language
GPA	=	Grade point average
HTTP	=	Hypertext transfer protocol
IADQ	=	Internet addiction diagnostic questionnaire
IAT	=	Internet addiction test
ID	=	Identification
ISPs	=	Internet service providers
Jquery	=	JavaScript library
JSON	=	JavaScript object notation
LAN	=	Local-area network

n	=	number
OAuth	=	Open authentication
p	=	Probability value
P-value	=	Probability value
PHP	=	Recursive acronym for PHP: Hypertext preprocessor
PK	=	Primary key
Q	=	Question
RIA	=	Rich Internet application
SD	=	Standard deviation
SE	=	Standard Error
Sig	=	Significant
SNS	=	Social network sites
SNWAS	=	Social networking website addiction scale
SSO	=	Single sign-on
t	=	T-value
XML	=	Extensible markup language

Chapter 1

Introduction

This chapter introduces the motivation underlying my doctoral dissertation "Study on User Behavior for Assessing Symptoms of Excessive SNS usage." It also describes my research goal and contribution. Finally, the organization of my dissertation is presented.

1.1 Motivation

Digital technology plays an important role in daily life. Social Network Sites (SNSs) have become an incredibly popular type of communication through which groups of people virtually meet and interact with others who share similar interests [1]. People can access SNSs on different platforms (computer, tablet or smartphone devices) for different activities. Young people engage in SNSs in order to not miss out, to stay up to date, and to

connect [2]. SNSs tends to be used for social purposes [3]. In addition, many businesses also use them as tools to enhance better relational experiences with their employees and customers [4]. With the emergence of SNSs, their usage has become a global consumer phenomenon. Figure 1.1 illustrates the growth of SNS users from 2012-2017. Over six years, SNS users has risen 88%, from 1.7 billion to 3.2 billion users [5]. In 2017, the active SNS users are about 42% of the world's population.
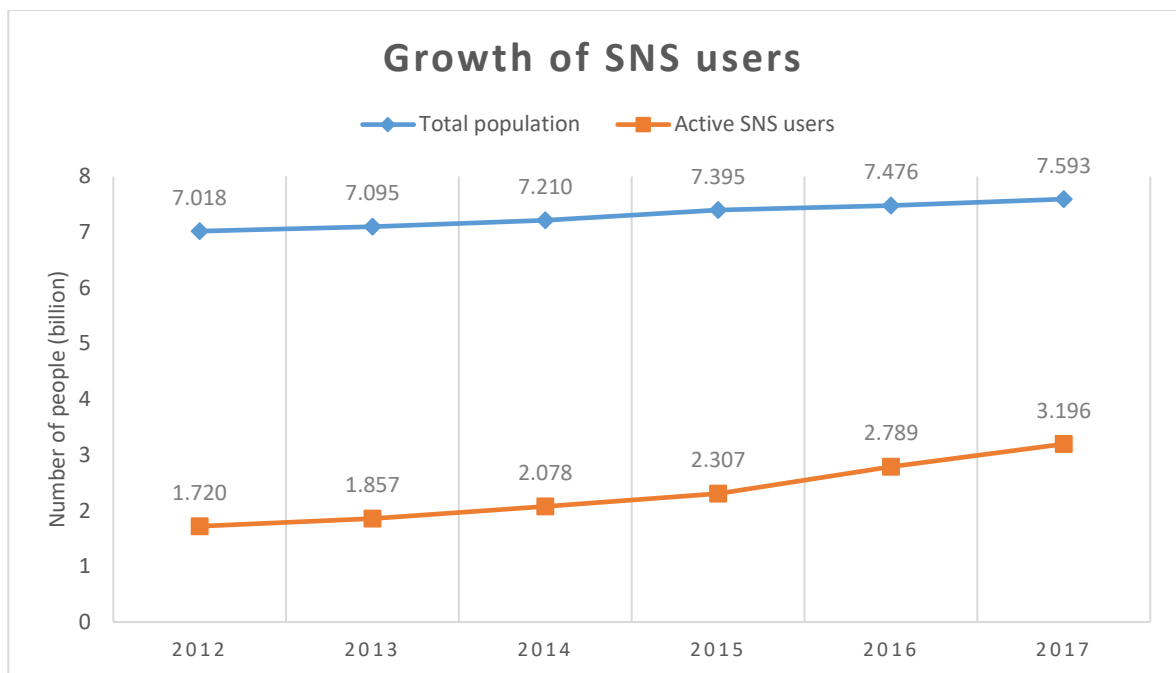
Figure 1.1 The growth of SNS users

In term of usage, online users have an average of seven SNS accounts. Over 80% of Facebook users log on at least once a day, and 30% of Twitter users and Instagram users log on daily. Furthermore, SNS users spend an average of two hours on SNSs every day [6]. In Thailand, over 50% of population are active SNS users and 96% of Thai Internet users use SNSs [7]. The top three most popular SNSs are YouTube, Facebook and, Line [7]. The average daily SNS use was almost three hours [7].

Some people spend too much time on SNSs and use them in ways that are becoming excessive. Excessive SNS users can spend many hours on SNSs for numerous reasons without being addicted to them [8]. A key distinction between excessive SNS usage and SNS addiction is that the latter, in contrast to the former, is associated with

unfavorable consequences, and that SNS becomes uncontrolled and compulsive. In short, excessive users remain in control [9]. However, excessive usage often associated with a loss of sense of time [10] and addicts have the excessive behaviors. Researchers have suggested that excessive users have a possibility to become addicts [11-13]. Figure 1.2 illustrates the comparison between excessive usage and addiction.
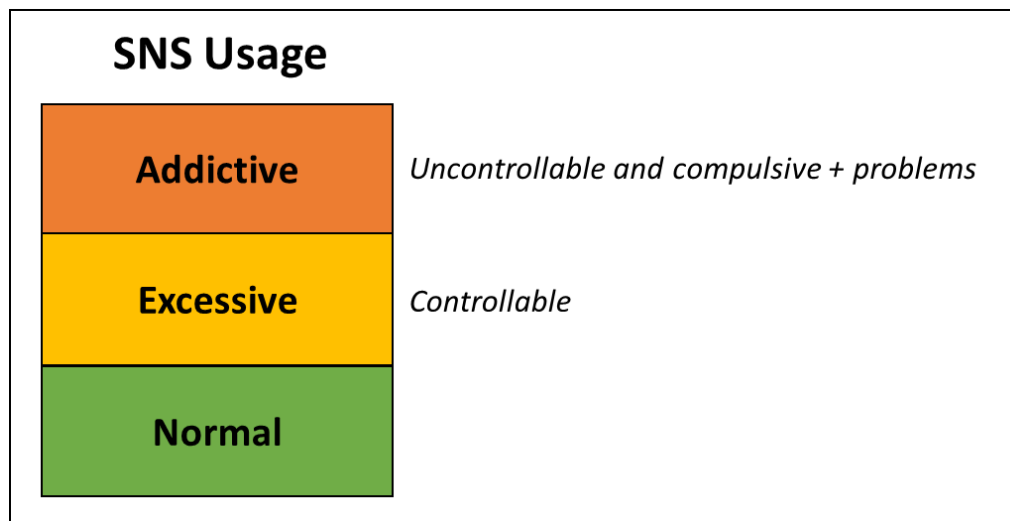
Figure 1.2 Excessive usage and addiction

As for SNS addiction, it is defined as excessive and compulsive behaviors on SNSs that lead to various negative consequences [14]. Some studies have highlighted a number of potential negative consequences of SNS addiction, such as relationship problems [15, 16], performance problems [18-21], health-related problems [11, 22], and emotional problems [20, 23-25]. Moreover, the excessive and compulsive behaviors on SNSs have been linked to behavioral addictions [11, 12, 14]. SNS addiction shares similarities with other behavioral addiction (e.g. Internet addiction, online gaming addiction, and gambling addiction) [1, 11]. Kuss and Griffiths [1] argued that symptoms of SNS addiction resemble those of other behavioral addictions. These symptoms have been described as salience, mood modification, tolerance, withdrawal, relapse, and conflict [26] and have been validated in the context of the Internet addiction components model [27]. Griffiths [26] argued that any behavior that fulfills these six addiction components can be operationally defined as an addiction.

Even though researchers were drawn to the emerging phenomenon of SNS addiction and its relationships with others (e.g. SNS usage pattern, interpersonal relationship, and other addictions), SNS addiction has received relatively less attention compared to other kinds of addictions [28].

1.2   Research Questions

The use of SNSs continues to dramatically increase. People are spending unexpected and unprecedented amount of time online. Such often excessive and compulsive use has been categorized as a behavioral addiction. Understanding how people behave with SNSs creates opportunities for assessing the symptoms of excessive SNS usage. Therefore, I addressed the following questions.

1.   How to aggregate SNS usage data for analysis?

There are many different types of data and collection methods that can help in studying SNS user behaviors [29]. The technical issue of existing data collection methods is that while they present benefits and provide useful data, these methods have limitations. For example, self-report measures are less accurate than actual behavior and some data on SNSs cannot be collected by their APIs [30]. Moreover, there are the large amount and kinds of data generated by SNSs [29]. Therefore, I set this question as the first one.

2.   What is the relationship between SNS usage and SNS addiction?

Understanding how users behave on SNSs has attracted great interest in such research field as sociology [31, 32], marketing [33, 34], and healthcare [29, 35]. There are different types of SNS data obtained by various data collection methods while standard analysis methods are not established. Moreover, existing studies endorsing only a few potential addiction criteria are not sufficient for establish clinically significant addiction status [12]. Therefore, I set this question as the second one.

3. What is the SNS usage that correlates with addiction components?

According to the review of [12], the studies in SNS addiction are classified into four types: (1) Self-perception studies of social networking addiction, (2) Studies of social networking addiction utilizing a social networking addiction scale, (3) Studies examining the relationship between social networking and other online addictions and (4) Studies examining social networking addiction and interpersonal relationships. A few researches have addressed the studies of addiction components. However, the standard analysis methods are not established. Therefore, I set this question as the third one.

4. How to assess the symptoms of excessive SNS usage?

Users can use SNSs extremely without be addicted if they are still in control. [9-11]. However, excessive usage often associates with a loss of sense of time [10] and addicts have the excessive behaviors. Researchers have suggested that excessive users have a possibility to become addicts [11-13]. Therefore, I set this question as the final one.

To answer these questions, I will design and develop a data collection application and use it to aggregate SNS usage data for analysis. After that, I will experimentally collect SNS usage data and statistically analyze them to identify the effective factors associated with SNS addiction and those associated with addiction component. Effective factors are SNS usage variables that differentiated excessive from normal users. Finally, the combination of data collection application and analysis methods used for assessing the symptoms of excessive SNS usage.

1.3 Research Goals and Contributions

Regarding motivation and research questions, understanding user behaviors on SNSs creates the opportunity to prevent the excessive behaviors on SNSs that lead to addiction symptoms. The objective of this research is to study on user behaviors for assessing symptoms of excessive SNS usage. For this objective, research goals described below:

1. Designing and implementing a data collection application

I design and implement the data collection application because there are large amount and kinds of SNS data. This application is designed to aggregate data from various sources represent SNS usage in different aspects. It should be designed and implemented first for collecting data for analysis to achieve the second and third research goals.

2. Clarifying the relationship between SNS usage and SNS addiction

The data obtained by the data collection application (result of the first goal) are analyzed by various analysis methods to clarify the relationship between SNS user behaviors and SNS addiction to achieve the second research goal.

3. Identifying the effective factors associated with addiction components

The data obtained by the data application are also analyzed by various methods to identify the effective factors associated with addiction components to achieve the third research goal.

4. Assessing symptoms of excessive SNS usage

Addiction components are named from associated symptoms. There is the possibility for excessive users to become addicts. Therefore, the symptoms of excessive usage may resemble those of addiction. To assess the symptoms of excessive SNS usage, the combinations of the data collection application and those analysis methods used for identifying effective factors associated with SNS addiction and those associated with addiction components can be applied for assessing the symptoms of excessive SNS usage to achieve the fourth research goal.

The final goal can achieve the development of prevention strategies to increase awareness of the risk of excessive SNS usage.

1.4 Organization of Dissertation

This dissertation consists of seven chapters including this one, which are organized as follows. Figure 1.3 shows the organization of this dissertation.

Chapter 2 presents background knowledge and a literature review of the current researches in SNS, behavioral addiction, measurement of SNS addiction, and data collection.

Chapter 3 presents the design and implementation of data collection application to achieve the first research goal. The data collection application, the outcome of the first research, is a tool for aggregating SNS usage data for analysis in Chapter 4 and 5.

Chapter 4 presents the SNS usage and its relationship with SNS addiction. I experimentally collected SNS usage data using the data collection application (Chapter 3) and employed web data. I analyzed the obtained data to clarify the relationship between SNS usage and SNS addiction to achieve the second goal. The outcomes of the second research goal were the effective factors associated with SNS addiction.

Chapter 5 presents the effective factors associated with addiction components. The data obtained by application (Chapter 3) and SNS usage (Chapter 4) are used in Chapter 5 to identify the effective behavioral factors associated with addiction components to achieve the third goal. The outcomes of the third goal were effective factors associated with each addiction component.

Chapter 6 discusses the methods used to achieve the research goals including the combination of them for assessing the symptoms of excessive to achieve the last research goal. This chapter also discusses the unique of this dissertation and the outcomes to increase awareness of the risks of excessive SNS usage

Finally, I conclude this dissertation and summarize its process, including the future work in Chapter 7.
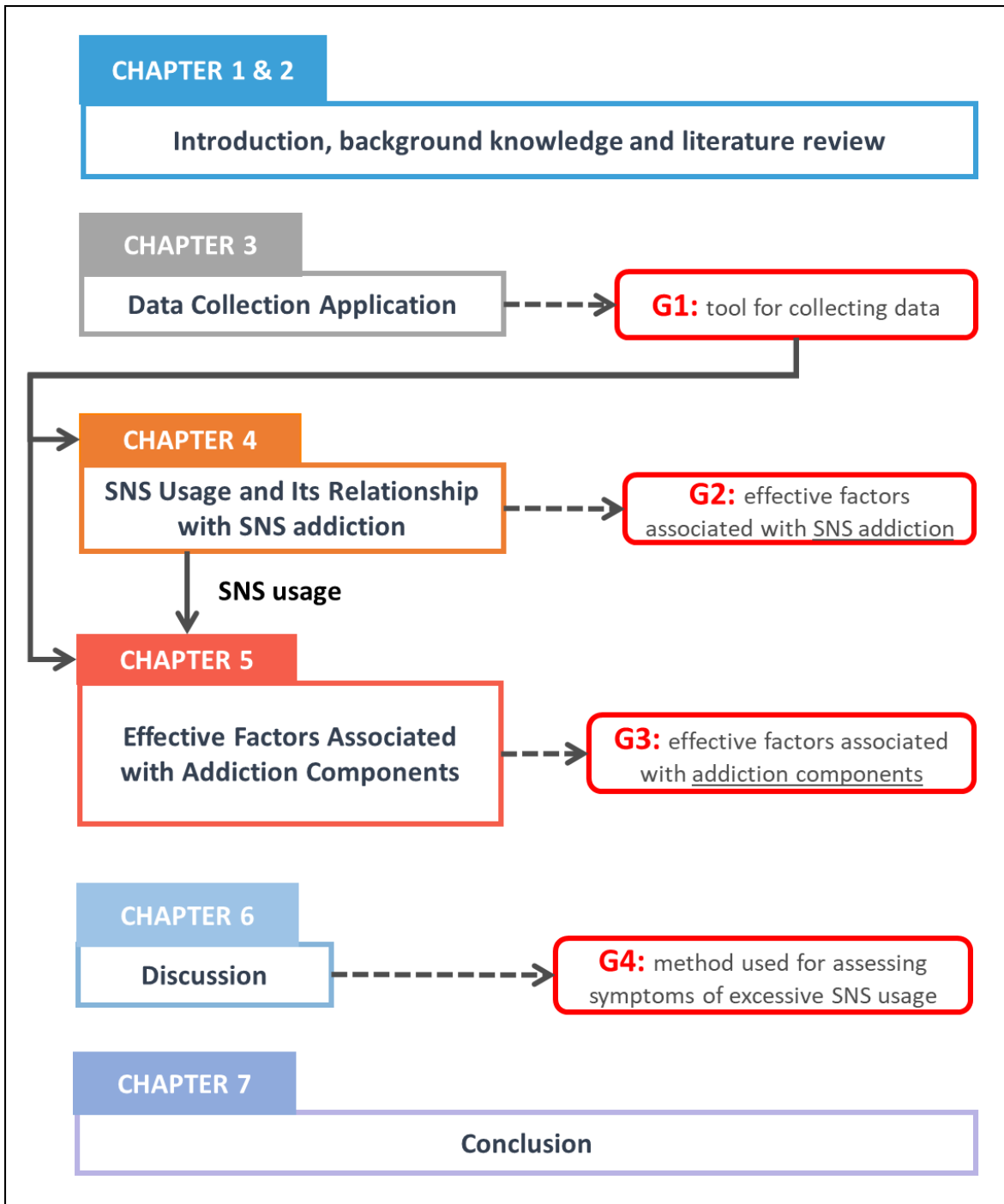
Figure 1.3 Organization of this dissertation

Chapter 2

Background Knowledge and

Literature Review

2.1 Social Network Site

Ellison and Boyd [36] suggested that "Terminology varied widely with the interchangeable use of 'social networking sites, 'online social networks' or even simply, 'social network' to refer to a diffuse – and sometimes improbable – range of sites and services". They argued that the term of "Social Network Sites" is more accurate that other terminologies because it emphasizes the role of networks, unlike previous online interaction space.

Social network sites (SNSs) are virtual communities where groups of people with similar interests can create individual public profiles and interact with others [1]. Elison [37] defined social network sites as follows: "web-based services that allow individual to

(1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system." According to Burke [38], "social networking is all about engagement – creating relationships, communicating with your readers, building your following and connecting with your online audience." Wikipedia [39] defines social networking services or sites as platforms that allow people with common interests, activities, backgrounds, or real-life connections to create social relations.

The first social network sites, launched in 1997, was SixDegrees.com, which allowed people to connect with others and send messages [37]. The next wave of SNSs included Friendster, which was launched in 2002. While other SNSs were designed to facilitate meetings between strangers with similar interests, Friendster helped friends of friends meet [37]. In 2004, Facebook was established on a college network and expanded worldwide [1]. Currently, it is the most successful SNS [1]. In 2016, Facebook had almost 1.5 billion users, added six new users every second [6].

Due to shifts in technology, some features have improved SNS user experiences: integration of SNSs with other tools and sites by Application Programming Interfaces (APIs, a form of third-party integration) and using SNS credentials for site authentication (single sign-on: SSO). SNSs provided several features to update profiles easily, such as status updates for Facebook and tweets for twitter. SNSs also began to support media sharing, including posting photographs and videos and access by mobile phones and tablets [36].

2.2   SNS Addiction

2.2.1 Definition of SNS addiction

Andreassen and Pallesen [14] defined SNS addiction as "being overly concerned about SNSs, to be driven by a strong motivation to log on to or use SNSs, and to devote so much time and effort to SNSs that it impairs other social activities, studies/job, interpersonal

relationships, and/or psychological health and well-being." In other word, SNS addiction is the excessive and compulsive behaviors on SNSs that lead to various negative consequences [11, 12, 14, 40, 41].

2.2.2 Negative consequences of SNS addiction and symptoms

SNS addiction leads to various negative consequences. People who spend too much time on SNSs are less involved in their real life communities [15]. They become preoccupied with and devote most of their time to SNSs [16, 17]. According to study examining the relationship between academic achievement and SNS usage, students who use SNS had lower grades than those who did not use [18-20]. A potential explanation for this may be that students are easily distracted and exercise poor time management [19]. A case study of a SNS addict reported loss of job due to the SNS behavior [21]. Moreover, SNS addicts had more sleep problems and poorer sleep quality compared to non-SNS addicts [11, 22]. Some studies reported a link between SNS addiction and depression and anxiety [20, 23], whereas other reported poor self-esteem and well-being [23-25]. In Thailand, many teenagers suffer from such negative effects of excessive SNS usage as lack of sleep, reduced academic performance, inappropriate manners, negative emotional expressions, impairment of family and social functions, and mental health problems [42].

Moreover, the excessive and compulsive use of SNSs has been linked to behavioral addictions [11, 12, 14]. In 2010, the term "behavioral addictions" was added in Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) [43] to set of official psychiatric diagnoses [44]. Internet-related behavioral addictions were also issued in the drafting of the DSM-5 [44]. The examples of Internet-related behavioral addictions are Internet addiction, online gaming addiction, social networking addiction, and Facebook addiction. Figure 2.1 illustrates the types of behavioral addiction.
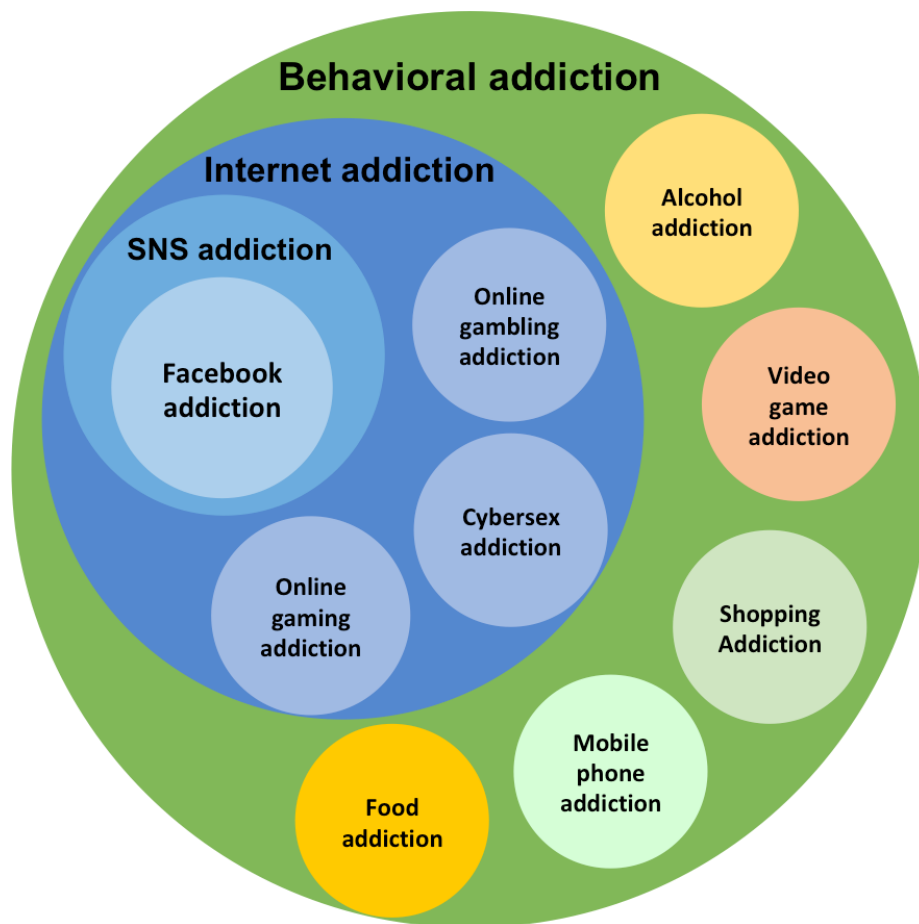
Figure 2.1 Types of behavioral addiction

Internet addiction is one type of behavioral addiction. Young [45, 46] addressed Internet addiction in five categories: computer addiction, information overload, net compulsion, cyber-sexual addiction, and cyber-relationship addiction. SNS addiction falls in the last category [1]. Such extreme cases have led to some researchers to conceptualize SNS addiction as Internet spectrum addiction disorder [21]. This indicates that SNS addiction can be classified with the large framework of Internet addiction [47].

All addictions have their own particular characteristics such as usage, interaction, and cause of addiction [26]. For example, someone addicted to video games will often avoid sleeping or eating proper meals in order to continue gaming [48] while people who addict to online gambling will place bets more and more frequently [49]. However, they share more commonalities than differences [50]. Addicts suffering from a behavioral addiction describe addiction-specific phenomena and diagnostic criteria, such as craving to

conduct the behavior excessively, psychological and physical withdrawal symptoms, loss of control, development of tolerance to induce and perceive the expected psychotropic effect (e.g., pathological gamblers gamble several slot machines at the same time) [51]. Griffiths [26] build on other researchers' consensus to define a behavioral addiction by six core addiction components: salience, tolerance, mood modification, conflict, withdrawal, and relapse. The addiction components are named from associated symptoms [27]. Griffiths argues that any behavior that fulfills these six addiction components can be defined as an addiction [26].

SNS addiction shares similarities with other behavioral addictions [1, 11]. Kuss and Griffiths [1] argued that its symptoms resemble those of other behavioral addictions. In relational to SNS, the six addiction components are as follows:

(1) Salience – SNSs become the most important activity in a person's life. Addicts dominate their thinking, feeling, and behavior. For example, they will think about the next time they will use SNSs.

(2) Mood modification – The engagement that modifies/changes emotional states. Addicts use SNSs in order to reduce feelings of guilt, anxiety, restless, helplessness, and depression, in order to forget about personal problems.

(3) Tolerance – Addicts spend much more time on SNSs than intended and they gradually increase amount of time spent every time.

(4) Withdrawal – Addicts typically become unpleasantness e.g. stressed, restless, troubled, or irritable when the use is restricted.

(5) Conflict – This refers to the conflicts between a person and those around that person, conflicts with other activities, or from within the individual himself/herself. Addicts give a lower priority to other activities and ignore their family and friends because of SNSs.

(6) Relapse – Addicts fail to reduce time spent on SNSs or avoid use.

2.3   Measurement of SNS Addiction

Several screening instruments have appeared in the literature. The earliest diagnostic criterion was the Internet Addiction Diagnostic Questionnaire (IADQ) proposed by Young in 1996 [52]. She developed eight yes/no questions as an initial screening instrument based on the DSM-IV criteria of pathological gambling and alcoholism. In 1998, she modified IADQ and proposed the Internet Addiction Test (IAT) [45].

IAT is a 20-items questionnaire that measures the characteristics and behaviors associated with compulsive Internet use. It is scored on 6-point Likert scale that ranges from *rarely* to *always* and includes *not applicable*. The scores of compulsive use range within the following four levels: none (0-30), normal Internet user; mild (31-49), sometimes online too long but able to control usage; moderate (50-79), experiences frequent problems; and severe (80-100), significant impact on daily life.

Owing to the growth of SNSs and the negative consequences of excessive SNS usage, several screening instruments have been specifically developed for assessing the problematic use of SNSs. For example:

- **Addictive Tendencies Scale (ATS)**. It is a three-item questionnaire for excessive text messaging/instant messaging [53]. It is scored on 7-point Likert scale that ranges from strongly disagree to strongly agree. Cut-off scores are not suggested.

- **Bergen Facebook Addiction Scale (BFAS).** It is a six-item questionnaire that assesses Facebook addiction in epidemiology studies and clinical trials [11]. It is scored on 5-point Likert scale from very rarely (0) to very often (4). The total addiction score ranges from 0 to 24 points. The cut-off score for excessive users is 12 points (e.g., scoring 3 or above on at least four of the six items).

- **Bergen Social Media Addiction Scale (BSMAS).** It is a six-item questionnaire, which was adapted from BFAS for assessing social media use [54]. The modification involves using the words "social media" instead of the word "Facebook".

- **Facebook Dependence Questionnaire (FDQ).** It is an eight-item questionnaire for measuring Facebook dependence [22]. The answer is Yes/No format. The cut-off score is answering "Yes" on at least five items.

- **Social Networking Website Addiction Scale (SNWAS).** It is a five-item questionnaire, which was developed based on video game engagement/addiction scales [55]. It is scored on 7-point Likert scale that ranges from completely disagree to completely agree. Cut-off scores are not suggested. The high score indicates SNS addiction.

In this study, I measured SNS addiction with two tests: the Internet Addiction Test (IAT) and the Bergen Facebook Addiction Scale (BFAS) with the following reasons.

Internet addiction is one type of behavioral addiction. Young [45, 46] identified five types of Internet addiction: computer addiction, information overload, net compulsion, cyber-relationship addiction. SNS addiction falls in the last category [1]. IAT covers a variety of Internet usage behaviors and common addiction symptoms. It has been widely cited in the research and translated in several languages: Arabic [56], German [57], French [58], Japanese [59], and Thai [60], and had developed new scales based on it [61-63]. Among similar tests, the IAT provides the standardization, reliability, and validity.

Since Facebook has become one of the world's most commonly used Internet sites, research in the SNS addiction fields has largely focused on it. BFAS was translated into several languages and has shown good psychometric [11][42][40][8]. Then, a modified version of BFAS named Bergen Social Media Addiction Scale (BSMAS) was proposed in 2017 [54]. The modification involves using the word "social media" instead of the word "Facebook."

To measure SNS addiction, I modified IAT and BFAS and used them to distinguish excessive from normal users for analysis in Chapters 4 and 5.

2.4   Data Collection Methods

Understanding user behavior on SNSs has attracted great interest in such research fields as sociology [31, 32], marketing [33, 34, 64], and healthcare [29, 35]. Researchers have studied it by collecting the data of SNS usage behaviors as a first step [29, 32, 65-68]. Many types of data and collection methods exist. Abdesslem et al. [29] summarized the existing data collection methods as follows.

2.4.1 Self-reported data

This approach gathers difficult to obtain or expensive data and save times. It can be implemented on such large samples as web questionnaire systems [67]. Most researchers have employed this method in their studies for various purposes [62, 63, 65, 69-76]. Self-reported data may be useful for understanding user behavior, but their information may be inaccurate when users forget their experiences. Some research in human behavior areas has argued that self-report measures are less accurate that actual behavior [29, 30, 77]. For instance, Young and Quan-Haase [77] conducted a survey about information revelation on Facebook. The results showed that the participants are often have forgotten what information they have disclosed and which privacy settings they have activated.

2.4.2 SNS measurement

The most common way to directly retrieve data from SNSs uses the application programming interfaces (APIs) provided by the SNSs themselves [78, 79]. However, this method has some limitations. For example, Twitter APIs limit the number of request operation to 15 requests per window. The return data are limited to 200 records per request and up to 3,200 records [78]. As a result, not all Twitter data can be retrieved in one time. Some studies employ automated script that automatically scans and crawls content from websites using HTTP requests/responses [32]. Other researchers collect data through a social network aggregator [68]. However, some data available on SNSs cannot be collected through APIs especially reading activities.

Some studies collect data by tracing network traffic from Internet service providers (ISPs) [29, 80]. HTTP traffic activities through the network are recorded as web log files. Web log files can inform about what types of websites are accessing. Nevertheless, this approach can represent only the activities in the same network. Other activities outside cannot be traced.

2.4.3 Application Deployment

This application monitors records and logs the operations and activities of users while they are using computers or smartphones and provides flexibility and privacy for data access [29]. Unfortunately, researchers need to install applications on user devices and manually get the data.

Regarding such existing data collection methods, they are all useful to capture user behaviors, even though they have some limitations. Abdesslem et al. [29] believe that "more reliable data can be obtained by using a new methodology based on the combinations of existing methods: this way, the data collected come from different sources and describe better users' behaviors." In this dissertation, I aggregated data for analysis from self-reported questionnaire, SNSs via APIs, and web log.

2.5   Empirical Studies of SNS addiction

According to the review of Griffiths et al. [12], the increase in amount of SNS usage drew many researchers to be interested in SNS addiction. They classified such studies into four types:

(1) Self-perception studies of social networking addiction. A study by Machold et al. [69] examined general pattern of Internet use and identified potential overuse and addiction among 474 young Irish teenagers using a survey-based method. Another study [70] explored the factors that affect the use of SNSs by focusing on frequency and time spent using regression analysis. Some studies [71, 72] surveyed the university students to identified the potential of SNS

addiction. None of these studies employed assessment scale for measuring SNS addiction.

(2) Studies of social networking addiction utilizing a social networking addiction scale. Using a survey-based method, Poh et al. [65] examined the relationship between social networking dependency and mood modification.-Wan et al. [63] assessed SNS addiction in a sample of 335 Chinese college students using the IAT [45] modified for Chinese SNS, namely Xiaonei.com. A study by Cam an Isbulan [62] examined gender differences in Facebook addiction among 1,257 Turkish university students by adapted IAT [45] and named the new instrument as Facebook Addiction Scale (FAS).

(3) Studies examining the relationship between social networking and other online addictions. A study by Kittinger et al. [73] examined how the use of Facebook relates to problematic Internet use. IAT [45] was used to assess Internet addiction. Another study also used IAT [45] for assessing SNS game addiction. Andressen [74] examined the relationship between additive use of social media and video game.

(4) Studies examining social networking addiction and interpersonal relationships. A study by Porter et al. [75] examined the relationship between social media use, interpersonal relationship satisfaction, and addiction. Wilson et al. [24] also examined the relationship between extraversion and addictive tendencies. Another study [76] conducted a paper-based survey to determine Facebook addiction among Turkish university students and found a relation between loneliness levels and time on Facebook.

Literatures do exist that employs self-report questionnaires to gather SNS data while some researches have argued that self-report data are less accurate than actual behavior [29, 30, 77]. There are only a few studies, which have used more complex online behavior traits generated by SNS data [81]. For example, Burke et al [82] and Burke et al. [83] discuss the concept of social support and how it can be measured through Facebook behaviors. This is important because increased social support has been linked to a decrease in depressive symptoms.

Moreover, a few researches have addressed the studies of addiction components (e.g. salience, tolerance, mood modification, conflict, withdrawal, and relapse). For example, Poh et al. [65] examined the relationship between social networking dependency and mood modification. They employed the Internet-Related Problem Scale (IRPS) [84] for measuring SNS addition, modified Pathological Internet Use (PIU) [85] for assessing social networking dependency, and Chinese Internet Addiction Inventory (CIAI) for measuring mood modification [63]. Pearson's correlation analysis was used and found that mood modification correlated positively with SNS addiction. Chou and Hsiao [86] analyzed the qualitative data and discovered that pleasurable changes in mood as a consequence of being online as opposed to the feeling of being irritable, angry or moody when Internet dependents are offline.

In addition, the participants of SNS addiction studies are young SNS users (aged 11-30 years). This may because of young people tend to be more likely engage in SNSs [1, 5]. They are the majority of SNS users for studies of SNS addiction.

For this dissertation, I study SNS usage related SNS addiction and those associated addiction components. The participants of this study were undergraduate students. The data obtained from self-report questionnaire and SNSs via APIs were analyzed to identify the effective factors related with SNS addiction and those associated with addiction components. IAT and BFAS were employed for measuring SNS addiction and reflecting addiction components.

Chapter 3

Data Collection Application

This chapter presents the design and development of a data collection application. From background knowledge and literature review of existing data collection methods (section 2.4), the data collection application is designed and implemented as a tool for collecting SNS usage data from questionnaire and SNSs. Design and implementation are described as below.

3.1 Conceptual Design

Data collection application is a web-based application that aggregates SNS data from self-report questionnaires and SNSs [87]. The obtained data will be analyzed to clarify the characteristics of SNS usage and association with SNS addiction. Figure 1.1 shows the

conceptual design of the data collection application.
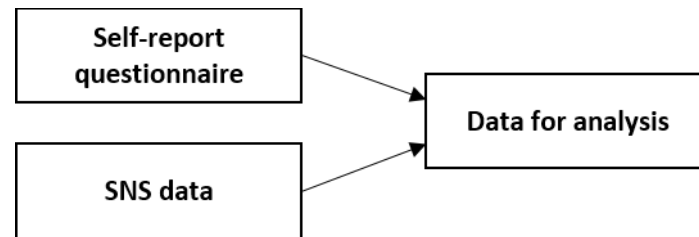
Figure 3.1 Conceptual design for data collection

3.2   Application Design

The data collection application can be referred to as client-server architecture, which is software architecture that describes communication between clients and servers. This application has two parts: questionnaire and quizzes. Questionnaire is employed for gathering the user experiences of SNSs. Quizzes are implemented to engage and motivate users for data collection, which retrieve from SNSs via APIs. They are small games that ask such questions as "How often do you Tweet?" When users complete the quizzes, the SNS data are retrieved by APIs. In this study, I focused on retrieving data from Facebook and Twitter. Figure 3.2 shows an architecture overview of the data collection application.

The client and server establish a connection and transmit the data using HTTP protocol. On the client side, the interaction and communication occur within a Rich Internet Application (RIA), which has the characteristics of a browser-based application. RIA provides opportunities to reduce the load of web servers. The interaction between users and web interfaces, such as clicking buttons and validating forms, are handle by JavaScript library. On the server side, the authentication and retrieving data between web server and SNSs is handle by the library of SNS APIs e.g. Graph API and REST API. The obtained data from questionnaire and SNSs are stored in a database.

A cookie technique is employed to prevent data duplication from identical users who do questionnaires and quizzes in the same period. When the first user's data are stored in the databased, the application generates a unique number and sets a cookie value and expired time. Then, the cookies are sent to user browsers and stored on computer hard

drives. If the same user completes another questionnaire or quiz, the data are stored with the existing unique identifiers.

I will explain the design detail and implementation of questionnaire, Facebook quiz and Twitter quiz including the methods for retrieving data in next section.
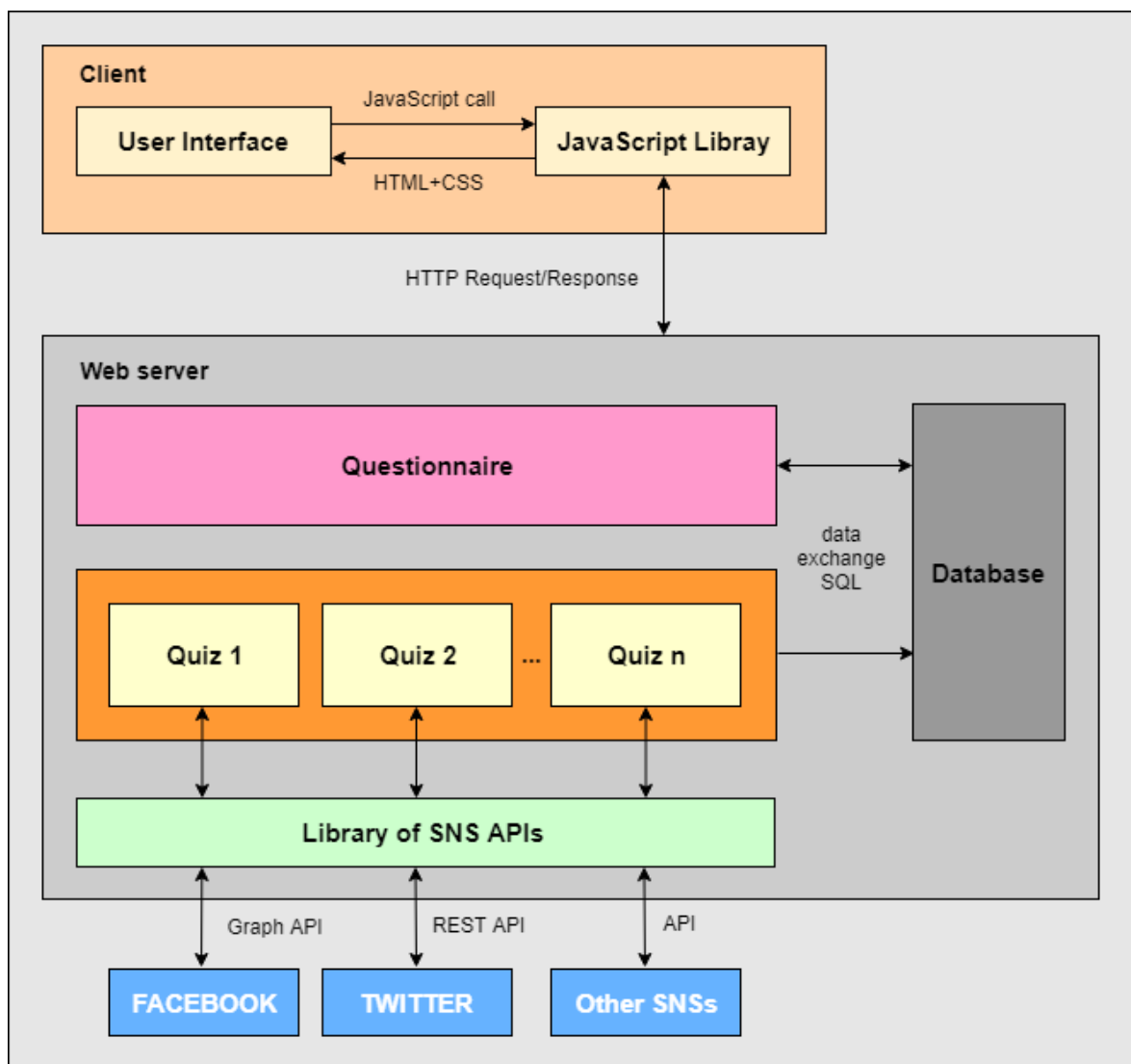
Figure 3.2 Architecture overview of data collection application

3.3 Design Detail and Implementation

Based on the application design, I implemented the data collection application based on a bootstrap framework and a PHP platform [88, 89]. Bootstrap is used as a front-end framework, which combines HTML, CSS, and JavaScript and supports responsive screens from small mobiles to large desktop. PHP is used as a server scripting language.

3.3.1 Questionnaire design

I designed the questionnaire for gathering user experiences with SNSs [87]. There are three main parts as below.

I.   Personal information

This part contains five questions, which ask for personal information that are gender, age, occupation, nationality, GPA and familiarity of using computer and Internet.

II. SNS usage

This part contains ten questions (Table 3.1), which is divided into two parts. Participants are asked about experience in using SNSs in the first part and indicated the frequency of usage in the second part.

III. SNS addiction

In this part, I employed the Internet Addiction Test (IAT) [45] and the Bergen Facebook Addiction Scale (BFAS) [11] to reflect the core components of addictive behaviors. Originally, the purpose of IAT is for Internet addiction and BFAS is for Facebook addiction. We modified IAT and BFAS to use for SNS by retaining the original concept and analyzing result. This part contains 26 questions: 20 questions from modified IAT (Table 3.2) and 6 questions from modified BFAS (Table 3.3).

Table 3.1 Social Network Usage Questions

1	How long have you been using SNSs?
2	Why do you use SNSs?
3	How much time do you spend on SNSs in each day?
4	How long do you spend on SNSs in each time?
5	How often do you use SNSs?
6	What time do you usually use SNSs?
7	Where do you use SNSs?
8	What device do you use for using SNSs?
9	Which SNSs do you currently use?
10	Which activities do you do on SNSs?

Table 3.2 IAT Modification

1	How often do you find that you use SNSs longer than you intended?
2	How often do you neglect household chores to spend more time on SNSs?
3	How often do you prefer the excitement of SNSs to intimacy with your partner?
4	How often do you form new relationships with people on SNSs?
5	How often do others in your life complain to you about the amount of time you spend on SNSs?
6	How often do your studies or work suffer because of the amount of time you spend on SNSs?
7	How often do you check SNSs before something else that you need to do?
8	How often does your job performance or productivity suffer because of SNSs?
9	How often do you become defensive or secretive when anyone asks you what you do on SNSs?
10	How often do you block out disturbing thoughts about your life with soothing thoughts of SNSs?
11	How often do you find yourself anticipating when you will use SNSs again?
12	How often do you fear that life without the SNSs would be boring, empty, and joyless?
13	How often do you snap, yell, or act annoyed if someone bothers you while you are on SNSs?
14	How often do you lose sleep due to SNSs?
15	How often do you feel preoccupied with SNSs, or fantasize about using SNSs?
16	How often do you find yourself saying "just a few more minutes" when using SNSs?
17	How often do you try to cut down the amount of time you spend on SNSs and fail?
18	How often do you try to hide how long you spend on SNSs?
19	How often do you choose to spend more time staying on SNSs over going out with others?
20	How often do you feel depressed, moody, or nervous when you are not on SNSs, which go away once you are back on SNSs?

Table 3.3 BFAS Modification

1	You spend a lot of time thinking about SNSs or plan use of SNSs
2	You feel an urge to use SNSs more and more.
3	You use SNSs in order to forget about personal problems.
4	You have tried to cut down on the use of SNSs without success.
5	You become restless or troubled if you are prohibited from using SNSs.
6	You use SNSs so much that it has had a negative impact on your job/studies.

3.3.2 Preliminary Experiment for Questionnaire Design

3.3.2.1 Method

To evaluate the design of my questionnaire, I conducted a preliminary experiment of its content validity and usability [87].

Seventeen Shibaura Institute of Technology (SIT) students participated in this experiment: eight males and nine females, between 20-30 years of age. Their nationalities were Brazilian, Malaysian, Thai, Vietnamese, Indonesian, and Japanese. They completed the SNS usage questionnaire (see Appendix A), which is in English language. Because of participants are not native English speakers, I allowed them to circle any words that confused them and skip any question that they could not answer for content validity and reliable result. Finally, participants completed an evaluation questionnaire (see Appendix A) that used a 5-point Likert scale that ranged from "strongly disagree" to "strongly agree" as feedback for questionnaire evaluations. Additionally, I observed and recorded the start to finish times for each part of the questionnaire while participants answered it.

3.3.2.2 Result

The average time for answering the questionnaire was 9.42 minutes. Most participants spent more time in the third part (SNS addiction) than on the first and second parts. Moreover, participants only circled confusing words and skipped questions in the third part. The most frequently skipped question was "How often do you prefer the excitement of SNSs to intimacy with your partner?" from IAT (3). The word "intimacy" was most

frequently chosen as being confusing; that word is also in the question that had the highest skipping frequency.
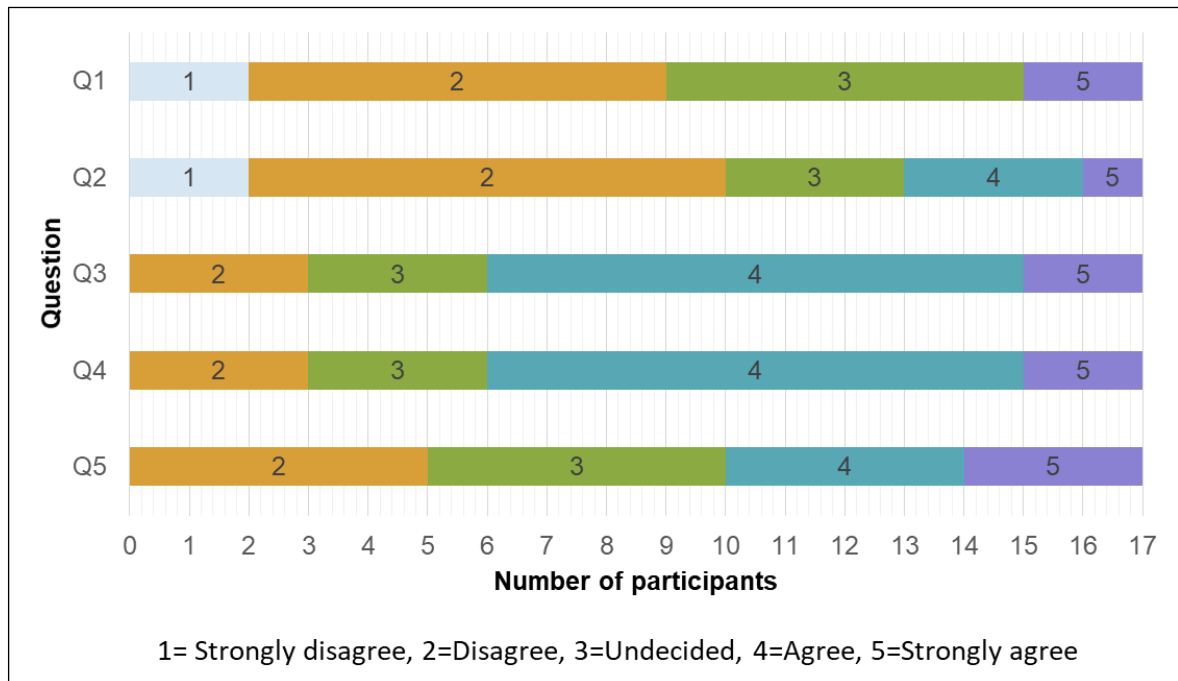
Figure 3.3 Questionnaire evaluation

The feedback for the SNS usage questionnaire from the participants is shown in Figure 3.3. Most participants did not think that the SNS usage questionnaire or the time spent answering was too long. Most agreed that the questions were clear and easy to understand without complicated syntax. Seven of the 17 participants understood each question clearly without any confusion.

3.3.2.3 Discussion
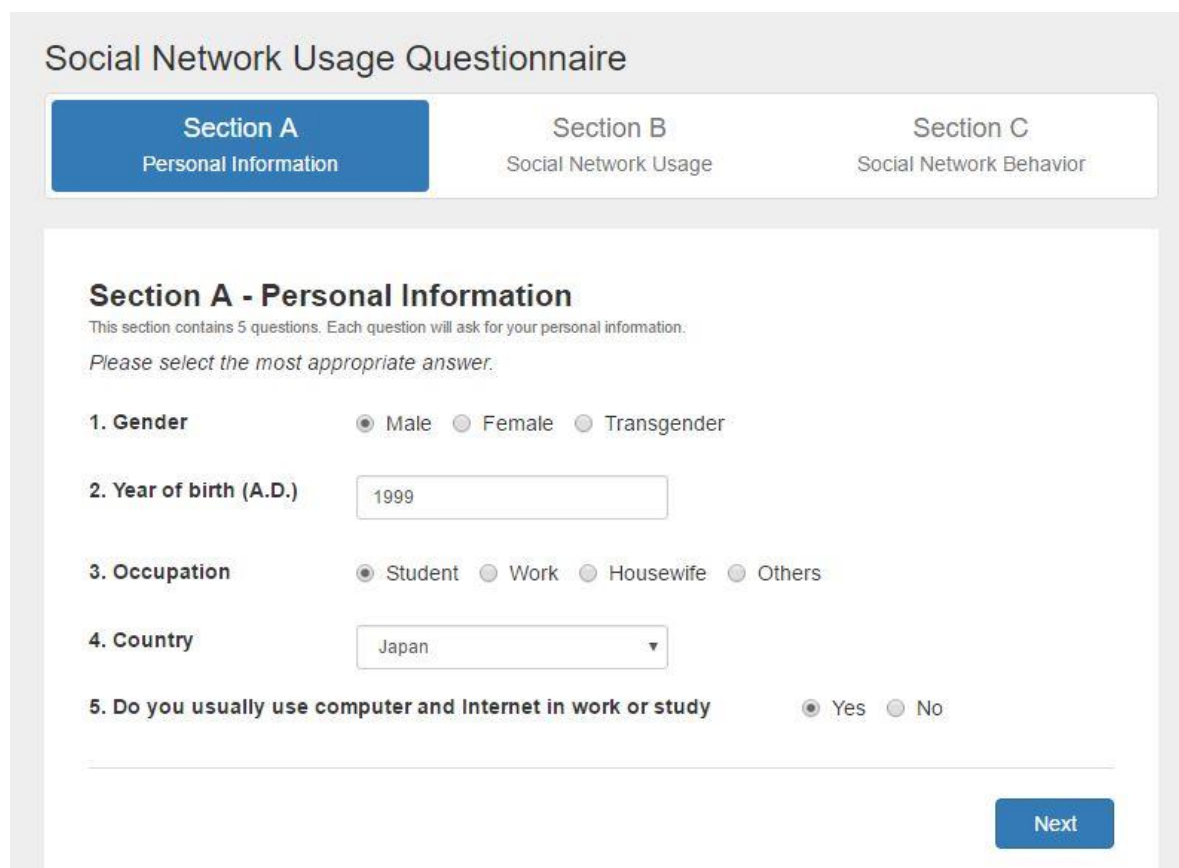
I designed the questionnaire for gathering user experiences with SNSs. I also experimentally validated its content and usability. The results showed that most participants were satisfied with it. The time required for answering it and its length was appropriate. In addition, they clearly understood the questions. However, some confusing words might cause skipping answering in the third part where I employed IAT and BFAS. Probably these words were technical or uncommon. In addition, the participants were not

native English speakers. Because, I should not rewrite or add descriptions to avoid distorting of the original meaning of each question. Thus, I should allow the participants to skip questions to avoid imprecise data.

In conclusion, the results showed that the questionnaire has validity and usability as an instrument for gathering data.

3.3.3 Implementation of questionnaire

Based on the design, I implemented a web-questionnaire as one part of data collection application. The interface of questionnaire is shown in Figure 3.4. The interactions, navigation, and form validation of the questionnaire are handled by JQuery (JavaScript library). The questionnaire data are asynchronously sent to server-side using Ajax in a JSON format (in the background).

Figure 3.4 Screenshot of questionnaire

3.3.4 Implementation of Twitter quiz

I implemented Twitter quiz for retrieving usage data from Twitter. Twitter quiz is a small game that asks question "How often do you Tweet?" and get the answer, which retrieved from Twitter through APIs. The interface of Twitter quiz is shown in Figure 3.5.

(a)   (b)
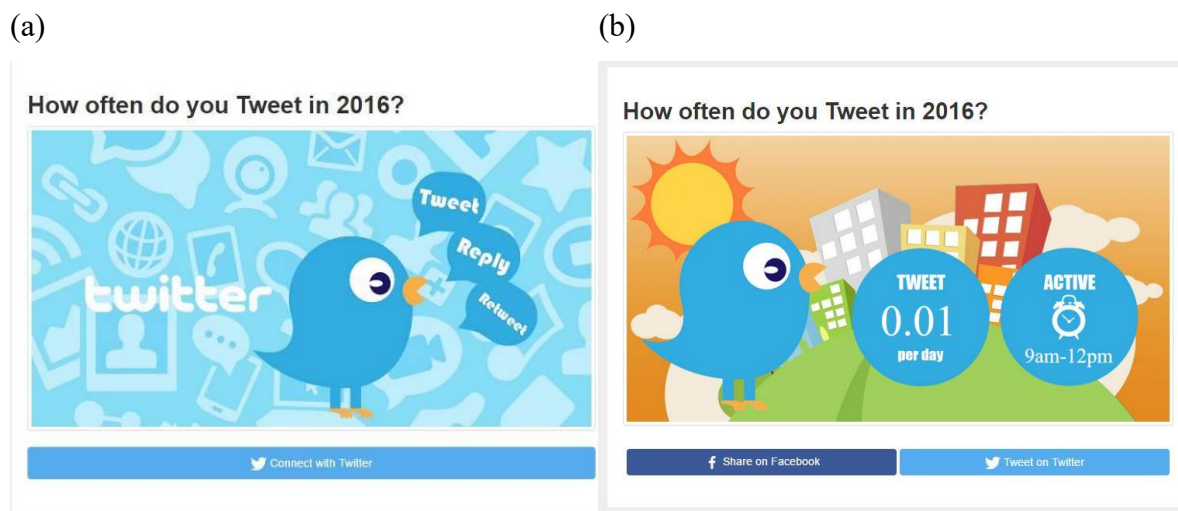
Figure 3.5 Screenshot of Twitter quiz: (a) start page (b) quiz result

Twitter provides two APIs [78] for accessing its data: REST API and Streaming API. The Streaming API is appropriate for long-running requests, which are in real-time. However, since real-time APIs are not necessary for this study, I chose the REST API for retrieving Twitter activities in my implementation.

The REST API identifies Twitter applications and users using OAuth authentication and uses an HTTP-based communication interface. This API provides two operations: read and write for accessing Twitter data and response data in a JSON formation.

The following is the steps for implementing Twitter quiz [90]:

1. Create Twitter account
2. Create Twitter application
3. Authenticate with Twitter
4. Get Twitter data

The procedures for creating Twitter account and application are explained in [78]. In order to authenticate with Twitter, I used PHP wrapper, *TwitterAPIExchange.php* for authentication. Keys and tokens from second step are used in this step. The authentication process is illustrated in Figure 3.6. When user plays Twitter quiz by clicking "Connect with Twitter" button, the data collection application requests token from Twitter. Twitter grant request token and send back to my application. User's interface is redirected to Twitter authentication page. User login (once user is logged in, click "authorize app"). Then, Twitter verify the authentication, grant access token and send back to the data collection application. Finally, the data collection application can access Twitter data. The communication between user, data collection application and Twitter is based on HTTP interface. After successful authentication with Twitter, I collected two types of Twitter data: user profile and activities such as tweet, retweet, reply, and favourite/like (see Appendix B).

Even though I retrieved the data of favorite/like actions, I failed to get their action times because Twitter does not provide them. Instead, I collected the information of favorite/like action tweets.
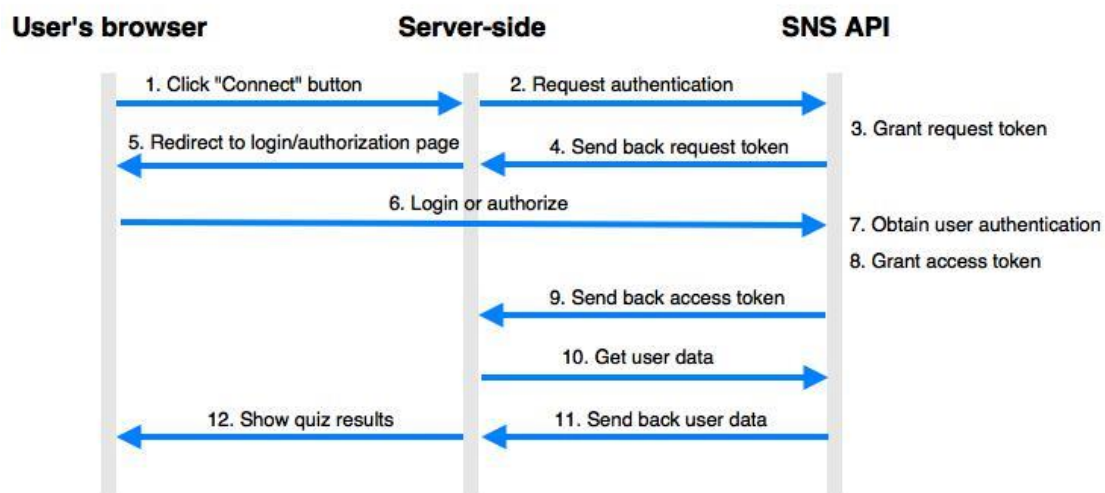
Figure 3.6 process of authentication with Twitter

3.3.5 Implementation of Facebook quiz

I implemented Facebook quiz for retrieving usage data from Facebook. Facebook quiz is a small game that asks question, "Popular Facebook profile in 2013-2016 is …" and get answer, which retrieved from Facebook through APIs. The interface of Facebook quiz is shown in Figure 3.7.

(a)   (b)

Figure 3.7 Screenshot of Facebook quiz: (a) start page (b) quiz result

I used Graph API [79] provided by Facebook for accessing its data. Graph API is the primary way to access data on the Facebook platform based on HTTP. This API has multiple versions. In our implementation, we used Graph API version 2.5, which is the latest version published in 2015.

Most Graph API requests require an access token, which is "an opaque string that identifies a user, app or page" [79], generally obtained in the OAuth authentication process. The steps for implementing Facebook quiz are the same as implementing Twitter quiz as follows:

1. Create Facebook account
2. Create Facebook application
3. Authenticate with Facebook and
4. Get Facebook data.

After successfully authentication with Facebook, I collected two types of Facebook data: user profile and activities such as post, comment, and like (see Appendix B).

3.3.6 Scheduling data collection for Twitter and Facebook

After successfully authentication with Twitter and Facebook, the next step is collecting their data. Due to their data size and the maximum execution time for PHP scripts, the whole data (user profile and activities data) cannot be retrieved at once. Therefore, only user profile data and data for processing quiz results are retrieved after authentication. For activities data, I used task scheduler for collecting them as described below.

Task scheduler is a process that runs in the background. It provides the ability to schedule the launch of programs or scripts at pre-defined times or after specified time intervals. In this study, I used task scheduler to run PHP script automatically for collecting activities data from Twitter and Facebook. The PHP scripts do these following actions:

1. Query new users and reserve the record: this action queries user table to find the records that has not retrieved that data and then reserves those records to prevent the duplication. There are five users as maximum per task.

2. Get activities data: in this action, the access token obtained in authentication process is used for access Twitter/Facebook data. The activities data are retrieved through APIs. For Twitter, the retrieved data are tweet, retweet, reply and favorite/like. For Facebook, the retrieved data are post, comment and like. The data are retrieved until reach the expected date or the limitation of APIs for accessing data.

3. Store obtained data to database: the obtained data from Twitter and Facebook are stored to database. The database design is described in next section.

Figure 3.8 shows the overview of these steps for collecting activities data from Twitter and Facebook. Step 2 and 3 are repeated for each new users queried from step 1. The task scheduler runs this process repeatedly. If there is no new user, step two and three will be skipped and the task will finish.
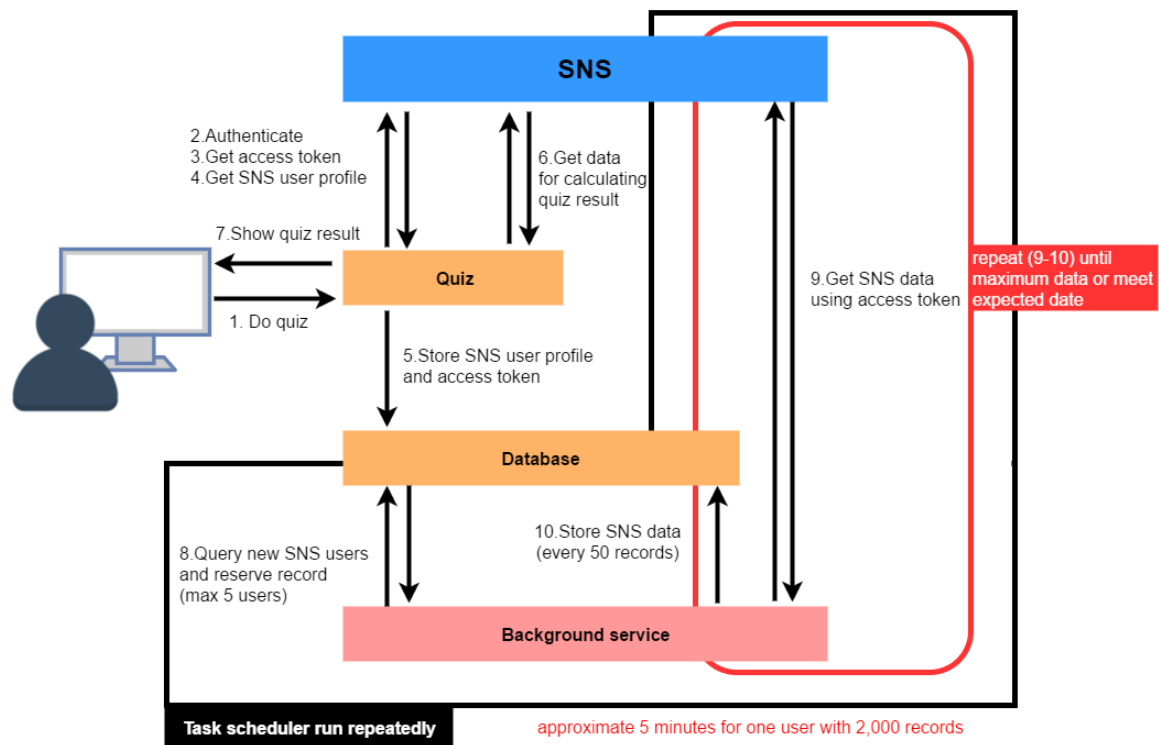
Figure 3.8 Process of collecting activities data from SNSs

3.4 Database Design

I used a relational database to store data from questionnaire, Twitter and Facebook. The database design is presented in Figure 3.9. There are ten tables as follow:

- *User Information Table:* store user's information from questionnaire: gender, age, occupation, nationality, GPA and familiarity of using computer and Internet including unique identifiers for each user.

- *SNS Usage Table:* store questionnaire's answers in second parts about SNS usage

- *SNS Addiction Table*: store questionnaire's answers in third parts about addictive behavior.

- *Facebook Profile Table:* store Facebook's user profile that are Facebook ID, number of friends and access token (temporary).

- *Facebook Post Table:* store Facebook's post information such as post ID, status type, number of like, message and created date.

Facebook profile

PK	FBID
FK1	pid
	number_of_friends
	access_token
	created_date
	updated_date

Facebook comment

PK	comment_id
FK1	FBID
	parent_id
	type
	total_like
	total_reply
	message
	media
	message_tags
	comment_created_date
	created_date

Facebook post

PK	post_id
FK1	FBID
	status
	status_type
	media
	action
	total_like
	message
	story
	place
	no_msg_tags
	no_story_tags
	no_with_tags
	post_created_date
	created_date

Facebook like

PK	parent_id
FK1	FBID
	type
	reactions
	parent_created_date
	created_date

SNS usage

PK	id
FK1	pid
	question
	choice
	rate
	activity
	created_date

User information

PK	pid
	gender
	age
	occupation
	nationality
	GPA
	usecom
	created_date
	updated_date

SNS addiction

PK	id
FK1	pid
	question
	rate
	created_date

Twitter profile

PK	TwitterID
FK1	pid
	no_following
	no_follower
	no_tweet
	no_favorite
	joined_date
	token
	token_secret
	created_date
	updated_date

Tweet

PK	TweetID
FK1	TwitterID
	action
	source
	no_favorite
	no_retweet
	no_user_mention
	no_hashtags
	message
	media
	attached_link
	tweet_created_date
	created_date

Twitter favorite

PK	parent_id, pid
	message
	media
	attached_link
	source
	no_retweet
	no_favorite
	no_user_mention
	no_hashtags
	tweet_created_date
	created_date

Figure 3.9 Database design

- *Facebook Comment Table:* store Facebook's comment information such as comment ID, parent post ID, message, type of comment (comment or reply) and created date.

- *Facebook Like Table:* store Facebook's like information that user did like action such as parent ID and type (post, comment or reply).

- *Twitter Profile Table:* store Twitter user profile that are Twitter ID, number of following, number of follower and number of favorite and access token (temporary)

- *Tweet Table:* store information of tweet/reply/retweet that are tweet ID, action (tweet, reply or retweet), message and created date.

- *Twitter Favorite Table*: store Twitter's favorite information such as parent ID, message and created data.

3.5   Discussion

Collecting data is an important step for analyzing SNS user behavior. A single data collection method is inadequate to capture all of the aspects of SNS user behavior. I implemented the data collection application for aggregating data from questionnaire, Twitter and Facebook. Even though these methods have benefits for collecting data, they also have limitations as follows:

- **Inaccuracy of self-reported information**. Self-report data might inaccurately represent user behavior compared to actual behavior. Questionnaire participants might overlook or downplay their SNS experiences and inaccurately report information. However, self-report data might be useful where data cannot be collected from other sources.

- **Restriction of SNS APIs**. Some data available on SNSs cannot be collected through APIs. SNS APIs are insufficient to capture all SNS activities, especially reading activities.

  The following are the limitations of the Twitter REST API:

  - We cannot get the action times of favorites/likes.
  - Twitter does not allow request operations with data period conditions.
  - Twitter limits the number of request operations to 15 requests per window.
  - Return data are limited to 200 records per request and up to 3,200 records.

  The following are the limitations of the Facebook Graph API:

  - Activity data are available only on the user feeds on the profile page since API versions after 2.0 do not support Facebook Query Language (FQL).
  - We cannot get the action time of likes.
  - The latest APIs do not support the new reactions: love, haha, wow, sad, and angry

Furthermore, SNSs continue to update the versions of their APIs. The development requires the migration of new update, or otherwise some commands will work incorrectly or maybe not at all.

Even the employed methods have limitations, they are all useful to capture users behaviors that cannot be collected by other methods.

3.6 Summary

Collecting data is an important first step for analyzing SNS usage. Many types of data and collection methods exist. In this chapter, I presented the design and development of a data collection application. This application collects data from self-report questionnaires and SNSs via APIs. I designed the questionnaire for gathering SNS user experiences and employed IAT and BFAS for measuring SNS addiction. I also experimentally validated the content and usability of the questionnaire design. The results showed that the questionnaire has validity and usability as an instrument for gathering data. Then, I implemented the data collection application, which consists of web-questionnaire, Twitter quiz and Facebook quiz including the part of retrieving data from Twitter and Facebook by their APIs.

In the next chapter, I experimentally collect data using the data collection application. The obtained data will be analyzed to clarify the relationship between SNS usage and SNS addiction.

Chapter 4

SNS Usage and Its Relationship with SNS Addiction

In the previous chapter, I explained the design and implementation of data collection application as a tool for collecting SNS usage data from questionnaires, Facebook and Twitter. This chapter aims to clarify the relationships between SNS usage and SNS addiction. Information related to SNS usage I used in this chapter was from questionnaire, Facebook, Twitter, and web log. I experimentally collected data from undergraduate students in Thailand using the data collection application. I also employed web log data for analysis. The analysis results of questionnaire, Facebook, Twitter and web log are presented as below.

4.1   Data Preparation

4.1.1   Data obtaining by application

4.1.1.1 Method

I constructed an experiment on December 2016 using a data collection application (Chapter 3) as a tool for collecting questionnaire, Facebook and Twitter data [91]. The data collection application was originally implemented in English. In this experiment, I translated it into Thai. I used Thai version of IAT [60] and BFAS (Thai-BFAS) [42] and modified them for SNSs.

The following are the experimental procedures:

1. Instructor introduces an overview of the research and the data collection application.
2. Instructor distributes the instruction documents to participants and explains the experiment's procedure.
3. Participants access the application via web browser and follow the procedures in the document.
   a. Participants complete Twitter quiz and/or Facebook quiz, based on which the account they use.
   b. Participants answer the questionnaires

Before starting quizzes and/or questionnaire, the application displayed the term of agreement that contains overview of research and explanation of collecting data. Participants read and accepted the terms of agreement before they did the quizzes and answered the questionnaires.

4.1.1.2 Participants

I did the experiment with 177 volunteers who were undergraduate students in the factory of Information Technology, the Thai-Nichi Institute of Technology (TNI). After data cleaning, it remained valid data of 155 participants (87.57%): 101 males and 54 females. Their ages

ranged from 17 to 26 ($\bar{x}$=21.17, SD= 1.64), and their cumulative grade point averages (GPAs) ranged from 1.22-4.00 ($\bar{x}$=2.64, SD= 0.62). 92.9% were familiar with computers and the Internet. An overwhelming majority (83.2%) had been using SNSs for more than five years.

4.1.2 Web log data

4.1.2.1 Method

In cooperation with Information and Communication Center, Thai-Nichi Institute of Technology (TNI), I could get a dataset of web activities over a 38-day period (January 4 to February 10, 2017) [92]. The firewall device records HTTP traffic activities passing though the TNI network. These recorded activities are found in web log files, which are stored on a local hard drive. Web log files can inform about what types of websites are accessing. However, due to the privacy issue, I could not get web log files directly. Instead, Information and Communication Center, TNI provided the report files of web activity. These files contain information of accessed websites including SNSs by multiple users and reflect SNS usage. Therefore, I used them for analysis instead of web log files. After this, I will call the report files of web activities as "web log files."

4.1.2.2 Data description

There are two types of data: web usage and detailed usage of users.

1. **Web usage.** It summarizes the access of websites by all the users such as browsing time, Internet bandwidth usage, and top visited websites.
2. **Detailed usage.** It includes the activities of individual user across multiple websites. The data contain information of the host IP addresses/user IDs, hostnames of accessed websites, and timestamps.

4.1.2.3 Data limitation

The data available from the detailed usage do not provide information of page views. These data only contain the hostnames of the accessed websites, which are insufficient for describing the types of usage behaviors in detail. Moreover, such detailed usage data are from LAN connections, which do not represent all user activities.

4.2 Data Pre-Processing

I used session identification approach for calculating the following variables from Facebook, Twitter and web log data:

- Frequency of use (times/day)
- Time spent (minutes/time)
- Length of use (minutes/day)

Session identification categorizes the different activities performed by each user and segments them into individual access sessions. If the activities are not connected to previous activities or there is more than a 30-minute delay (based on previous empirical findings [93]) between the activities, then it is defined as a different session.

I organized the data retrieved from Facebook, Twitter and web log as the sequences of activities with action times. I segmented the session and calculated the duration between first and last activities within session.

Table 4.1 shows an example of defining the session characteristics. User AAAA has two sessions. The first and second activities are defined as the same session (A) with a 14-minute-time difference, and four activities (from three to seven) are defined as the same session (B) with a 9-minute-time difference.

Table 4.1 Example of defining session characteristics

#	User ID	Action times	Time differences (minutes)	Session IDs
1	AAAA	2017-01-26 10:21:51	N/A	A
2	AAAA	2017-01-26 10:36:38	14	A
3	AAAA	2017-02-01 10:17:04	N/A	B
4	AAAA	2017-02-01 10:18:13	1	B
5	AAAA	2017-02-01 10:19:17	1	B
6	AAAA	2017-02-01 10:23:50	4	B
7	AAAA	2017-02-01 10:27:18	3	B

4.3   Questionnaire Results

4.3.1 Descriptive statistics

4.3.1.1 Usage

A summary of SNS usage is shown in Table 4.2 A majority of participants (40.3%) spent 3-6 hours per day on SNSs and used them less than 1 hour per time (29.68%). 68.9% of participants used SNSs in the evening (18:00-24:00).

In term of frequency of use, all participants visited SNS every day. They were divided into two groups: low and high frequency of use. The low frequency group (47.74%) visited SNS at most twice a day and the high frequency group (52.26%) visited SNS every 2 hours.

4.3.1.2 Purpose and activity

Participants used SNSs to keep in touch with friends (91.61%); to find information (89.03%); to play games (78.06%); to kill time (70.32%); to share their experience (43.87%); to make new friends (30.52%) and to express their identity (16.77%).

The daily activities on SNSs were viewing feed (95.36%), messaging (62.25%), commenting (38.41%), play games (20.53%), posting (19.87%), viewing friend page (15.23%) and updating profile (1.99%).

Table 4.2 SNS usage behaviors of participants

Variable		N	(%)
Time spent (per day)	Less than 3 hours	28	18.06
	3-6 hours	63	40.65
	6-10 hours	42	27.10
	More than 10 hours	22	14.19
Length of use (per time)	Less than 1 hour	46	29.68
	1-2 hours	38	24.52
	2-3 hours	19	12.26
	3-4 hours	20	12.90
	4-6 hours	14	9.03
	More than 6 hours	18	11.61
Period of use	06:00-09:00	43	27.74
	09:00-12:00	68	43.87
	12:00-13:00	70	45.16
	13:00-18:00	56	36.13
	18:00-24:00	106	68.39
	After midnight	21	20.00
Frequency of use	Low	74	47.74
	High	81	52.26

Table 4.3 Location and device of accessing SNSs

Variable		N	(%)	$\bar{x}$	SD
Location	Home	151	97.42	2.72	0.57
	University/School	131	84.52	1.88	0.77
	Walking	67	43.22	1.57	0.70
	Vehicles	72	46.45	1.67	0.71
Device	Computer	140	90.32	2.44	0.72
	Smartphone	141	90.97	2.62	0.58

4.3.1.3 Location and device

In the scale of rating for location and device of accessing SNSs, 1 is sometimes and 4 is always. A summary of location and device for accessing SNSs is shown in Table 4.3

A majority of participants (97.42%) used SNSs at home ($\bar{x}$=2.72) and 84.52% of them use them at university/school ($\bar{x}$=2.79). More than 90% of participants frequently accessed SNS via computer ($\bar{x}$=2.44) and smartphone ($\bar{x}$=2.62).

4.3.1.4 Account and usage

Figure 4.1 presents a summary of SNS account and usage of participants. They had at least 5.26 accounts. Most of them were Facebook user ($\bar{x}$=3.58).
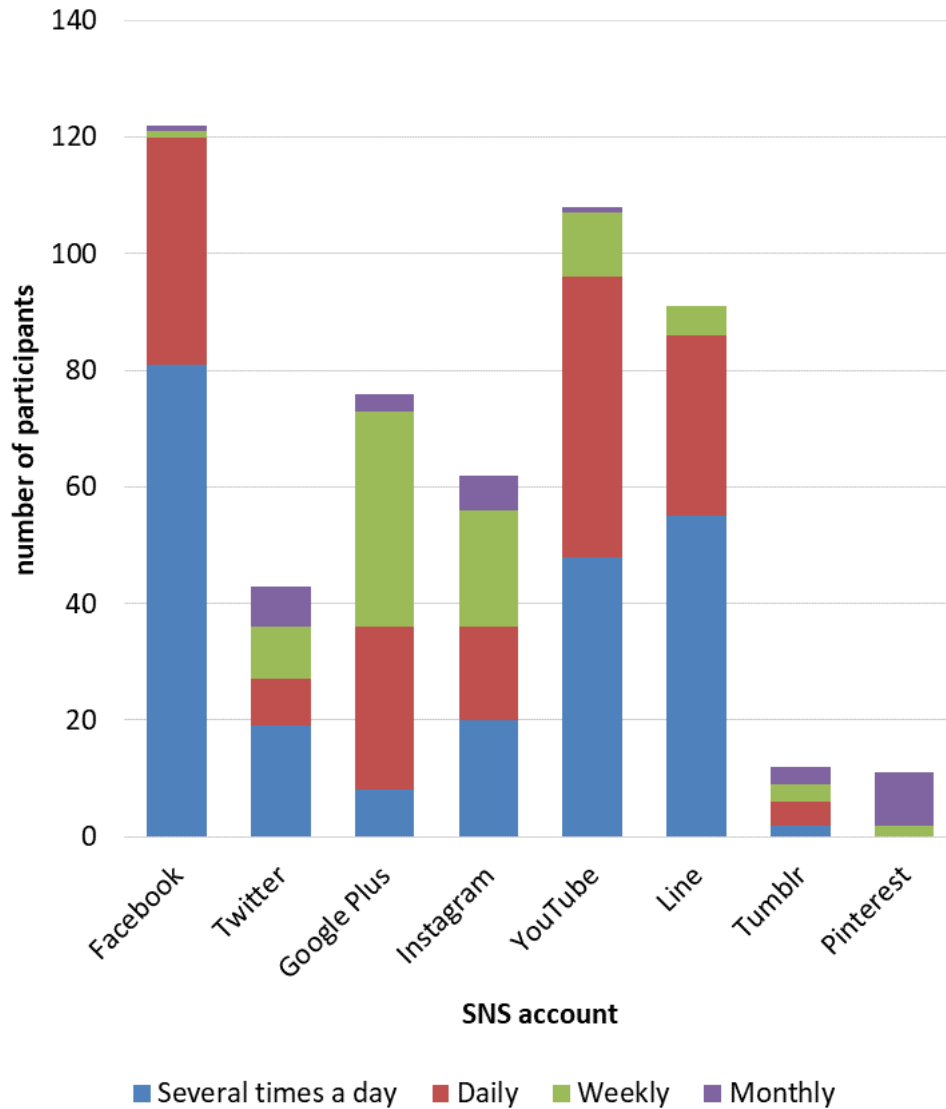
Figure 4.1 SNS account and usage

Table 4.4 Correlation matrix among questionnaire variable

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1 Gender	1																													
Purpose of use																														
2 Find information	0.083	1																												
3 Play games	0.038	0.163*	1																											
4 Make new friends	0.132	0.188*	0.013	1																										
5 Keep in touch	0.026	0.043	0.065	0.049	1																									
6 Express identity	0.038	0.008	0.054	0.304**	0.074	1																								
7 Share experience	0.046	0.019	0.097	0.234**	0.127	0.264**	1																							
8 Kill time	0.029	0.224**	0.202*	0.063	0.109	0.027	0.147	1																						
SNS usage behavior																														
9 Time spent	0.147	0.084	0.131	0.121	0.169	0.047	0.119	0.202	1																					
10 Frequency of use	0.033	0.119	0.055	0.121	0.177	0.083	0.298**	0.227**	0.255*	1																				
11 Length of use	0.204	0.185	0.203	0.174	0.146	0.128	0.162	0.18	0.396**	0.174	1																			
Period of use																														
12 Period_1 (06:00-09:00)	0.151	0.055	0.186*	0.153	0.032	0.223**	0.149	0.15	0.143	0.131	0.263	1																		
13 Period_2 (09:00-12:00)	0.101	0.019	0.042	0.243**	0.08	0.125	0.135	0.147	0.303**	0.142	0.227	0.178*	1																	
14 Period_3 (12:00-13:00)	0.065	0.055	0.009	0.14	0.041	0.113	0.06	0.079	0.307**	0.193*	0.213	0.220**	0.269**	1																
15 Period_4 (13:00-18:00)	0.014	0.006	0.009	0.144	0.034	0.273**	0.039	0.011	0.196	0.154	0.128	0.194*	0.147	0.289**	1															
16 Period_5 (18:00-24:00)	0.056	0.117	0.025	0.132	0.045	0.029	0.042	0.047	0.250*	0.039	0.165	0.013	0.294**	0.219**	0.078	1														
17 Period_6 After midnight	0.041	0.072	0.109	0.066	0.093	0.207*	0.02	0.148	0.288**	0.123	0.341**	0.022	0.046	0.259**	0.262**	0.201*	1													
Location																														
18 Home	0.122	0.22	0.13	0.13	0.139	0.068	0.249**	0.163	0.162	0.275**	0.151	0.105	0.155	0.115	0.148	0.154	0.082	1												
19 School/University	0.162	0.114	0.167	0.056	0.204	0.091	0.049	0.125	0.220**	0.224	0.25*	0.21	0.148	0.260*	0.212	0.065	0.243**	0.16	1											
20 Walking	0.134	0.151	0.125	0.16	0.098	0.195	0.301**	0.303**	0.262**	0.419**	0.209	0.19	0.277**	0.216	0.228*	0.06	0.225*	0.17	0.246*	1										
21 On vehicles	0.141	0.094	0.172	0.142	0.207	0.149	0.235*	0.241*	0.261**	0.364**	0.159	0.343**	0.181	0.189	0.187	0.073	0.186	0.13	0.183	0.373**	1									
Device																														
22 Computer	0.432	0.325**	0.195	0.202	0.118	0.081	0.146	0.17	0.158	0.013	0.224	0.106	0.161	0.159	0.083	0.217	0.11	0.297**	0.17	0.097	0.139	1								
23 Smartphone	0.265	0.087	0.137	0.181	0.293**	0.206	0.151	0.139	0.194*	0.22	0.23	0.215	0.069	0.121	0.21	0.146	0.122	0.182	0.291**	0.202*	0.245**	0.207*	1							
Activity																														
24 View feed	0.114	0.11	0.11	0.145	0.189	0.187	0.223*	0.115	0.214*	0.364**	0.193	0.171	0.121	0.151	0.157	0.115	0.017	0.254**	0.123	0.234**	0.243**	0.137	0.252**	1						
25 View friend page	0.06	0.031	0.134	0.084	0.084	0.324**	0.151	0.192	0.149	0.151	0.195	0.178	0.135	0.109	0.158	0.084	0.095	0.162	0.179	0.251**	0.182	0.131	0.129	0.165	1					
26 Post	0.065	0.13	0.111	0.175	0.031	0.324**	0.268**	0.146	0.159	0.143	0.143	0.209	0.176	0.191	0.141	0.129	0.098	0.128	0.251**	0.260*	0.167	0.167	0.195	0.16	0.337**	1				
27 Comment	0.098	0.104	0.093	0.163	0.14	0.367**	0.311**	0.222*	0.213*	0.242**	0.253*	0.129	0.15	0.235*	0.262**	0.129	0.280**	0.159	0.211*	0.329**	0.15	0.15	0.212*	0.188*	0.344**	0.451**	1			
28 Update profile	0.103	0.049	0.074	0.132	0.043	0.108	0.159	0.091	0.193	0.134	0.232	0.075	0.092	0.112	0.112	0.141	0.094	0.056	0.315**	0.272**	0.079	0.096	0.079	0.078	0.359**	0.293**	0.258**	1		
29 Message	0.051	0.082	0.076	0.17	0.155	0.119	0.13	0.07	0.211*	0.119	0.167	0.254**	0.062	0.117	0.098	0.081	0.145	0.263**	0.245**	0.286**	0.173	0.082	0.264**	0.249**	0.141	0.197*	0.334**	0.138	1	
30 Play games	0.097	0.072	0.187	0.175	0.039	0.116	0.127	0.059	0.219*	0.1	0.350**	0.136	0.088	0.136	0.107	0.118	0.076	0.202*	0.151	0.132	0.116	0.176	0.157	0.069	0.151	0.179*	0.154	0.162	0.103	1

*significant at p<0.05 ** significant at p<0.01*

4.3.2 Relationships among questionnaire variables

From the questionnaire data, I can get the variables related to SNS addiction as shown in Table 4.4. I used Cramver's V to clarify the relationships among questionnaire variables. The results indicated that some questionnaire variables are dependent. The V values between the variables are shown in Table 4.4.

4.3.3 SNS addiction

I used the modified IAT and BFAS tests to determine the SNS addiction of the participants. Their internal consistency and reliability were verified with a Cronbach's alpha of 0.93 and 0.80, respectively [94].

According to the cut-off score of IAT, participants were classified into four level as shown in Table 4.5. 47.10% of them were normal user (None in Table 4.5). Others were mild level of addiction (32.26%) and moderate level of addiction (20.65%). No participants were categorized as severe level of addiction [91].

According to the cut-off score of BFAS, participants were classified to normal user and excessive user. Table 4.5 shows that 54.84% of participants were excessive user.

Table 4.5 IAT and BFAS level

		BFAS		**Total**
		Normal	*Excessive*	
IAT	*None*	54 (34.84%)	19 (12.26%)	73 (47.10%)
	Mild	15 (9.67%)	35 (22.58%)	50 (32.25%)
	Moderate	1 (0.65%)	31 (20.00%)	32 (20.65)
	Severe	0 (0%)	0 (0%)	0 (0%)
Total		70 (45.16%)	85 (54.84%)	155 (100.0%)

4.3.4 Correlation between IAT and BFAS

I used Pearson's correlation analysis to clarify the relationship between IAT and BFAS. As shown in Table 4.6, there were significant positive correlations between IAT and BFAS. The IAT scores had a strong positive correlation with the BFAS scores (r=0.773, p<0.01). The IAT levels also had a positive correlation with the BFAS levels (r=0.574, p<0.01). Moreover, there were significant positive correlations between the IAT scores and each BFAS question. BFAS_5 had the strongest correlation with the IAT score (r=0.635, p<0.01), while BFAS_1 had the weakest correlation with the IAT score (r=0.421, p<0.01) [91].

Table 4.6 Correlation matrix between IAT and BFAS

Variables	IAT score	IAT level	BFAS score	BFAS level	BFAS_1	BFAS_2	BFAS_3	BFAS_4	BFAS_5	BFAS_6
IAT score	1									
IAT level	.893**	1								
BFAS score	.773**	.703**	1							
BFAS level	.619**	.574**	.744**	1						
BFAS_1	.421**	.425**	.646**	.413**	1					
BFAS_2	.550**	.500**	.758**	.427**	.560**	1				
BFAS_3	.525**	.470**	.741**	.527**	.349**	.494**	1			
BFAS_4	.564**	.508**	.736**	.628**	.354**	.418**	.431**	1		
BFAS_5	.635**	.552**	.777**	.634**	.313**	.515**	.504**	.507**	1	
BFAS_6	.613**	.553**	.600**	.541**	.193**	.249**	.308**	.390**	.482**	1

** Correlation is significant at 0.01 level (2-tailed).

4.3.5 Difference between excessive and normal users

4.3.5.1 Excessive and normal users

Based on the definition of the original IAT level, I named participants as *excessive users* if their scores appeared in all three levels of Internet addiction (mild, moderate, and severe) and the others as *normal users*. The original BFAS also classified users in this way.

4.3.5.2 Gender

I used a Chi-square test to examine the differences between genders. The analytic results indicated no significant differences between genders for both IAT ($\chi2= 0.032$; $p>0.05$) and BFAS ($\chi2= 3.309$; $p>0.05$).

4.3.5.3 Academic performance

I used cumulative GPA to compare the academic performances of excessive and normal users. The test for the equality of variances indicated that excessive and normal users had no significant differences. T-test results also indicated that GPA was significantly different between excessive and normal users for both IAT ($t=2.260$; $p<0.05$) and BFAS ($t=2.160$; $p<0.05$).

4.3.5.4 SNS usage

I constructed discriminant analysis and decision trees for both IAT and BFAS to find effective SNS usage variables from questionnaires for differentiating excessive from normal users.

Discriminant analysis was implemented for both the IAT and BFAS results to determine importance of the effective variants used to discriminate excessive from normal users. The analyze results are shown in Table 4.7.

For IAT, the following variables differentiated excessive from normal users:

- Frequency of use
- Time spent
- Length
- Period of use: 09:00-12:00 and 18:00-24:00;
- Purpose: making new friends;
- Location: school/university and on vehicles
- Activity: posting, commenting, and messaging

For BFAS, the following variables differentiated excessive from normal users:

- Period of use: 18:00-24:00

- Location: school/university

- Activity: messaging

Table 4.7 Discriminant analysis for IAT and BFAS

Variables	Structure Coefficient	
	IAT	BFAS
Gender	0.012	-0.202
Frequency of use	*0.314	-0.151
SNS usage behavior		
Time spent	*0.374	-0.199
Length of use	*0.288	0.025
Period of use		
Period_1 (06:00-09:00)	0.055	-0.014
Period_2 (09:00-12:00)	*0.290	-0.047
Period_3 (12:00-13:00)	0.194	-0.180
Period_4 (13:00-18:00)	0.196	-0.147
Period_5 (18:00-24:00)	*-0.318	*0.486
Period_6 After midnight	0.115	0.032
Purpose of use		
Find information	0.004	0.045
Play games	0.114	0.068
Make new friends	*0.296	-0.003
Keep in touch	0.075	0.150
Express identity	0.190	0.021
Share experience	0.036	0.210
Kill time	0.222	-0.119
Location		
Home	-0.103	0.103
School/University	*0.292	*-0.327
Walking	0.228	-0.179
On vehicles	*0.311	-0.137
Device		
Computer	0.023	0.221
Smartphone	0.170	-0.193
Activity		
View feed	0.208	-0.003
View friend page	0.157	0.031
Post	*0.337	-0.057
Comment	*0.437	-0.224
Update profile	0.221	-0.023
Message	*0.326	*-0.308
Play games	0.131	-0.066
Group Centroids		
SNS Addicts	0.540	-0.513
Non-addicts	-0.615	0.632
Case Correctly Classified	70.1%	74.7%

*p<0.05

The decision trees were constructed for IAT and BFAS. The tree structures showed that the following variables influenced the differentiation of excessive from normal users:

- For IAT (Figure 4.2), excessive users commented several times a day and messaged daily.

- For BFAS (Figure 4.3), excessive users did not use SNSs between 18:00-24:00 or 09:00-12:00.

Based on the decision tree results for BFAS, we compared each period of use for BFAS and found that during the 18:00-24:00 period, excessive users used SNSs less than normal users (Figure 4.4). We also compared each period of use for the participants who did not use SNSs during the 18:00-24:00 period and found that during the 09:00-12:00 period, excessive users used SNSs less than normal users (Figure 4.5).
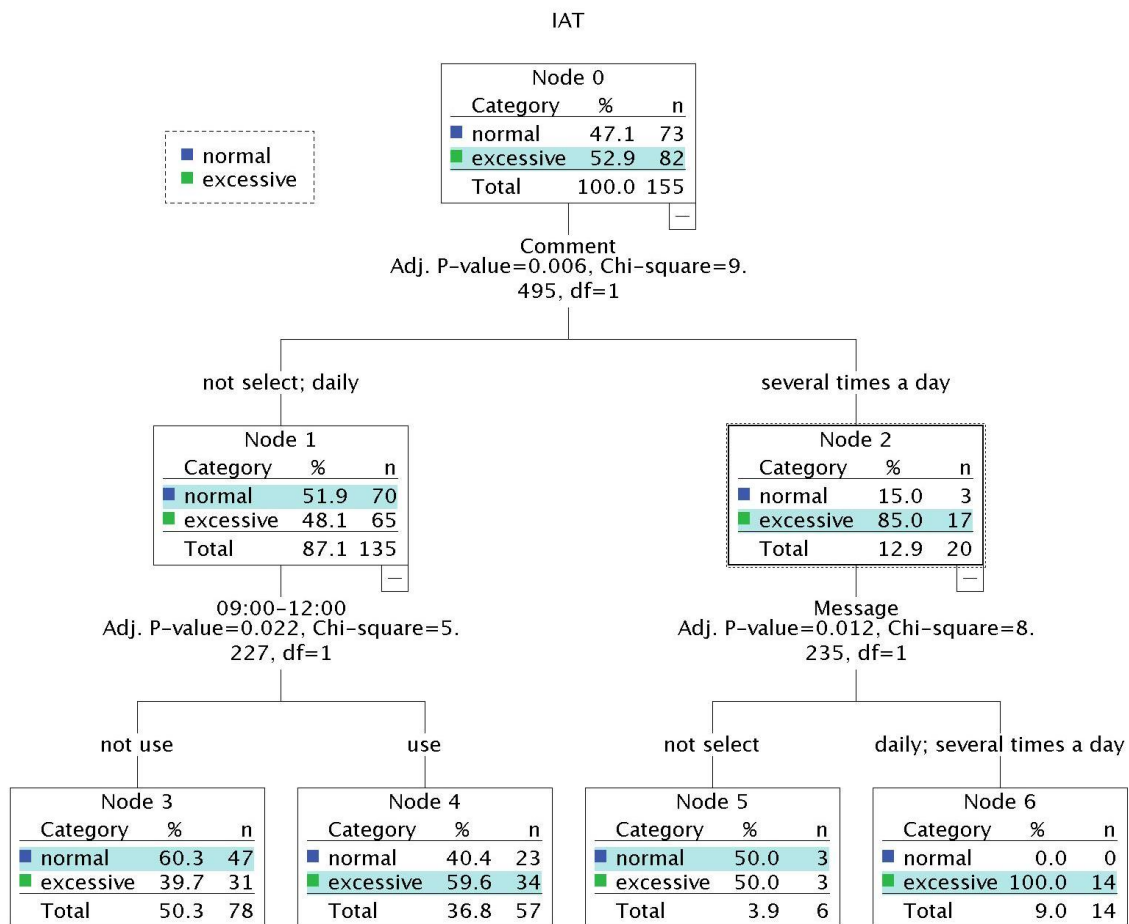
Figure 4.2 Decision tree for IAT
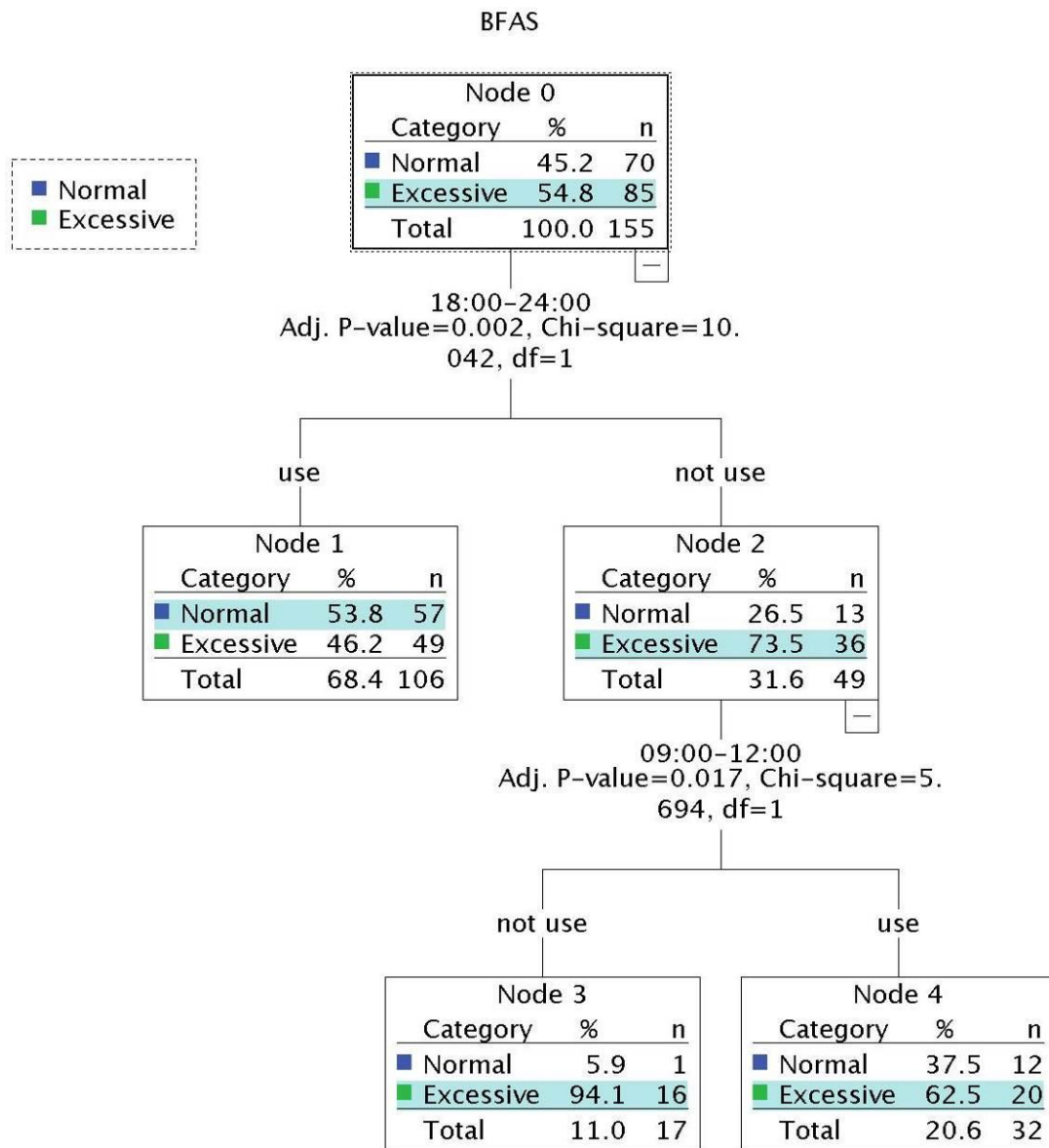
Figure 4.3 Decision tree for BFAS
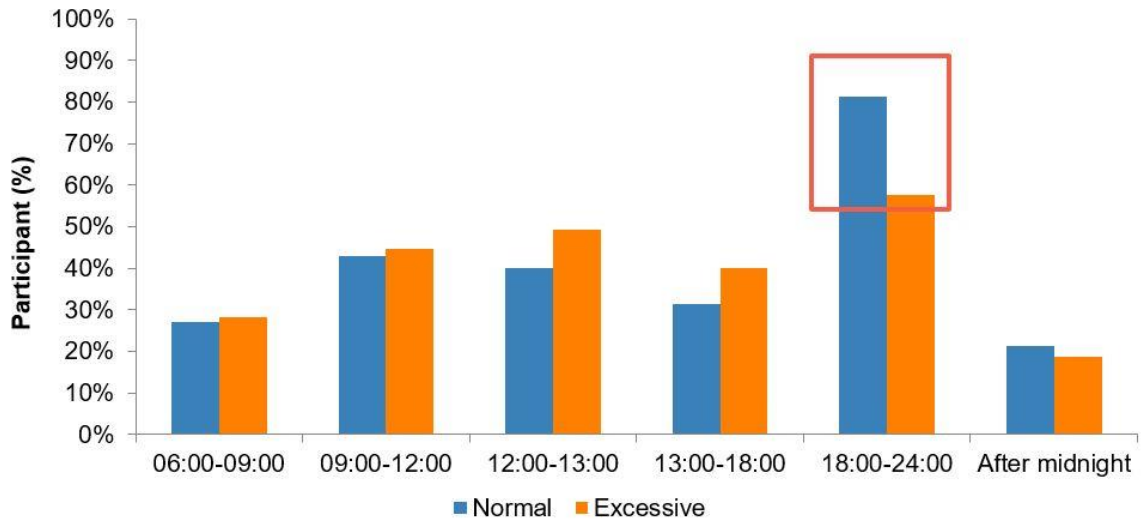
Figure 4.4 Period of use of normal and excessive users
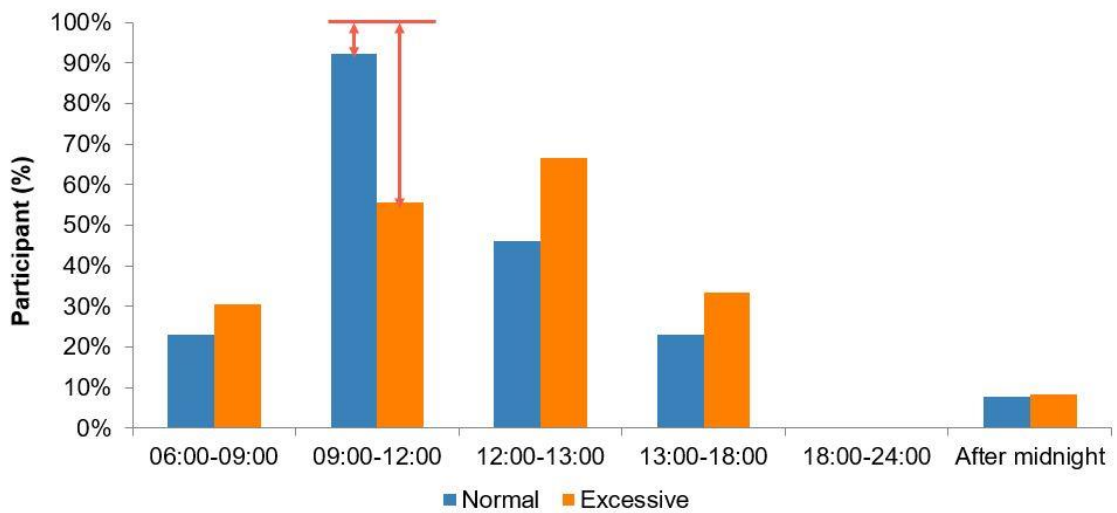
Figure 4.5 Period of user of normal and excessive users
who did not use SNSs from 18:00-24:00

4.4   Facebook Results

4.4.1 Facebook usage

99 participants granted the data-access to their Facebook accounts: 65 males and 34 females. The data were retrieved by Graph APIs in a three-month period.

Facebook usage is summarized in Table 4.8. The average usage frequency was 1.41 times per day, and the average amount of time spent on Facebook was 15.38 minutes per session and 22.88 minutes per day. The most common activities on the user feeds were replying ($\bar{x}$=101.08), followed by posting ($\bar{x}$=84.55). The ratio of posting types was 22% for status updates, 47% for photos, 13% for videos, and 18% for links.

Table 4.8 Facebook usage in three-month period

Variables	Median	Mean	SD
Friends	636.00	836.60	828.09
Time spent (mins/time)	15.46	15.38	6.62
Frequency of use (times/day)	1.33	1.41	0.38
Length of use (mins/day)	21.82	22.88	13.15
User feed usage (time)			
Posts	49.00	84.55	91.13
Comments	12.00	20.29	21.51
Replies	36.00	101.08	154.03
Tagged posts	5.00	7.46	7.61
Type of post (time)			
Status updates	7.00	18.98	29.07
Photos	19.00	39.66	48.93
Videos	4.00	10.58	13.74
Links	8.00	15.29	20.38
Ratio of usage period			
06:00-09:00	0.6	0.08	0.08
09:00-12:00	0.18	0.19	0.14
12:00-13:00	0.06	0.07	0.06
13:00-18:00	0.40	0.43	0.24
18:00-24:00	0.70	0.80	0.50
After midnight	0.10	0.14	0.15

Figure 4.6 shows the usage activities: posting, commenting, and replying. Facebook users did them several times during the 13:00-18:00 (6.06%) and 18:00-24:00 (21.21%) time periods. They also did these activities daily, except for the 12:00-13:00 period. Chi-square analysis results indicated significant differences among each usage period ($p < 0.05$).
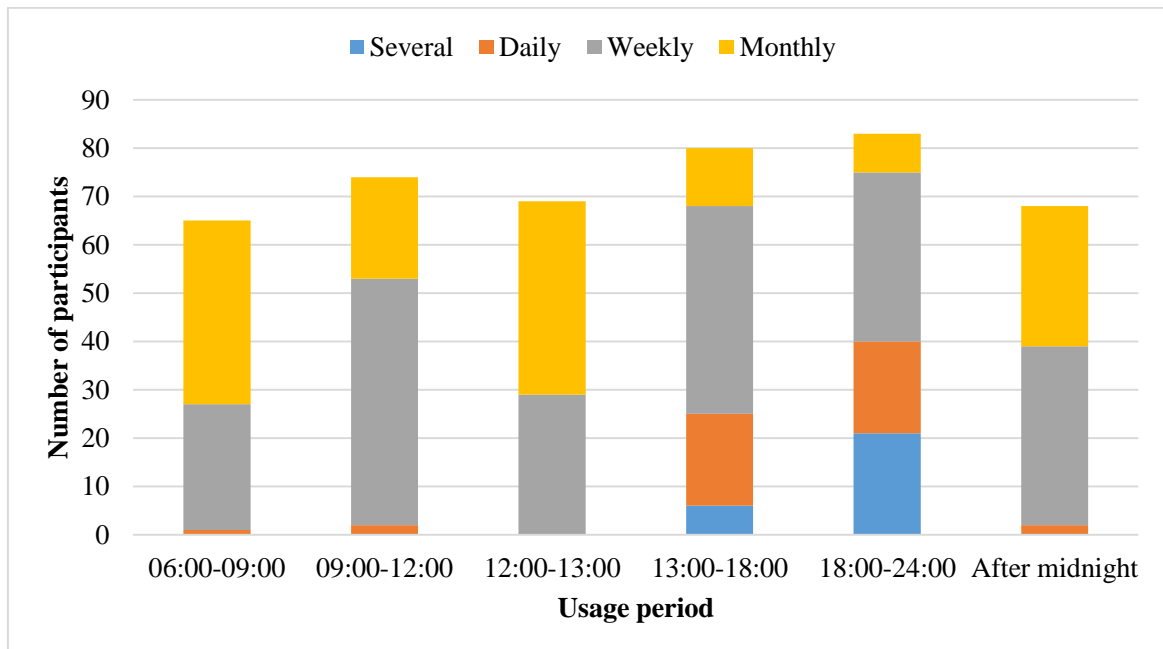
Figure 4.6 Frequency of usage: posting and commenting

4.4.2 Relationships among Facebook variables

From the Facebook data, I can get the variables related to SNS addiction as shown in Table 4.9. I used Spearman's correlation analysis to examine the relationships among Facebook variables. The results indicated that some Facebook variables are dependent. The correlation coefficient (r_s) values between the variables are shown in Table 4.9.

Table 4.9 Correlation matrix among Facebook variables

Facebook variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1 Friends	1																					
2 Time spent	.236*	1																				
3 Frequency of use	.133	.530**	1																			
4 Length of use	.233*	.926**	.783**	1																		
5 Posts	.191	.488**	.768**	.681**	1																	
6 Comments	.315**	.524**	.722**	.679**	.722**	1																
7 Replies	.411**	.626**	.795**	.775**	.766**	.867**	1															
8 Tagged posts	.221*	.073	.097	.065	.127	0.309**	0.351**	1														
Ratio of usage period																						
9 06:00–09:00	.076	.246*	.374**	.323*	.428**	.429**	.487**	.307**	1													
10 09:00–12:00	.212*	.375**	.422**	.439**	.392**	.428**	.520**	.161	.468**	1												
11 12:00–13:00	.284**	.280**	.490**	.418**	.476**	.590**	.589**	.198*	.199*	.345**	1											
12 13:00–18:00	.264**	.481**	.385**	.497**	.248*	.410**	.543**	.134	.180	.273**	.231*	1										
13 18:00–24:00	.337**	.332**	.359**	.365**	.160	.406**	.581**	.369**	.220*	.219*	.218*	.176	1									
14 After midnight	.072	.062	.081	.075	.150	.155	.215*	.033	-.203*	-.162	.157	-.018	.101	1								
Type of post																						
15 Status updates	.303**	.599**	.747**	.748**	.836**	.765**	.861**	.220*	.442**	.446**	.472**	.387**	.362**	.176	1							
16 Photos	.199*	.444**	.749**	.647**	.950**	.734**	.761**	.109	.411**	.351**	.492**	.266**	.192	.128	.795**	1						
17 Videos	.162	.313**	.580**	.468**	.799**	.559**	.583**	.211*	.279**	.323**	.413**	.142	.097	.171	.616**	.777**	1					
18 Links	.213*	.337**	.476**	.437**	.820**	.500**	.514**	.084	.259**	.286**	.361**	.063	.002	.124	.553**	.704**	.670**	1				
Ratio of posts																						
19 Status updates	.291**	.535**	.417**	.567**	.412**	.526**	.646**	.247*	.361**	.340**	.301**	.333**	.490**	.093	.830**	.356**	.187	.092	1			
20 Photos	.005	-.042	.146	.059	.135	.168	.112	-.102	.057	-.065	.134	.068	-.027	-.120	.007	.390**	.030	-.142	-.161	1		
21 Videos	.080	-.189	.031	-.138	.142	.075	.074	.226*	.004	.147	.038	-.070	.067	.139	.010	.141	.661**	.102	-.133	-.179	1	
22 Links	-.016	-.099	-.319**	-.208	-.064	-.195	-.282**	-.086	-.178	-.044	-.042	-.272**	-.243**	-.074	-.299**	-.200	-.062	.474**	-.308**	-.455**	-.064	1

*significant at $p<0.05$ **significant at $p<0.01$

4.4.3 Facebook usage and SNS addiction

I analyzed the data obtained from Facebook (including the combination with data from questionnaire) to find factors associated with SNS addiction [95]. Since the normality test on Facebook variables resulted in negative outcomes, a non-parametric test was used. The IAT and BFAS results from the questionnaires were used for measuring SNS addiction based on the reasonable results from a previous study.

To examine the relationship of SNS addiction with Facebook variables, the Mann-Whitney U Test was employed. As shown in Table 4.10, the ratio of usage during the 18:00-24:00 period was significantly different for both the IAT level (z=-2.376, $p<0.05$) and the BFAS level (z=-1.966, $p<0.05$). Moreover, the ratios of posting status updates (z=-2.305, $p<0.05$) and videos (z=-1.974, $p<0.05$) were significantly different for the IAT level.

Table 4.10 Mann-Whitney U Test for variables from Facebook

Variables	Z-Value	
	IAT	**BFAS**
Ratio of posts		
Status updates	*-2.305	
Videos	*-1.974	
Ratio of usage period		
18:00-24:00	*-2.376	*-1.966
*p<0.05		

To identify how excessive and normal users differ, we applied logistic regression analysis to both the IAT and BFAS results to determine the importance of the effective variants used to distinguish excessive from normal users. The results are shown in Table 4.11.

For both IAT and BFAS, the following variables distinguish excessive from normal users:

- number of comments and replies in a three-month period
- number of daily activities (posting, commenting, replying)
- the ratio of usage during 18:00-24:00 period

The ratio of posting video was another effective variant for IAT.

Table 4.11 Logistic Regression Analysis for variables from Facebook

Variables	IAT (β)	BFAS (β)
User feed usage		
Comments and replies	*-0.018	*-0.016
Posts, comments, and replies (times/day)	*0.274	*0.195
Ratio of posts		
Videos	*-5.777	-2.791
Ratio of usage period		
18:00-24:00	*2.561	*2.902
Constant	-1.317	-1.110
Correct percentage	68.5%	66.3%

p<0.05

4.5   Twitter Results

4.5.1 Twitter usage

36 participants granted the data-access to their Twitter accounts: 19 males and 17 females. The data were retrieved by REST APIs over a three-month period.

A summary of the Twitter usage is shown in Table 4.12. The average usage frequency was 2.02 times per day, and the average time spent on Twitter was 14.71 minutes per session and 40.13 minutes per day. The average number of years using Twitter was 3.47 years. Twitter activities were tweets ($\bar{x}=258.81$), retweets ($\bar{x}=166.78$), and replies ($\bar{x}=62.28$).a

According to Figure 4.7, Twitter users engaged in daily activities on it during all periods. After midnight was the top period in which 33.33% of Twitter users engaged in daily activities. Chi-square analysis results indicated that the periods between 13:00-18:00 and after midnight were significantly different from other periods ($p<0.05$).

Table 4.12 Twitter usage in three-month period

Variables	Median	Mean	SD
Time spent (mins/time)	12.17	14.71	10.34
Frequency of use (times/day)	1.34	2.02	1.61
Length of use (mins/day)	16.92	40.13	57.27
Profile			
Year Twitter use began	4.00	3.47	2.02
Followers	55.00	129.14	227.16
Friends	164.50	206.22	194.50
Statistics of use	1,309.00	10,921.56	20,175.06
Statistics of favorites	164.50	490.25	671.15
Usage (time)			
Tweets	34.00	258.81	581.35
Retweets	35.50	166.78	239.37
Replies	4.00	62.28	169.48
Ratio of usage period			
06:00-09:00	0.14	0.17	0.18
09:00-12:00	0.05	0.09	0.13
12:00-13:00	0.00	0.03	0.04
13:00-18:00	0.18	0.21	0.17
18:00-24:00	0.20	0.22	0.15
After midnight	0.26	0.28	0.19
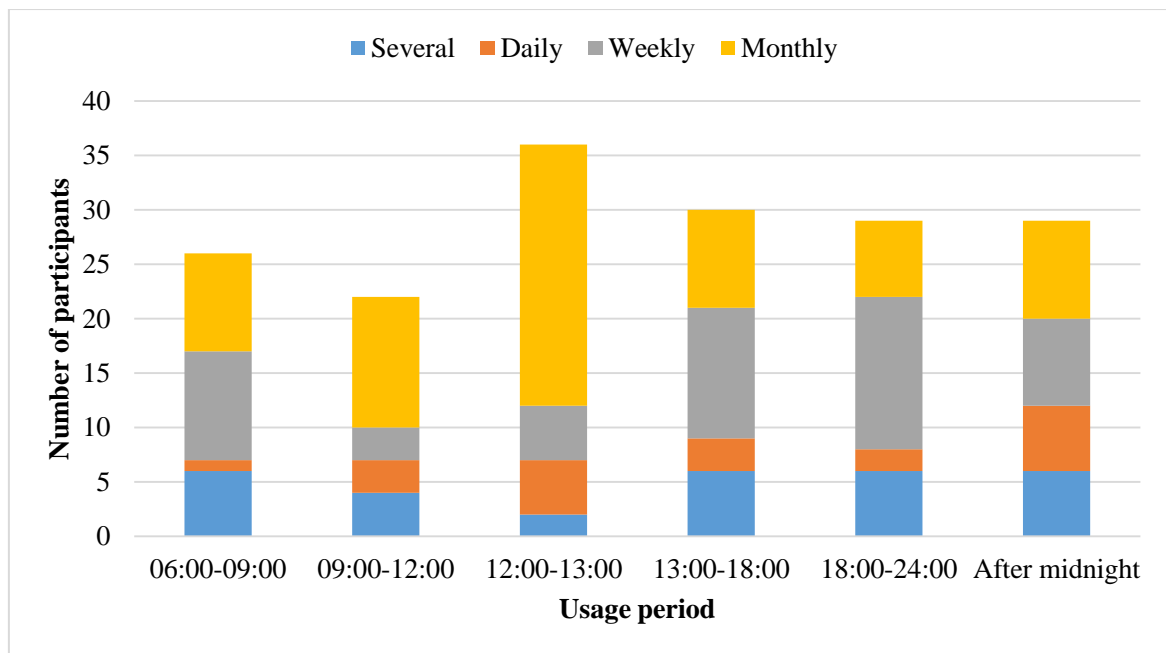
Figure 4.7 Frequency of Twitter usage

4.5.2 Relationships among Twitter variables

From the Twitter data, I can get the variables related to SNS addiction as shown in Table 4.13. I used Spearman's correlation analysis to examine the relationships among Twitter variables. The results indicated that some Twitter variables are dependent. The correlation coefficient (r_s) values between the variables are shown in Table 4.13.

Table 4.13 Correlation matrix among Twitter variables

Twitter variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Time spent	1																
2. Frequency of use	.792**	1															
3. Length of use	.954**	.915**	1														
4. Year Twitter use began	-.087	-.078	-.076	1													
5. Followers	.438*	.437*	.474**	.534**	1												
6. Friends	.224	.296	.254	.309	.579**	1											
7. Statistics of use	.527**	.631**	.594**	.337*	.756**	.516**	1										
8. Statistics of favorites	.308	.509**	.382*	.226	.579**	.640**	.675**	1									
Usage (time)																	
9. Tweets	.667**	.697**	.709**	.150	.511**	.315	.620**	.522**	1								
10. Retweets	.320	.696**	.507**	.122	.436**	.382*	.615**	.720**	.535**	1							
11. Replies	.500**	.714**	.638**	.048	.496**	.311	.639**	.601**	.701**	.709**	1						
Ratio of usage period																	
12. 06:00-09:00	-.100	-.054	-.095	.173	.240	.309	.156	.230	.131	.353*	.143	1					
13. 09:00-12:00	.011	.153	.069	-.219	-.030	-.079	.190	.199	.255	.190	.173	-.190	1				
14. 12:00-13:00	.131	.175	.170	-.330*	-.025	-.038	.224	.143	.116	.146	.201	-.529**	.470**	1			
15. 13:00-18:00	-.165	-.242	-.192	-.143	-.107	-.185	-.084	-.066	-.293	-.038	-.301	-.400*	.226	.363*	1		
16. 18:00-24:00	.152	.218	.160	.022	.052	-.155	-.003	.162	.228	.263	.266	-.012	-.243	-.045	-.098	1	
17. After midnight	-.021	.054	.042	.345*	.140	.158	.175	.072	.337*	.124	.274	.086	-.220	-.239	-.591**	-.017	1

*significant at p<0.05 **significant at p<0.01*

4.5.3 Twitter usage and SNS addiction

The data obtained from Twitter (including the combination with the data from questionnaire) were analyzed to find the factors associated with SNS addiction [95]. Since the normality test on Twitter variables resulted in negative outcomes, I used a non-parametric test. The IAT and BFAS results from the questionnaires were used for measuring SNS addiction.

To examine the relationship of SNS addiction with the Twitter variables, I used the Mann-Whitney U test and logistic regression analysis. The analytic results indicated no significant differences between the Twitter variables and IAT. On the contrary, the results from both the Mann-Whiney U test and logistic regression analysis indicated a significant difference between the ratio of usage after midnight and BFAS.

4.6   Web Log Results

4.6.1 SNS usage

As mentioned in section 4.1.2, there are two types of data. First, I summarized the web usage data of 4,191 users over a 38-day period. The total browsing time from the top 50 sites was 25,864 hours, 26 minutes, and 32 seconds or about six hours per user. 40% of the browsing time used SNSs. The top SNSs were Facebook, Twitter, Line, Google Plus, and LinkedIn. For Facebook, users spent 9,537 hours, 12 minutes, and 44 seconds or about two hours per user [92].

Next, I used the dataset of the detailed usage of 96 participants whom I obtained questionnaires data for examining the relationships with SNS addiction [92]. The session characteristics (section 4.2) were defined to represent the activities of each user.
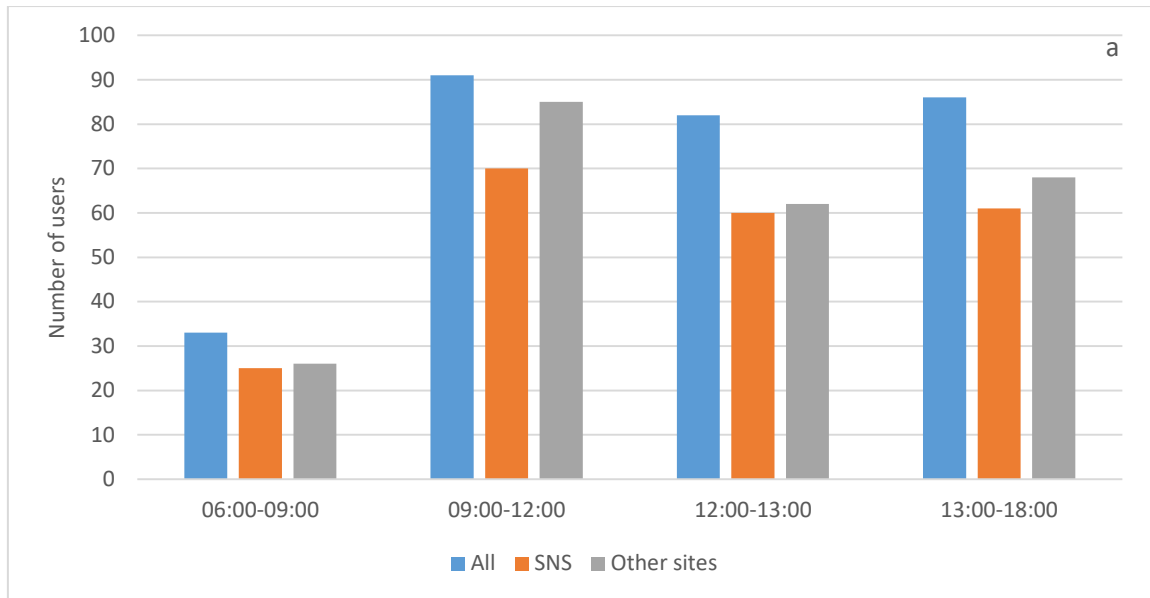
(a) Comparison among all sites, SNSs and other sites
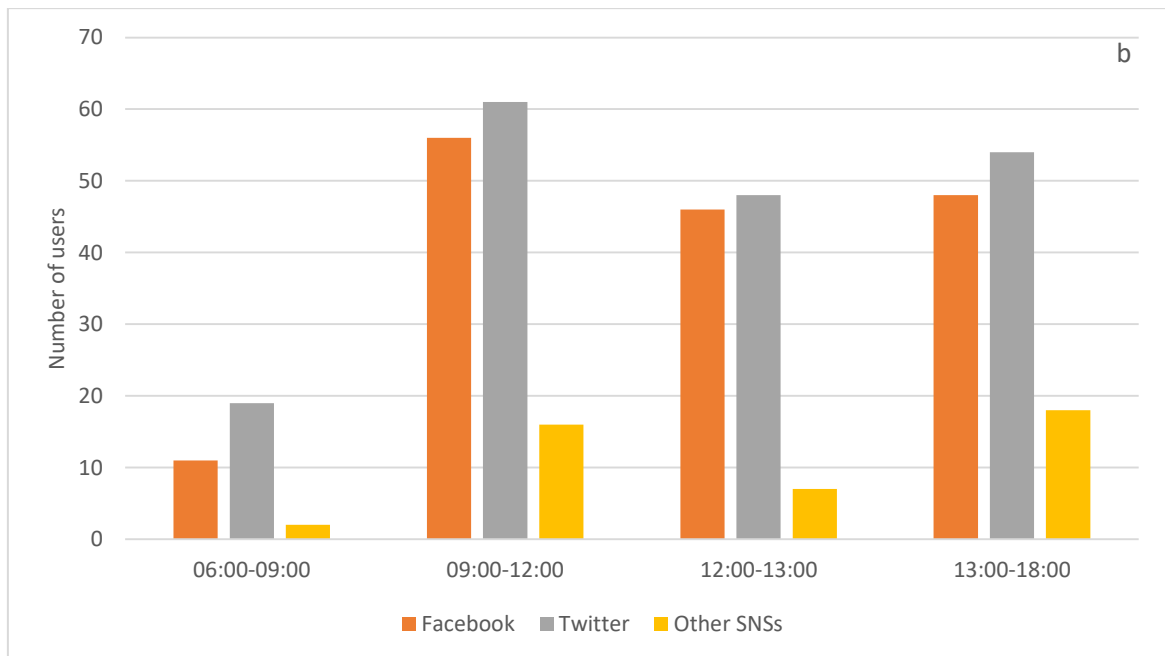
(b) Comparison among Facebook, Twitter and other SNSs

Figure 4.8 Number of users in each usage period

4.6.1.1 Usage

An overwhelming majority of the users (96.88%) visited SNSs. They also visited Twitter (89.58%), Facebook (82.29%), and other SNSs (35.42%). In terms of time spent, 29% of their browsing time was on SNSs: Twitter (65%), Facebook (35%), and others (2%).

4.6.1.2 Usage Period

Figure 4.8 shows that the top usage period was between 9:00-12:00 for all sites and SNSs, and there was no usage after 18:00. Fewer users visited SNSs than other sites in all periods. There was also more Twitter than Facebook users in all periods web log data: number of sessions, time spent, and number of sessions in each usage period.

To compare the usage in each period, I calculated the number of sessions per hour as normalized values due to the different length of each period. Figure 4.9 shows the normalization of the number of sessions in each usage period. The highest number of sessions was during the 12:00-13:00 period, and the lowest number was during the 6:00-9:00 period for all sites, SNS sites, Facebook, and Twitter.
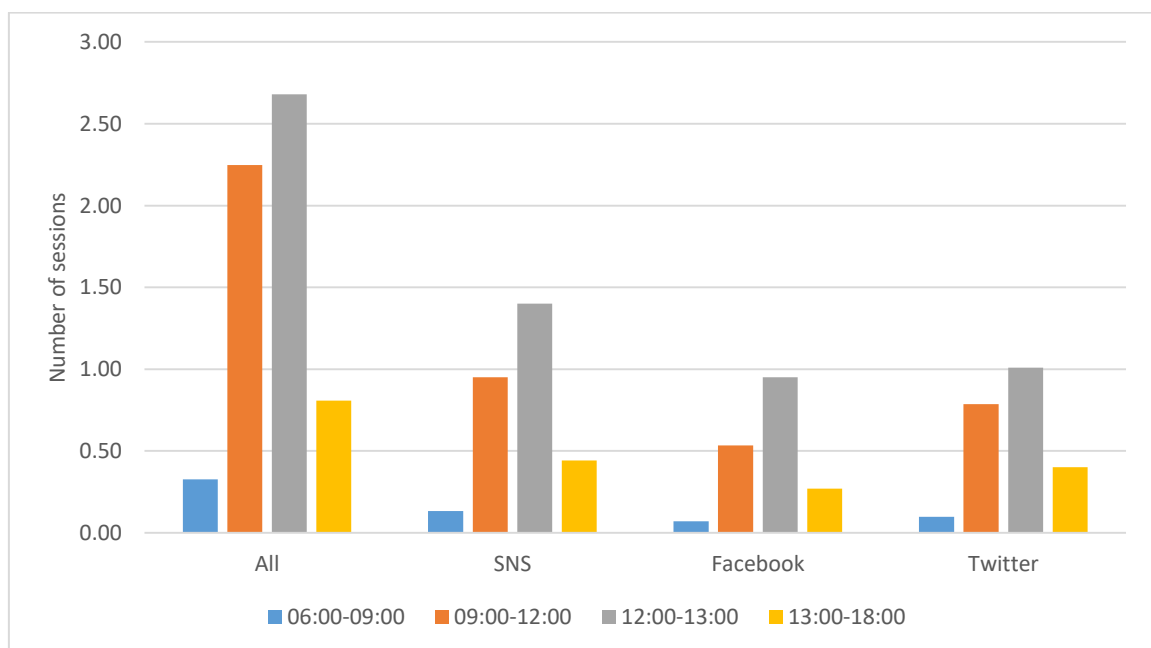
Figure 4.9 Normalization of number of sessions in each usage period

4.6.2 Relationships among variables

By defining the session characteristics, I obtained the following variables from the web log data: number of sessions, time spent, and number of sessions in each usage period.

I performed a Spearman's correlation analysis to measures the strength and the direction of the monotonic relationships between two variables. The Spearman's correlation coefficient (rs) ranged from -1 to +1, where -1 indicates a perfect negative association of variables, +1 indicates a perfect positive association, and 0 indicates no association. The rs values between the variables are shown in Table 4.14. For the relationships between the number of sessions and time spent, the correlation analysis indicated a strong correlation for Facebook (rs=0.718, p<0.01) and Twitter (rs=0.746, p<0.01), and moderate correlation for all other sites (rs=0.463, p<0.01).

For the relationships between time spent and usage period, I found a strong correlation in the 13:00-18:00 period (rs=0.557, p<0.01) and moderate correlation in the 06:00-09:00 period (rs=0.353, p<0.01) for all sites. For Facebook, I found a strong correlation in the 13:00-18:00 period (rs=0.531, p<0.01) and moderate correlation in the 09:00-12:00 (rs=0.486, p<0.01) and 12:00-13:00 periods (rs=0.358, p<0.01). For Twitter, I also found strong correlation in the 13:00-18:00 period (rs=0.541, p<0.01) and moderate correlation in the 09:00-12:00 (rs=0.391, p<0.01) and 12:00-13:00 periods (rs=0.385, p<0.01).

For the relationship between using Facebook and Twitter in each period, the correlation analysis indicated strong correlation in the 13:00-18:00 period (rs=0.757, p<0.01) and moderate correlation in the 09:00-12:00 (rs=0.453, p<0.01) and 12:00-13:00 periods (rs=0.468, p<0.01).

Table 4.14 Relationship among variables by Spearman's correlation analysis

Comparison pairs	Correlation coefficient (r_s)
Number of sessions and time spent	
All sites	0.463**
Facebook	0.718**
Twitter	0.746**
Time spent and usage period	
All sites	
06:00-09:00	0.353**
09:00-12:00	0.237**
12:00-13:00	0.291**
13:00-18:00	0.557**
Facebook	
06:00-09:00	0.122
09:00-12:00	0.486**
12:00-13:00	0.358**
13:00-18:00	0.531**
Twitter	
06:00-09:00	0.217
09:00-12:00	0.391**
12:00-13:00	0.385**
13:00-18:00	0.541**
Use of Facebook and Twitter in each period	
06:00-09:00	0.251*
09:00-12:00	0.453**
12:00-13:00	0.468**
13:00-18:00	0.757**

** Correlation is significant at 0.01 level (2-tailed)
*   Correlation is significant at 0.05 level (2-tailed)

4.6.3 SNS usage and addiction

4.6.3.1 Method

I analyzed the web log data, including a combination with the data obtained from questionnaires, to identify the factors associated with SNS addiction [92]. I used the IAT and BFAS results from the questionnaires for measuring SNS addiction based on the results from a previous section.

4.6.3.2 Excessive and normal users

According to the IAT results, 52.63% were excessive users and the others were normal users. For the BFAS results, 54.74% were excessive user and the others were normal users.

4.6.3.3 Location and device for accessing SNSs

84.21% of the users accessed SNSs from their university (TNI). The number of excessive users who accessed SNSs from TNI exceeded the number of normal users. The number of excessive users who accessed SNSs by computer also exceeded the number of normal users. Chi-square analysis results indicated that accessing SNSs from their university was significantly different between normal and excessive users classified by IAT ($p<0.05$) with a medium effect (contingency coefficient=0.310). On the contrary, my analysis results indicated that accessing SNSs by computer had no significant difference between normal and excessive users for both IAT and BFAS.

Table 4.15 Mann-Whitney U Test for number of sessions in each usage period

Variables	Z-Value	
	IAT	BFAS
Number of sessions in each usage period		
All SNSs		
06:00-09:00	-0.057	-1.707
09:00-12:00	-2.038*	-3.105*
12:00-13:00	-0.009	-1.723
13:00-18:00	-0.194	-0.076
Facebook		
06:00-09:00	-0.697	-0.634
09:00-12:00	-0.782	-2.526*
12:00-13:00	-1.483	-1.577
13:00-18:00	-0.564	-0.430
Twitter		
06:00-09:00	-0.181	-1.412
09:00-12:00	-2.123*	-3.341*
12:00-13:00	-0.367	-1.255
13:00-18:00	-0.080	-0.43

*significant at 0.05 level (2-tailed)

4.6.3.4 Usage period and SNS addiction

To examine the relationships of SNS addiction with usage periods, I employed the Mann-Whitney U Test. As shown in Table 4.15, the number of sessions that accessed SNSs during the 09:00-12:00 period was significantly different for both the IAT ($z=-2.038$, $p<0.05$) and BFAS levels ($z=-3.105$, $p<0.05$). The number of sessions that accessed Twitter during the 09:00-12:00 period was also significantly different for both the IAT ($z=-2.123$, $p<0.05$) and BFAS levels ($z=-3.341$, $p<0.05$). These results indicated significant differences between the 09:00-12:00 period and the number of sessions that accessed Facebook for the BFAS level ($z=-2.526$, $p<0.05$).

4.7   Discussion

This chapter aims to clarify the relationships between SNS usage and SNS addiction. Information related to SNS usage I used in this chapter was from questionnaire, Facebook, Twitter, and web log.

4.7.1 SNS usage

Results of questionnaire data indicated that most participants had the experiences with SNSs, which mean that they are the majority of SNS users. Participants spent time on SNSs 3-6 hours per day. The top thee of daily activities were viewing feed, messaging and commenting. Over half of participants were Facebook users, 20% were Twitter users, and 18% used both Facebook and Twitter. These finding correspond with the survey of Thai SNS users with a random sample of 16,661 participants in Thailand [7].

The usage on Facebook and Twitter are different. A majority of activities for Facebook was responding to content while a majority for Twitter was sharing content with others. Twitter users did activities on Twitter several times for all of the time periods, while Facebook users did activities on Facebook several times during the 13:00-18:00 and 18:00-24:00 time periods.

Results of web log data indicated that SNS usage by all users as well as specific users were different. For all users, 40% of their browsing time accessed SNSs and Facebook was the top SNS. For specific users, 29% of their browsing time accessed SNSs and Twitter was the top SNS.

4.7.2 IAT and BFAS for SNS addiction

In this study, I measured SNS addiction with two tests: IAT and BFAS. Many studies also employed IAT for assessing SNS addiction [45, 65, 73]. As for BFAS, it originally developed for Facebook addiction. I modified it for SNS addiction by retaining the original concepts and cut-off score. After that, in 2017, a modified version of BFAS named Bergen Social Media Addiction Scale (BSMAS) was proposed [54]. The modification involves using the word "social media" instead of the word "Facebook" as I did.

Moreover, the results of my study observed from modified IAT and BFAS scores showed the similar results: over half of the participants were excessive users. The finding also indicated a positive correlation between the modified IAT and BFAS.

Therefore, I confirmed that modified IAT and BFAS can be used for measuring SNS addiction.

4.7.3 Effective factors associated with SNS addiction

To measure SNS addiction, modified IAT and BFAS were used for distinguishing excessive and normal users. In this chapter, I identified the effective factors associated with SNS addiction. Effective factors are SNS usage variables that differentiated excessive from normal users.

As for gender, there was no different between excessive and normal users. This finding was difference to [96] which found that males have higher potential to develop addiction. Differences in finding may be because age and area of participants. All participants of this study were undergraduate students in Bangkok, Thailand.

To find the relationships between SNS usage and SNS addiction, I separately analyzed the data from questionnaire, Facebook, Twitter and web log.

As for the questionnaire variables, the discriminant analysis for both IAT and BFAS indicated the variables that differentiate excessive from normal users. All variables that influenced BFAS also influenced IAT. This finding also resembled the decision tree results. The following are the candidates of effective factors associated with SNS addiction:

- SNS activities:
    - (+) Commenting
    - (+) Messaging
- Usage period:
    - (+) From 09:00-12:00
    - (-) From 18:00-24:00

The (+) sign indicates that excessive users engaged in more SNS activities than normal users. The (-) sign indicates that excessive users did fewer SNS activities than normal users.

Regarding questionnaire results, excessive users did commenting and messaging more than normal users. These activities are the particular form of virtual communication in SNSs. Therefore, it can be hypothesized that excessive users used SNSs for communication and prefer virtual communication than face-to-face communication. As for usage period, excessive users were active in 09:00-12:00 period. Based on the background of participants who are undergraduate students, this period is a study time. It means that excessive users accessed SNSs during the class. On the contrary, excessive users did fewer SNS activities than normal users in 18:00-24:00 period. However, this period was the protruding peak time of SNS usage for normal users. Therefore, it showed the big different between excessive and normal users. Then, discriminant analysis and decision tree finds this distinction between excessive and normal users. Based on the results of decision tree, as for participants who did not use SNSs in 18:00-24:00 period, most of them tended to be active during 09:00-12:00. This usage period was also the protruding peak time of SNS usage for normal users. Therefore, the decision tree finds this second distinction between

excessive and normal users.

As for Facebook variables, the Mann-Whitney U test and logistic regression analysis for both IAT and BFAS indicated that Facebook variables differing excessive users from normal users. All of the variables that influence BFAS also influenced IAT. The following are the candidates of effective factors associated with SNS addiction:

- (+) Daily activities on Facebook
- (+) The ratio of posting videos on Facebook
- (-) The ratio of usage on Facebook in the 18:00-24:00 period

Regarding Facebook results, excessive users engaged in activities on Facebook every day. The activities on Facebook that can be observed in this study are posting, commenting and replying. It means that excessive users used Facebook in order to express their identity (posting) and keep in touch with friends (commenting and replying). The posted video may involve with expressing their identity. Nevertheless, excessive users did fewer Facebook activities than normal users in 18:00-24:00 period. This result is the same as questionnaire results, which is the 18:00-24:00 period was the protruding peak time of SNS usage for normal users.

As for Twitter variables, the Mann-Whitney U test and logistic regression analysis indicated that no variables could distinguish between excessive and normal users for IAT. On contrary, the ratio of usage after midnight period was the Twitter variable that separated excessive users from normal users for BFAS. This may because of there was a small Twitter data for analysis.

As for web log variables, I found a correlation between the number of session and the time spent. There were also correlations between time spent and each usage period. Additionally, the Mann-Whitney U test indicated that the usage in the 09:00-12:00 period, excessive users did fewer SNS activities than normal users. This may because of the limitation of web log data that can represent only the activities in the same network. Excessive users may use their own devices connected with mobile network for accessing SNSs.

In summary, I analyzed the SNS usage data obtained from questionnaire, Facebook, Twitter, and web log to clarify the relationships between SNS usage and SNS addiction. The results identified the candidates of effective factors associated with SNS addiction.

4.7.4 Data limitation.

To clarify SNS usage behaviors and factors associated with SNS addiction, I analyzed data collected from questionnaire, Facebook, Twitter and web log. The differences in finding might be from data limitations. For questionnaire data, participants might inaccurately report their experiences with SNSs. For Facebook and Twitter data, some data are restricted to access using APIs. For web log data, the data represented only the activities by LAN connection. However, my results identified the differences between excessive and normal users.

Even though the obtained data were insufficient to capture all of the user activities due to the data limitations, the results of this study are similar to the survey of Thai SNS users with a random sample of 16,661 participants in Thailand in term of usage [26] and the report of global SNS users [25]. Therefore, there is a possibility that the results obtained from this study are broadly applicable to SNS users in general.

4.8   Summary

This chapter aim to clarify the characteristic of SNS usage and the relationships between SNS usage and SNS addiction. I constructed the experiment using the data collection application as a tool for collecting questionnaire, Facebook and Twitter data. I also employed web log data for analysis. I statistically analyzed the obtained data using various methods. Descriptive statistic was used to describe SNS usage. Correlation analysis was used to examining the relationships among variables. To identify how excessive and normal users differ, I employed discriminant analysis, decision tree analysis, Man-Whitney U test, and logistic regression. The analytic results identified the candidates of effective factors associated with SNS addiction as follows:

- Activities on SNSs: commenting and messaging
- Usage periods during 09:00-12:00 and 18:00-24:00
- Daily activities on Facebook
- The ratio of posting video on Facebook
- The ratio of usage on Facebook in the 18:00-24:00 period

Next chapter will assess the symptoms of excessive SNS usage by identifying the factors associated with addiction components, which are reflected by the question items of IAT and BFAS.

Chapter 5

Effective Factors Associated with Addiction Components

In previous chapter, I clarified the relationship between SNS usage and SNS addiction. I statistically analyzed data obtained by the data collection application and web log data to identify the effective factors associated with SNS addiction, which I measured with a modified IAT and BFAS. The analytic results identified the candidates of effective factors for SNS addiction. These effective factors are SNS usage variables that differentiated excessive from normal users. In this chapter, I identified the effective factors associated with IAT and BFAS addiction components [97]. The process I used for identifying effective factors is explained below.

5.1 Addiction Components as Background Knowledge

SNS addiction shares similarities with other behavioral addictions [1, 11]. Its symptoms resemble those of other behavioral addictions [1]. These symptoms have been validated in the context of the addiction components.

Figure 5.1 shows the IAT addiction components. The IAT total score is the sum of the rating. Each item (section 3.3.1) is rated on a 5-point scale ranging from 0 to 5. The IAT score is inspected for a pattern of symptom complaints as follows [45, 98]:
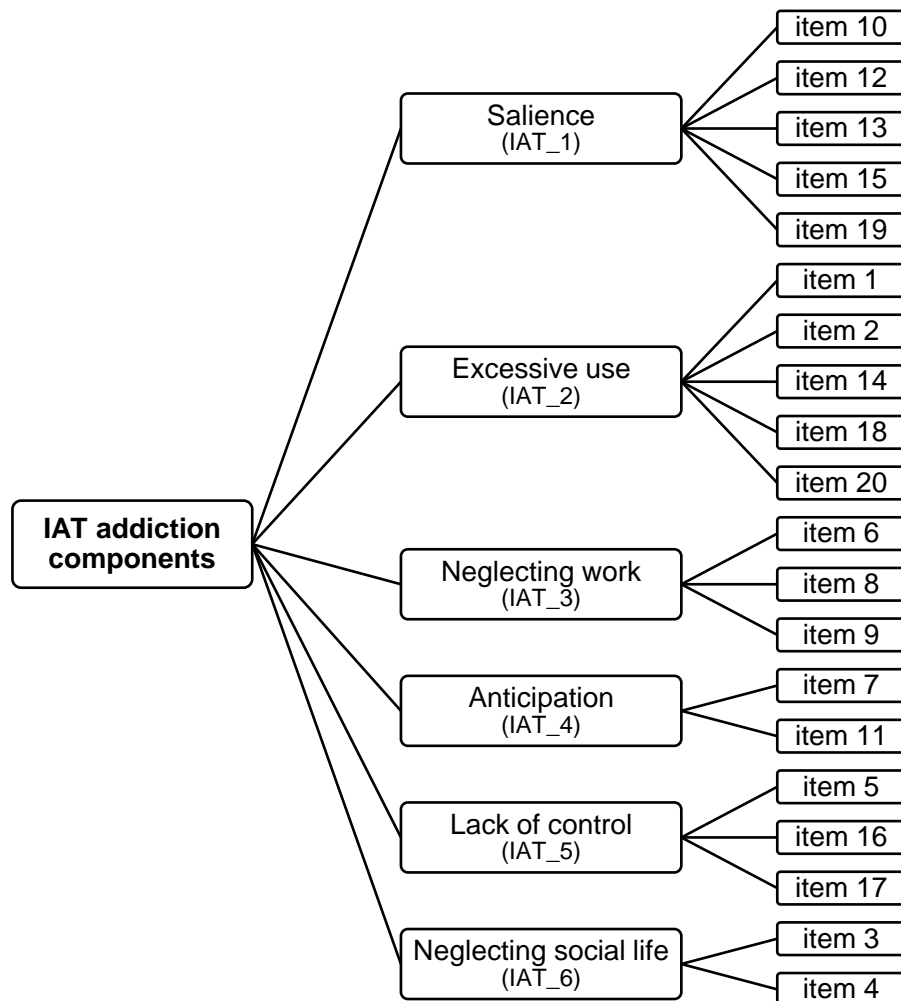
Figure 5.1 IAT addiction components

1. **Salience** (IAT_1): Addicts feel preoccupied with the Internet, hide such behavior from others, may display a loss of interest in other activities and/or relationships, and may feel bored or depressed without the Internet.

2. **Excessive use** (IAT_2): Addicts engage in excessive behavior and compulsive usage and have difficulty controlling their time online. High ratings also suggest that addicts become depressed, panicked, or angry when such use is restricted.

3. **Neglecting work (**IAT_3): Work performance and productivity are decreased due to the amount of time spent online. Addicts may also hide or lie about their time spent online.

4. **Anticipation (**IAT_4): Addicts think about being online and feel compelled to use the Internet when they are offline.

5. **Lack of control** (IAT_5): Addicts have trouble managing their time online. Family, friends, and co-workers complain about the amount of time a potential addict spends online.

6. **Neglecting social life** (IAT_6): Addicts form new relationships with online users to cope with problems and/or reduce mental tension and stress.
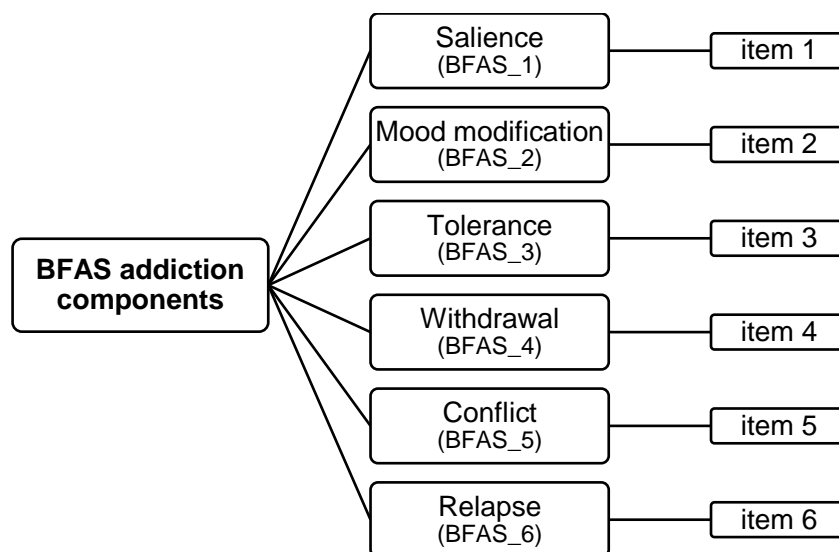
Figure 5.2 BFAS addiction components

Figure 5.2 shows the BFAS addiction components. The BFAS items (section 3.3.1) reflect the following addiction components [26, 99]:

1. **Salience** (BFAS_1): The use of SNS becomes the most important activity in a person's life, leading to preoccupations and obsessions. Addicts tend to dominate the behaviors, cognition, and feelings of addicts.

2. **Mood modification** (BFAS_2): Addicts use SNSs to make themselves feel better, to alter their moods, and create feelings of pleasure. Consequently, SNS activities modify their moods.

3. **Tolerance** (BFAS_3): Addicts increase the amount of time they spend on SNSs to achieve the same feelings and mental states that occurred in their initial usage phases.

4. **Withdrawal** (BFAS_4): This refers to the unpleasantness that occurs when SNS use is discontinued, slashed, or restricted.

5. **Conflict** (BFAS_5): SNS use causes relationship problems: (1) personal relationships (family and friends), (2) working and education lives, and (3) other social activities.

6. **Relapse** (BFAS_6): This refers to the failure to avoid using. Addicts quickly return to excessive behaviors after periods of control.

5.2 Data Preparation

In previous chapter, I experimentally collected data from 177 undergraduate student volunteers from the faculty of Information Technology, the Thai-Nichi Institute of Technology (TNI). To improve the data analysis, I recruited an additional 290 undergraduate volunteers from various universities in Thailand. Therefore, I had data from 467 participants in total. After data cleaning, I had questionnaire data from 374 participants (80.09%), Facebook data from 221 participants (47.32%), and Twitter data from 74 (15.85%).

5.3 Comparison of Excessive and Normal Users between Addiction Components

Based on the cut-off scores of IAT and BFAS, I classified the participants as excessive or normal users. Table 5.1 and 5.2 compare the mean scores between excessive and normal users for each of addictive symptoms.

Table 5.1 Comparison of mean scores of IAT addiction components between excessive and normal users (N=374)

Addictive symptoms	Normal users (N=128) *mean (SD)*	Excessive users (N=246) *mean (SD)*	T-value
Salience	0.952 (0.598)	2.424 (0.837)	19.605**
Excessive use	1.033 (0.507)	2.468 (0.761)	21.722**
Neglecting work	0.610 (0.528)	2.132 (0.914)	20.386**
Anticipation	1.695 (0.831)	2.909 (0.862)	13.227**
Lack of control	1.078 (0.742)	2.722 (0.907)	18.808**
Neglecting social life	1.277 (0.862)	2.463 (0.985)	11.519**

** significant at p<0.01

Table 5.2 Comparison of mean scores of BFAS addiction components between excessive and normal users (N=374)

Addictive symptoms	Normal users (N=124) *mean (SD)*	Excessive users (N=250) *mean (SD)*	T-value
Salience	2.820 (0.988)	3.720 (0.871)	8.926**
Mood modification	2.770 (1.021)	3.720 (0.762)	9.210**
Tolerance	2.110 (1.030)	3.520 (0.906)	13.503**
Withdrawal	1.760 (0.859)	3.220 (0.844)	15.627**
Conflict	1.440 (0.641)	2.870 (1.007)	16.585**
Relapse	1.670 (0.751)	2.690 (0.935)	10.556**

** significant at p<0.01

I used a T-test to examine the differences of the scores between excessive and normal users. T-test results indicated that the scores were significantly different between excessive and normal users for both the IAT (Table 5.1) and BFAS (Table 5.2) addiction components [100].

5.4   Correlation between Addiction Components of IAT and BFAS

The relationship between addiction components of IAT and BFAS was analyzed by Pearson's correlation analysis. The correlation matrix of addiction components between IAT and BFAS is shown in Table 5.3.

Table 5.3 Correlation matrix of addiction components between IAT and BFAS

Variables	IAT_1	IAT_2	IAT_3	IAT_4	IAT_5	IAT_6	BFAS_1	BFAS_2	BFAS_3	BFAS_4	BFAS_5	BFAS_6
IAT_1	1											
IAT_2	.770**											
IAT_3	.733**	.769**	1									
IAT_4	.586**	.568**	.559**	1								
IAT_5	.722**	.795**	.693**	.542**	1							
IAT_6	.577**	.595**	.526**	.396**	.533**	1						
BFAS_1	.364**	.390**	.288**	.271**	.377**	.367**	1					
BFAS_2	.458**	.439**	.373**	.375**	.430**	.331**	.527**	1				
BFAS_3	.530**	.440**	.391**	.356**	.429**	.416**	.362**	.489**	1			
BFAS_4	.424**	.486**	.454**	.322**	.559**	.390**	.349**	.422**	.443**	1		
BFAS_5	.593**	.571**	.510**	.335**	.585**	.424**	.306**	.445**	.471**	.533**	1	
BFAS_6	.530**	.625**	.640**	.369**	.505**	.371**	.214**	.297**	.355**	.398**	.489**	1

** Correlation is significant at the 0.01 level (2-tailed)

In the correlation matrix, there were significant positive correlations among IAT addiction components. Their coefficients ranged from 0.396 to 0.770. There also were positive correlations among BFAS addiction components. Their coefficients ranged from 0.214 to 0.527. Moreover, there were moderate positive correlations between IAT and BFAS addiction components [100].

5.5   Clarification of Effective Factors for Addiction Components

5.5.1 Dataset

Due to the small amount of Twitter data, only the questionnaire and Facebook data were used for clarifying the effective factors associated addiction components. There are 49 variables: 27 from questionnaire, which are categorical (Table 5.4), and 22 from Facebook,

which are continuous (Table 5.5).

Table 5.4 Questionnaire Variables

SNS usage	Purpose	Activity
• Time spent • Length of use • Frequency of use	• Find information • Play games • Make new friends • Keep in touch • Express identity • Share experiences • Kill time	• View feed • View friends' page • Posts • Comments • Update profile • Messages • Play games
Usage period • 06:00-09:00 • 09:00-12:00 • 12:00-13:00 • 13:00-18:00 • 18:00-24:00 • After midnight	**Location** • Home • University • Walking • In vehicles	

Table 5.5 Facebook Variables

Facebook usage	Ratio of usage period	Type of posts	Ratio of posts
• Friends • Time spent • Length • Frequency • Sessions • Posts • Comments • Replies	• 06:00-09:00 • 09:00-12:00 • 12:00-13:00 • 13:00-18:00 • 18:00-24:00 • After midnight	• Status • Photos • Videos • Links	• Status • Photos • Videos • Links

5.5.2 Method

Since the data types of the questionnaires and Facebook variables are different, I separately analyzed their data.

1. The relationship among the questionnaire variables was analyzed by Cramver's V and the relationship among the Facebook variables was analyzed by a Spearman's correlation analysis.

2. To clarify the effective factors associated with addiction components, I employed various methods. Figure 5.3 illustrates the method for clarifying the effective factors associated with addiction components.

A T-test and ANOVA were used to examine the differences between the questionnaire variables and the scores of each addictive symptom. A Spearman's correlation analysis clarified the relationships among the Facebook variables and the scores of each addiction component.

Curve estimation is the process of constructing a curve, or mathematical function that has the best fit to a series of data points. I used a curve estimation to examine the relationship between variables and addiction components.

Regression analysis examined the relationships between the sets of variables and the scores of each addictive symptom. A forward stepwise method was used with four different criteria for entry and removal:

- Akaike Information Criterion (AICC)
- F statistics
- Adjusted R-squared
- Average Squared Error (ASE).

I also used a decision tree analysis to examine the relationships between the sets of variables and the scores of each addictive symptom. The CHAID and Exhaustive CHAID algorithms were used.

Then I combined the analytic results of each method and selected the effective factors. Finally, I evaluated the selected factors using Support Vector Regression (SVR) to confirm the relationships between effective factors and addiction components.
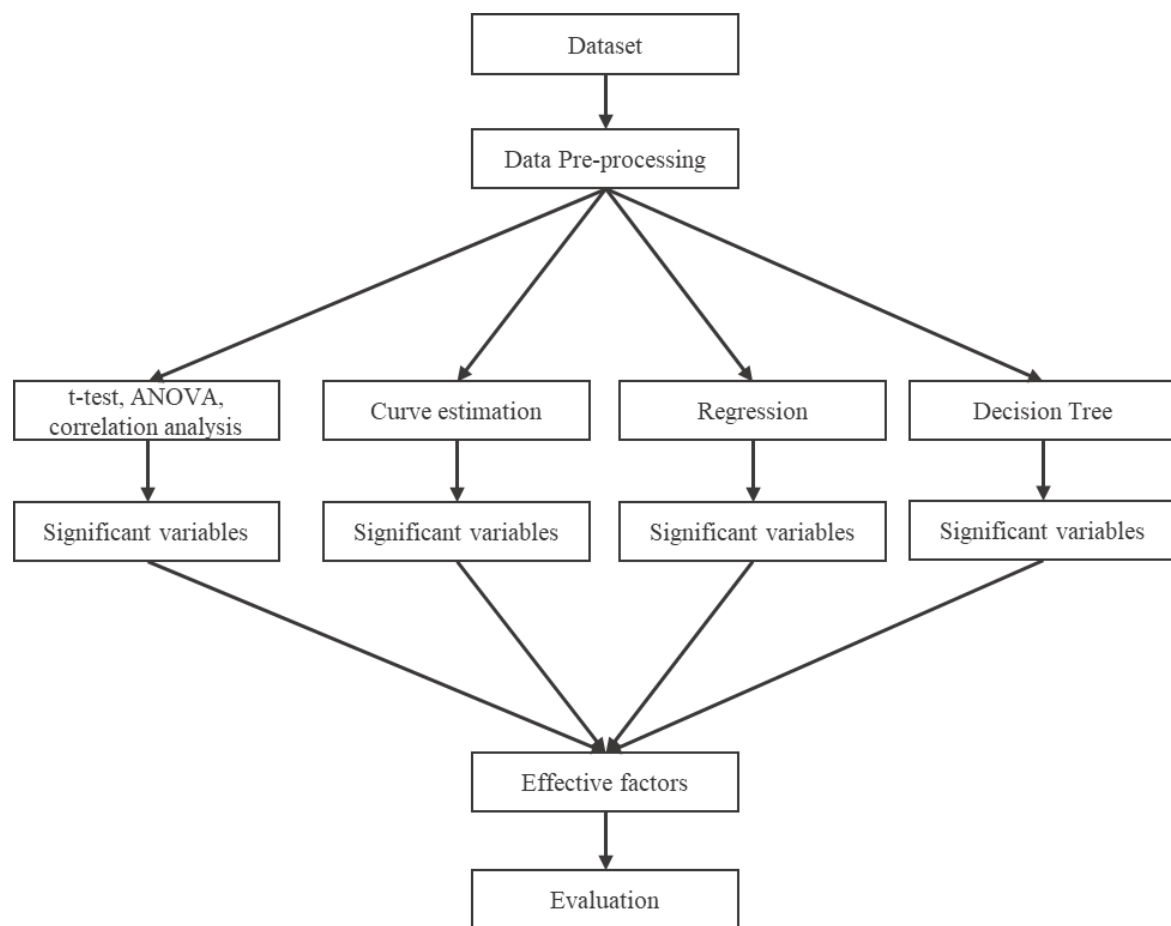
Figure 5.3 Method for identifying effective factors associated with addiction components

5.5.3 Results

5.5.3.1 Relationships among variables

The Cramer's V results indicated that some questionnaire variables are dependent. The results of Spearman's correlation analysis also indicated that some Facebook variables are dependent (see Appendix B). Therefore, the dependencies should be taken into account to interpret the following analysis results.

5.5.3.2 T-test, ANOVA and correlation analysis

The T-test and ANOVA results indicated the significant questionnaire variables associated with addiction components (see Appendix B). The results of Spearman's correlation analysis also indicated the significant Facebook variables associated with addiction

components (see Appendix B). Table 5.6 shows the significant variables for IAT addiction components. Table 5.7 shows the significant variables for BFAS addiction components.

For the IAT addiction components, the results indicated 25 out of 49 variables: 13 from questionnaires and 12 from Facebook. The common variable associated with all the addiction components were the activity for viewing the pages of friends and the usage period during 12:00-13:00. The common variables associated with any five addiction components were length of use, the usage period during 18:00-24:00, and updating profile. Neglecting social life is associated with 19 variables, which is the highest, while neglecting work is associated with seven variables, which is the lowest.

As for the BFAS addiction components, the results indicated 30 out of 49 variables: 17 from questionnaires and 13 from Facebook. The common variables associated with any five addiction components were sessions, posts, comments, replies, the usage period during 18:00-24:00, and ratio of posting status. Mood modification was associated with 21 variables, which is the highest, while relapse was associated with four variables, which is the lowest. There was no relationship among the variables from Facebook and relapse.

5.5.3.3 Curve estimation

The results of curve estimation indicated the significant questionnaire and Facebook variables associated with addiction components (see Appendix B). Table 5.8 shows the significant variables for IAT addiction component from curve estimation results. Table 5.9 shows the significant variables for BFAS addiction component from curve estimation results.

For the IAT addiction components, the curve estimation results indicated 26 out of 49 variables: 10 from questionnaires and 16 from Facebook. The common variables associated with any five addiction components were viewing friend's page, time spent on Facebook, and the ratio of posting photo. *Neglecting social life* is associated with 13 variables, which is the highest, while *anticipation* is associated with four variables, which is the lowest

Table 5.6 Significant variables for IAT addiction components

Type of variables	IAT addiction components					
	Salience	Excessive use	Neglecting work	Anticipation	Lack of control	Neglecting social life
Questionnaire						
Purpose					Find information	Find information Play games
SNS usage	Time spent Length of use	Length of use Frequency of use		Time spent Length of use	Length of use Frequency of use	Length of use Frequency of use
Usage period	09:00-12:00 12:00-13:00 18:00-24:00	09:00-12:00 12:00-13:00 18:00-24:00	09:00-12:00 12:00-13:00 18:00-24:00	09:00-12:00 12:00-13:00 13:00-18:00	12:00-13:00 18:00-24:00	12:00-13:00 18:00-24:00
Location						
Activity	View friend page	View friend page Update profile	View friend page Update profile	View friend page Post Comment Update profile	View friend page Update profile	View friend page Comment Update profile
Facebook						
Usage	Friends Replies	Friends Replies	Status	Time spent Length	Friends	Friends Posts Comments Replies Length Sessions
Ratio of usage period	12:00-13:00	12:00-13:00				
Type of posts	Status	Status				Status Photo
Ratio of posts	Status Videos	Status	Status		Status	Status Videos

Table 5.7 Significant variables for BFAS addiction components

Type of variables	BFAS addiction components					
	Salience	**Mood modification**	**Tolerance**	**Withdrawal**	**Conflict**	**Relapse**
Questionnaire						
Purpose	Kill time		Express identity	Play games	Play games	
SNS usage	Time spent Frequency of use	Time spent Length of use	Frequency of use		Time spent	Length of use
Usage period	12:00-13:00 18:00-24:00	09:00-12:00 12:00-13:00 13:00-18:00 18:00-24:00	12:00-13:00 18:00-24:00	18:00-24:00	12:00-13:00 13:00-18:00 18:00-24:00	09:00-12:00 13:00-18:00
Location	Home		Walking		Walking	
Activity		Post Comment Update profile Play games	View friend page Post Comment Update profile	View friend page	View friend page Comment	Update profile
Facebook						
Usage	Friends Posts Comments Replies Time spent Frequency Length Sessions	Posts Replies Time spent Length Sessions	Friends Posts Replies Time spent Sessions	Friends Posts Comments Replies Sessions		
Ratio of usage period	18:00-24:00	06:00-09:00	06:00-09:00			
Type of posts		Status Photo	Status Photo	Status Photo		
Ratio of posts	Status	Status	Status	Status		

Table 5.8 Significant variables for IAT addiction components by curve estimation

Type of variables	IAT addiction components					
	Salience	Excessive use	Neglecting work	Anticipation	Lack of control	Neglecting social life
Questionnaire						
Purpose						
SNS usage	Length of use	Frequency of use		Frequency of use	Frequency of use	
Usage period	09:00-12:00 18:00-24:00	09:00-12:00 12:00-13:00 18:00-24:00	09:00-12:00 12:00-13:00 18:00-24:00	13:00-18:00	12:00-13:00 18:00-24:00	12:00-13:00
Location	Home				Home	
Activity	View friend page	View friend page Update profile	View friend page Update profile	View friend page Comment	View friend page	View friend page Update profile
Facebook						
Usage	Time spent	Time spent Length	Time spent Length	Time spent Length	Friends	Friends Comments Replies Time spent Frequency Session
Ratio of usage period	06:00-09:00 After midnight	12:00-13:00			06:00-09:00 18:00-24:00 After midnight	
Type of posts		Status	Status Videos	Videos	Status Photos	Status
Ratio of posts	Status Videos Links	Status	Status Videos		Status Videos	Status Videos Links

Table 5.9 Significant variables for BFAS addiction components by curve estimation

Type of variables	BFAS addiction components					
	Salience	Mood modification	Tolerance	Withdrawal	Conflict	Relapse
Questionnaire						
Purpose	Kill time		Express identity		Play games	Play games
SNS usage	Length of use	Time spent Length of use	Time spent Frequency of use		Time spent	
Usage period				09:00-12:00	09:00-12:00 12:00-13:00	09:00-12:00
Location			Walking			
Activity			Comment			Update profile
Facebook						
Usage	Friends Comments Replies Time spent Frequency Length Sessions	Friends Comments Replies Time spent Length Sessions	Friends Comments Replies Time spent Frequency Sessions	Comments Replies Time spent Session		
Ratio of usage period	06:00-09:00 12:00-13:00 13:00-18:00 18:00-24:00 After midnight	06:00-09:00 18:00-24:00 After midnight	06:00-09:00 After midnight	13:00-18:00 18:00-24:00 After midnight		18:00-24:00
Type of posts	Status Photo	Photo	Status	Status		
Ratio of posts	Status Photos Links	Status Photos Videos Links	Status	Photos		Photos

For the BFAS addiction components, the curve estimation results indicated 29 out of 49 variables: 11 from questionnaires and 18 from Facebook. The common variables associated with any four addiction components were sessions, comments, replies, the usage period during 18:00-24:00 and after midnight, and the ratio of posting photos .*Salience* is associated with 19 variables, which is the highest, while *conflict* is associated with four variables, which is the lowest

5.5.3.4 Regression analysis

A forward stepwise method was used with four different criteria for entry and removal: AIC, F statistics, adjusted R-squared, and ASE. The regression analysis results indicated the significant questionnaire and Facebook variables associated with addiction components (see Appendix B).

A.   Akaike Information Criterion (AIC) criteria

Table 5.10 shows the set of significant variables associated with IAT addiction components by forward stepwise with AIC criteria and Table 5.11 shows the set of significant variables associated with BFAS addiction components by forward stepwise with AIC criteria.

For the IAT addiction components, the results of forward stepwise with AIC criteria indicated 24 out of 49 variables: 14 from questionnaires and 10 from Facebook. The common variables associated with all addiction components was length of use. The common variables associated with any five addiction components were viewing friend's page and the usage period during 12:00-13:00. *Lack of control* is associated with 12 variables, which is the highest, while *anticipation* is associated with 6 variables, which is the lowest

For the BFAS addiction components, the results of forward stepwise with AIC criteria indicated 29 out of 49 variables: 15 from questionnaires and 14 from Facebook. The common variables associated with any five addiction components were length of use and home. *Salience* is associated with 11 variables, which is the highest, while *conflict* is associated with 7 variables, which is the lowest

Table 5.10 Significant variables for IAT addiction components by forward stepwise with AIC criteria

Type of variables	IAT addiction components					
	Salience	Excessive use	Neglecting work	Anticipation	Lack of control	Neglecting social life
Questionnaire						
Purpose						Play games
SNS usage	Length of use	Length of use Frequency of use	Time spent Length of use	Length of use Frequency of use	Length of use Frequency of use	Length of use
Usage period	12:00–13:00 18:00–24:00	12:00–13:00 18:00–24:00	09:00–12:00 12:00–13:00	13:00–18:00	12:00–13:00 18:00–24:00	12:00–13:00
Location	Home	Home	Home	On vehicles	Home	School/University
Activity	View friend page	Update profile	View friend page Update profile	View friend page	View friend page	View friend page Update profile
Facebook						
Usage	Comments Time spent	Time spent	Time spent	Time spent	Friends Posts	Sessions
Ratio of usage period	After midnight				After midnight	
Type of posts			Videos		Status	
Ratio of posts	Status Photos	Status Photos			Status Photos	Status

Table 5.11 Significant variables for BFAS addiction components by forward stepwise with AIC criteria

Type of variables	BFAS addiction components					
	Salience	Mood modification	Tolerance	Withdrawal	Conflict	Relapse
Questionnaire						
Purpose	Kill time				Play games	Play games
SNS usage	Length of use	Length of use	Length of use Frequency of use	Time spent	Time spent Length of use	Length of use
Usage period	18:00-24:00	12:00-13:00		12:00-13:00	09:00-12:00 12:00-13:00	09:00-12:00 13:00-18:00
Location	School/University	School/University	School/University On vehicles	Home	Home School/University	School
Activity			Comment	View friend page		Update profile
Facebook						
Usage	Comments Replies Time spent Frequency	Time spent	Friends Replies	Sessions		Time spent
Ratio of usage period	18:00-24:00	06:00-09:00	06:00-09:00 13:00-18:00 18:00-24:00	18:00-24:00		
Type of posts	Video	Video				
Ratio of posts	Links	Status Photos				Links

B.   F statistics criteria

Table 5.12 shows the set of significant variables associated with IAT addiction components by forward stepwise with F statistics criteria and Table 5.13 shows the set of significant variables associated with BFAS addiction components by forward stepwise with AIC criteria.

For the IAT addiction components, the results of forward stepwise with F statistic criteria indicated 16 out of 49 variables: 11 from questionnaires and 5 from Facebook. The common variables associated with all addiction components was length of use. The common variables associated with any four addiction components were viewing friend's page and the ratio of posting status. *Lack of control* is associated with eight variables, which is the highest, while *anticipation* is associated with four variables, which is the lowest.

For the BFAS addiction components, the results of forward stepwise with F statistic criteria indicated 18 out of 49 variables: 11 from questionnaires and 8 from Facebook. The common variables associated with any five addiction components was length of use. *Salience* is associated with seven variables, which is the highest, while *mood modification* and *withdrawal* are associated with four variables, which is the lowest.

C.   Adjusted R-square criteria

Table 5.14 shows the set of significant variables associated with IAT addiction components by forward stepwise with adjusted R-square criteria and Table 5.15 shows the set of significant variables associated with BFAS addiction components by forward stepwise with adjusted R-square criteria.

Table 5.12 Significant variables for IAT addiction components by forward stepwise with F statistics criteria

Type of variables	IAT addiction components					
	Salience	Excessive use	Neglecting work	Anticipation	Lack of control	Neglecting social life
Questionnaire						
Purpose						Play games
SNS usage	Length of use	Length of use Frequency of use	Length of use	Length of use	Length of use	Length of use
Usage period	18:00-24:00	18:00-24:00	09:00-12:00 12:00-13:00	13:00-18:00	12:00-13:00 18:00-24:00	12:00-13:00
Location	Home		Home	On vehicles	Home	
Activity	View friend page	Update profile	View friend page		View friend page	View friend page
Facebook						
Usage		Time spent	Time spent	Time spent		Session
Ratio of usage period	After midnight					
Type of posts					Status	
Ratio of posts	Status	Status	Videos		Status Photos	Status

Table 5.13 Significant variables for BFAS addiction components by forward stepwise with F statistics criteria

Type of variables	BFAS addiction components					
	Salience	**Mood modification**	**Tolerance**	**Withdrawal**	**Conflict**	**Relapse**
Questionnaire						
Purpose	Kill time				Play games	Play games
SNS usage	Length of use	Length of use	Length of use Frequency of use		Time spent Length of use	Length of use
Usage period				12:00–13:00	09:00–12:00	09:00–12:00 13:00–18:00
Location			School/University	Home	School/University	
Activity			Comment			Update profile
Facebook						
Usage	Comments Replies Time spent	Friends Time spent	Replies	Sessions		
Ratio of usage period	06:00–09:00 18:00–24:00	06:00–09:00	06:00–09:00	18:00–24:00		
Type of posts						
Ratio of posts						

Table 5.14 Significant variables for IAT addiction components by forward stepwise with adjusted R-square criteria

Type of variables	IAT addiction components					
	Salience	Excessive use	Neglecting work	Anticipation	Lack of control	Neglecting social life
Questionnaire						
Purpose						Play games Make new friend
SNS usage	Length of use	Time spent Length of use Frequency of use	Time spent Length of use	Length of use	Time spent Length of use Frequency of use	Time spent Length of use
Usage period	09:00-12:00 12:00-13:00 18:00-24:00	12:00-13:00 18:00-24:00	09:00-12:00 12:00-13:00	13:00-18:00	12:00-13:00 18:00-24:00	12:00-13:00
Location	Home	Home	Home	On vehicles	Home	School/University Walking
Activity	View friend page	View friend page Update profile	View friend page Update profile		View friend page	View friend page Update profile
Facebook						
Usage	Comments Time spent	Posts Comments Time spent	Posts Time spent	Time spent	Posts Comments Time spent	Friends
Ratio of usage period	09:00-12:00 13:00-18:00 18:00-24:00 After midnight	12:00-13:00 13:00-18:00		06:00-09:00	13:00-18:00 After midnight	18:00-24:00
Type of posts		Status	Status		Status Photo	Link
Ratio of posts	Status Photos	Status Videos Links	Status Videos		Status Photo	Status Videos Links

Table 5.15 Significant variables for BFAS addiction components by forward stepwise with adjusted R-square criteria

Type of variables	BFAS addiction components					
	Salience	Mood modification	Tolerance	Withdrawal	Conflict	Relapse
Questionnaire						
Purpose	Kill time		Express identity		Play games	Play games
SNS usage	Length of use	Time spent Length of use	Length of use Frequency of use	Time spent	Time spent Length of use	Length of use
Usage period	18:00–24:00	12:00–13:00	12:00–13:00	09:00–12:00 12:00–13:00	09:00–12:00 12:00–13:00	09:00–12:00 13:00–18:00
Location	School/University	School/University	School/University On vehicles	Home	Home School/University	School Walking On vehicles
Activity			Comment	View friend page		View friend page Update profile
Facebook						
Usage	Comments Replies Time spent Frequency	Friends Frequency	Friends Posts Replies Frequency Sessions	Frequency Sessions		Friends Posts Replies Sessions Time spent
Ratio of usage period	06:00–09:00 12:00–13:00 18:00–24:00	06:00–09:00 After midnight	06:00–09:00 13:00–18:00 18:00–24:00	18:00–24:00 After midnight		
Type of posts	Video	Status Video	Photo Link			
Ratio of posts	Status Videos	Status Photos				Links

For the IAT addiction components, the results of forward stepwise with adjusted R-square criteria indicated 31 out of 49 variables: 14 from questionnaires and 17 from Facebook. The common variables associated with all addiction components was length of use. The common variables associated with any five addiction components were usage period during 12:00-13:00, viewing friend's page, time spent on Facebook, and the ratio of posting status. *Excessive use* is associated with 17 variables, which is the highest, while *anticipation* is associated with five variables, which is the lowest.

For the BFAS addiction components, the results of forward stepwise with adjusted R-square criteria indicated 36 out of 49 variables: 16 from questionnaires and 20 from Facebook. The common variables associated with any five addiction components were length of use and school. *Tolerance* is associated with 17 variables, which is the highest, while *conflict* is associated with seven variables, which is the lowest

D.   Average Square Error (ASE) criteria

Table 5.16 shows the set of significant variables associated with IAT addiction components by forward stepwise with ASE criteria and Table 5.17 shows the set of significant variables associated with BFAS addiction components by forward stepwise with ASE criteria.

For the IAT addiction components, the results of forward stepwise with adjusted ASE criteria indicated 28 out of 49 variables: 12 from questionnaires and 16 from Facebook. The common variables associated with any five addiction components were time spent on Facebook and the ratio of posting status, videos and links. *Excessive use* is associated with 16 variables, which is the highest, while *anticipation* is associated with 9 variables, which is the lowest

For the BFAS addiction components, the results of forward stepwise with ASE criteria indicated 31 out of 49 variables: 13 from questionnaires and 18 from Facebook. The common variables associated with any four addiction components were the usage period during 12:00-13:00 and the ratio of usage period 06:00-09:00. *Relapse* is associated with 13 variables, which is the highest, while *conflict* is associated with six variables, which is the lowest

Table 5.16 Significant variables for IAT addiction components by forward stepwise with ASE criteria

Type of variables	IAT addiction components					
	Salience	Excessive use	Neglecting work	Anticipation	Lack of control	Neglecting social life
Questionnaire						
Purpose						
SNS usage	Length of use	Time spent Frequency of use	Length of use	Frequency of use	Length of use Frequency of use	Time spent Length of use
Usage period	09:00-12:00 18:00-24:00	12:00-13:00 18:00-24:00	09:00-12:00	13:00-18:00	12:00-13:00 18:00-24:00	
Location	Home	Home	Home	On vehicles		School/University
Activity	View friend page	Update profile	View friend page Update profile			
Facebook						
Usage	Time spent	Posts Time spent	Friends Posts Time spent	Posts Time spent	Posts Time spent	Length
Ratio of usage period	09:00-12:00	12:00-13:00 13:00-18:00 18:00-24:00	09:00-12:00		12:00-13:00 18:00-24:00	13:00-18:00 18:00-24:00
Type of posts	Photo Link	Status Photo Video	Status Photo	Link	Status Photo	Link
Ratio of posts	Photos Videos Links	Status Links	Status Videos	Status Videos Links	Status Videos Links	Status Videos Links

Table 5.17 Significant variables for BFAS addiction components by forward stepwise with ASE criteria

Type of variables	BFAS addiction components					
	Salience	Mood modification	Tolerance	Withdrawal	Conflict	Relapse
Questionnaire						
Purpose	Kill time					Play games
SNS usage		Length of use	Length of use	Time spent	Time spent Length of use Frequency of use	
Usage period		12:00-13:00	12:00-13:00	12:00-13:00	12:00-13:00 18:00-24:00	09:00-12:00
Location	School/University	School/University	On vehicles	School/University	Home	
Activity			View friend page			Update profile
Facebook						
Usage	Comments Replies Frequency	Time spent		Time spent		Friends Posts Time spent Length of use
Ratio of usage period	06:00-09:00 18:00-24:00	06:00-09:00 09:00-12:00	09:00-12:00 18:00-24:00	06:00-09:00 12:00-13:00 13:00-18:00 18:00-24:00		06:00-09:00 12:00-13:00
Type of posts	Status Photos Videos	Status Links				Status Photos
Ratio of posts	Status Photos		Links	Photos		Status Photos

5.5.3.5 Decision tree analysis

The decision tree analysis with two algorithms: CHAID and Exhaustive CHAID were used. The analysis results indicated the significant variables associated with addiction components.

Table 5.18 show the set of significant variables associated with IAT addiction components and Table 5.19 show the set of significant variables associated with BFAS addiction components by CHAID algorithm.

For the IAT addiction components, the results of CHAID algorithm indicated 21 out of 49 variables: 13 from questionnaires and 8 from Facebook. The common variables associated with all addiction components was viewing friend's page and the common variables associated with any four addiction components was the ratio of posting status. *Anticipation* is associated with 12 variables, which is the highest, while *lack of control* is associated with five variables, which is the lowest

For the BFAS addiction components, the results of CHAID algorithm indicated 31 out of 49 variables: 21 from questionnaires and 11 from Facebook. The common variables associated with any four addiction components were the usage period during 09:00-12:00 and 18:00-24:00 *Salience* and *withdrawal* are associated with 11 variables, which is the highest, while *mood modification* is associated with seven variables, which is the lowest

Table 5.20 show the set of significant variables associated with IAT addiction components and Table 5.21 show the set of significant variables associated with BFAS addiction components by Exhaustive CHAID algorithm.

For the IAT addiction components, the results of Exhaustive CHAID algorithm indicated 23 out of 49 variables: 15 from questionnaires and 8 from Facebook. The common variables associated with all addiction components was viewing friend's page. The common variables associated with any four addiction components was share experiences. *Anticipation* is associated with 13 variables, which is the highest, while *salience* is associated with four variables, which is the lowest

Table 5.18 Significant variables for IAT addiction components by CHAID

Type of variables	IAT addiction components					
	Salience	Excessive use	Neglecting work	Anticipation	Lack of control	Neglecting social life
Questionnaire						
Purpose	Share experience	Share experience		Keep in touch Share experience Kill time		Play games Make new friend Share experience
SNS usage		Frequency of use		Frequency of use	Frequency of use	Posts
Usage period		18:00-24:00	13:00-18:00 18:00-24:00	06:00-09:00 13:00-18:00	18:00-24:00	
Location	Home School/University		Home School/University Walking	Home School/University		
Activity	View friend page	View friend page Message Play games	View friend page	View friend page Post Comment	View friend page	View friend page
Facebook						
Usage			Time spent	Frequency		
Ratio of usage period		06:00-09:00			06:00-09:00	
Type of posts						
Ratio of posts	Videos Links	Status	Videos		Status	Status

Table 5.19 Significant variables for BFAS addiction components by CHAID

Type of variables	Salience	Mood modification	Tolerance	Withdrawal	Conflict	Relapse
Questionnaire						
Purpose	Kill time	Make new friend Share experience	Play games Express identity Share experience		Play games Make new friends	Play games Share experiences
SNS usage		Length of use		Time spent	Time spent Length of use Frequency of use	Time spent
Usage period	06:00–09:00 09:00–12:00 13:00–18:00	06:00–09:00 12:00–13:00 18:00–24:00	12:00–13:00 18:00–24:00	06:00–09:00 09:00–12:00 18:00–24:00	09:00–12:00 13:00–18:00 18:00–24:00	09:00–12:00 13:00–18:00
Location						Home
Activity			Comment	View feed View friend page Play games	Comment	Update profile Message
Facebook						
Usage	Friends Replies		Posts	Friends		
Ratio of usage period	06:00–09:00 09:00–12:00 13:00–18:00	06:00–09:00		06:00–09:00 After midnight		
Type of posts	Link					
Ratio of posts	Photos		Status	Status		

Table 5.20 Significant variables for IAT addiction components by Exhaustive CHAID

Type of variables	IAT addiction components					
	Salience	Excessive use	Neglecting work	Anticipation	Lack of control	Neglecting social life
Questionnaire						
Purpose	Share experience	Share experience		Keep in touch Share experience Kill time		Play games Make new friend Share experience
SNS usage		Frequency of use		Frequency of use	Frequency of use	
Usage period		18:00–24:00	13:00–18:00 18:00–24:00	06:00–09:00 13:00–18:00	18:00–24:00	
Location	Home School/University		Home School/University Walking	Home School/University		
Activity	View friend page	View friend page Message Play games	View friend page	View friend page Post Comment	View friend page	View friend page
Facebook						
Usage				Frequency		Posts
Ratio of usage period		06:00–09:00		13:00–18:00	06:00–09:00	
Type of posts						
Ratio of posts		Status Links			Status	Status

Table 5.21 Significant variables for BFAS addiction components by Exhaustive CHAID

Type of variables		Salience	Mood modification	Tolerance	Withdrawal	Conflict	Relapse
Questionnaire							
Purpose		Kill time		Play games Express identity Share experience		Play games Make new friends	Play games Share experiences
SNS usage						Time spent Frequency of use	Time spent
Usage period				12:00-13:00 18:00-24:00	06:00-09:00 09:00-12:00 18:00-24:00	09:00-12:00 13:00-18:00 18:00-24:00	09:00-12:00 13:00-18:00
Location							Home
Activity				Comment	View feed View friend page Post Play games	Comment	Update profile Message
Facebook							
Usage		Replies		Posts	Friends		
Ratio of usage period		09:00-12:00 12:00-13:00	06:00-09:00		06:00-09:00 13:00-18:00 After midnight		
Type of posts		Link	Video Link				
Ratio of posts		Photos		Videos	Status Videos		

For the BFAS addiction components, the results of Exhaustive CHAID algorithm indicated 33 out of 49 variables: 20 from questionnaires and 13 from Facebook. The common variables associated with any three addiction components were the purpose for playing game and the usage period during 09:00-12:00 and 18:00-24:00. *Withdrawal* is associated with 13 variables, which is the highest, while *mood modification* is associated with three variables, which is the lowest.

5.5.4 Ensemble of significant variables

To clarify the effective factors associated with addiction components, we analyzed the questionnaire and Facebook data by the following methods:

1. Basic statistics: T-test, ANOVA, and correlation analysis
2. Curve estimation
3. Forward stepwise method with AICC criterion
4. Forward stepwise method with F statistics criterion
5. Forward stepwise method with adjusted R-squared criterion
6. Forward stepwise method with ASE criterion
7. CHAID algorithm
8. Exhaustive CHAID algorithm

The results of each analysis methods indicated the significant variables associated with addiction components. In this section, I combined these results to identify the effective factors. Ensemble of significant variables associated with IAT addiction components is shown in Table 5.22 and Ensemble of significant variable associated with BFAS addiction components is shown in Table 5.23.

Table 5.22 Significant variables associated with IAT addiction components from the results of methods 1-8

Variables	IAT addiction components					
	Salience	Excessive use	Neglecting work	Anticipation	Lack of control	Neglecting social life
Purpose						
Finding information					1	1
Playing games						1, 3,4,5,7,8
Making new friends						5,7,8
Keeping in touch				7,8		
Expressing identity						
Sharing experiences	7,8	7,8		7,8		7,8
Killing time				7,8		
SNS usage						
Time spent	1	5,6	3,5	1	5	5,6
Frequency of use		1,2,3,4,5,6,7,8	5	2,3,6,7,8	1,2,3,5,6,7,8	1
Length of use	1,2,3,4,5,6	1,3,4,5	3,4,5,6	1,3,4,5	1,3,4,5,6	1,3,4,5,6
Usage period						
06:00-09:00				7,8		
09:00-12:00	1,2,5,6	1,2	1,2,3,4,5,6	1		
12:00-13:00	1,3,5	1,2,3,5,6	1,2,3,4,5	1	1,2,3,4,5,6	1,2,3,4,5
13:00-18:00			7,8	1,2,3,4,5,6,7,8		
18:00-24:00	1,2,3,4,5,6	1,2,3,4,5,6,7,8	1,2,7,8		1,2,3,4,5,6,7,8	1
After midnight						
Location						
Home	2,3,4,5,6,7,8	3,5,6	3,4,5,6,7,8	7,8	2,3,4,5	
University	7,8		7,8	7,8		3,5,6
Walking			7,8			5
In vehicles				3,4,5,6		
Activity						
Viewing feed						
Viewing friend's page	1,2,3,4,5,6,7,8	1,2,5,7,8	1,2,3,4,5,6,7,8	1,2,3,5,7,8	1,2,3,4,5,7,8	1,2,3,4,5,7,8
Posting				1,7,8		
Commenting				1,2,7,8		1
Updating profile		1,2,3,4,5,6	1,2,3,5,6	1	1	1,2,3,5
Messaging		7,8				
Playing games		7,8				
Facebook usage						
Friends	1	1	6		1,2	1,2,5
Time spent	2,3,5,6	2,3,4,5,6	2,3,4,5,6,7	1,2,3,4,5,6	5,6	2
Length		2	2	1,2		1,2,6
Frequency				7,8		2
Sessions						1,2,3,4
Posts		5,6	5,6	6	3,5,6	1,7,8
Comments	3,5	5			5	1,2
Replies	1	1				1,2
Ratio of usage period						
06:00-09:00	2	7,8		5	2,7,8	
09:00-12:00	5,6		6			
12:00-13:00	1	1,2,5,6			6	
13:00-18:00	5	5,6		8	5	6
18:00-24:00	5	6			2,6	5,6
After midnight	2,3,4,5				2,3,5	
Types of posts						
Status	1	1,5,6	1,5,6		3,4,5,6	1,2
Photos	6	6	6		3,5,6	1
Videos		6				5,6
Links	6			6		1,2,3,4
Ratio of posts						
Status	1,2,3,4,5	1,2,3,4,5,6,7,8	1,2,5,6	6	1,2,3,4,5,6,7,8	1,2,3,4,5,6,7,8
Photos	3,5,6	3			2,3,4,5	
Videos	1,2,6,7	5	2,3,4,5,6,7	2,6	6	1,2,5,6
Links	2,6,7	5,6,8		6	6	2,5,6

Table 5.23 Significant variables associated with BFAS addiction components from the results of methods 1-8

Variables	BFAS addiction components					
	Salience	Mood modification	Tolerance	Withdrawal	Conflict	Relapse
Purpose						
Finding information						
Playing games			7,8	1	1,2,3,4,5,7,8	2,3,4,5,6,7,8
Making new friends		7			7,8	
Keeping in touch						
Expressing identity			1,2,5,7,8			
Sharing experiences		7	7,8			7,8
Killing time	1,2,3,4,5,6,7,8					
SNS usage						
Time spent	1	1,2,5	2	3,5,6,7	1,2,3,4,5,6,7,8	7,8
Frequency of use	1	1	1,2,3,4,5		6,7,8	
Length of use	2,3,4,5	1,2,3,4,5,6,7	3,4,5,6		3,4,5,6,7	1,3,4,5
Usage period						
06:00-09:00		7		7,8		
09:00-12:00		1		2,5,7,8	2,3,4,5,7,8	1,2,3,4,5,6,7,8
12:00-13:00	1	1,3,5,6,7	1,5,6,7,8	3,4,5,6	1,2,3,5,6	
13:00-18:00		1			1,7,8	1,3,4,5,7,8
18:00-24:00	1,3,5	1,7	1,7,8	1,7,8	1,6,7,8	
After midnight						
Location						
Home	1			3,4,5	3,5,6	7,8
University	3,5,6	3,5,6	3,4,5	6	3,4,5	3,5
Walking			1,2		1	5
In vehicles			3,5,6			5
Activity						
Viewing feed				7,8		
Viewing friend's page		1	1,6	1,3,5,7,8	1	5
Posting		1	1			
Commenting		1	1,2,3,4,5,7,8		1,7,8	
Updating profile		1	1			1,2,3,4,5,6,7,8
Messaging						7,8
Playing games		1		7,8		
Facebook usage						
Friends	1,2,7	2,5,6	1,2,3,5	1,7,8	1	5,6
Time spent	1,2,3,4,5	1,2,3,4,6	1,2	2,6	2,3,4,5,6	3,5,6
Length	1,2	1,2	2,7	2,5	2	6
Frequency	1,2,3,5,6	5	2,5	5	5,6	
Sessions	1,2	1,2	1,2,5	1,2,3,4,5	1,2,5	5
Posts	1	1	1,5,7,8	1	1,7	5,6
Comments	1,2,3,4,5,6	2	2	1,2	5	
Replies	1,2,3,4,5,6,7,8	1,2	1,2,3,4,5	1,2	1,6	5
Ratio of usage period						
06:00-09:00	2,3,4,5,6,7	1,2,3,4,5,6,7,8	1,2,3,4,5	6,7,8	2	6
09:00-12:00	7,8	6	6		6	
12:00-13:00	2,5,8			6	6	6
13:00-18:00	2,7		3,5	2,6,8	5	
18:00-24:00	1,2,3,4,5,6	2	3,5,6	2,3,4,5,6		2
After midnight	2	2,5	2	2,5,7,8	5	
Types of posts						
Status	2	1,5	1,2	1,2	1	6
Photos	2	1,2	1,5	1	1	6
Videos	3,5	3,5,8			5,6	
Links	7,8	8	5			
Ratio of posts						
Status	1,2,5,6	1,2,3,5,6	1,2,7	1,7,8	1,5	6
Photos	2,5,6,7,8	2,3,5		2,6	2,5,6	2,6
Videos	6	2	8	6,8		
Links	2,3	2,6	6		3,6	3,5

5.5.5 Evaluation

5.5.5.1 Method

To confirm the relationships between effective factors from previous section and addiction components, I employed the Support Vector Regression (SVR). SVR is a version of Support Vector Machine (SVM) for regression [101]. It uses the same principles as the SVM for classification. In SVR, the set of training data includes a dependent variable and independent variables.

I trained the SVR model with the set of selected factors that have at least N methods with significant results and measured the correlation, which represents the strength of the relationships between them and addiction components.

5.5.5.2 Evaluation results

Figure 5.4 shows the correlations between sets of selected factors and IAT addiction components. X-axis is the number of methods with significant variables. Y-axis is the correlation values. Line color represents each addiction components. Solid lines are the results of training sets while dot lines are the results of testing sets.

The sets of selected factors that have at least $N=2$ methods with significant variables shows the highest correlation between them and each addiction component. The correlations decrease when the number of methods with significant variables increases.

Figure 5.5 shows the correlation between sets of selected factors and BFAS addition components. The set of selected factors that have at least $N=2$ methods with significant variables also shows the highest correlation between them and each addiction component. The correlations decrease when the number of methods with significant variables increases.
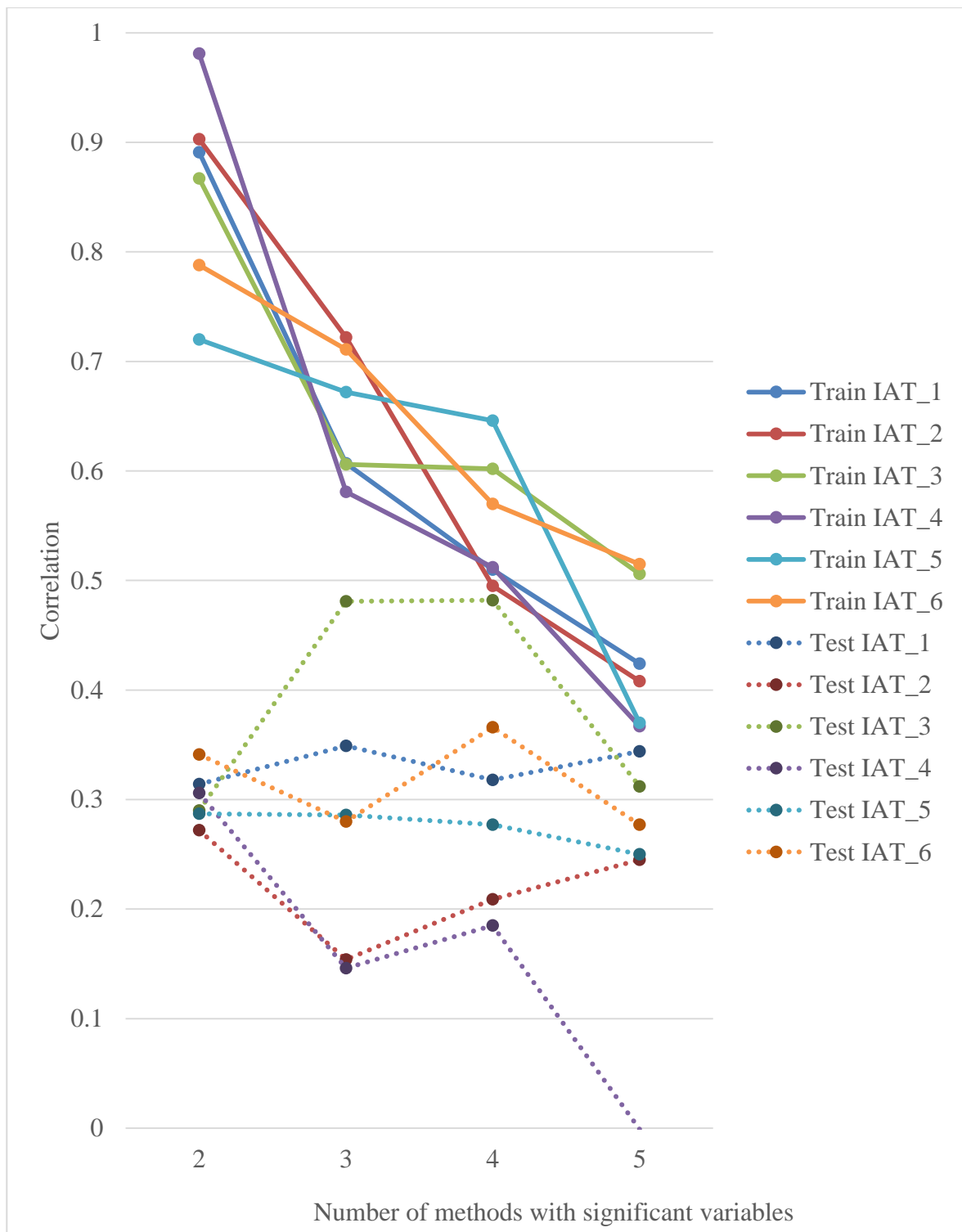
Figure 5.4 Correlation between set of selected factors and IAT addiction components
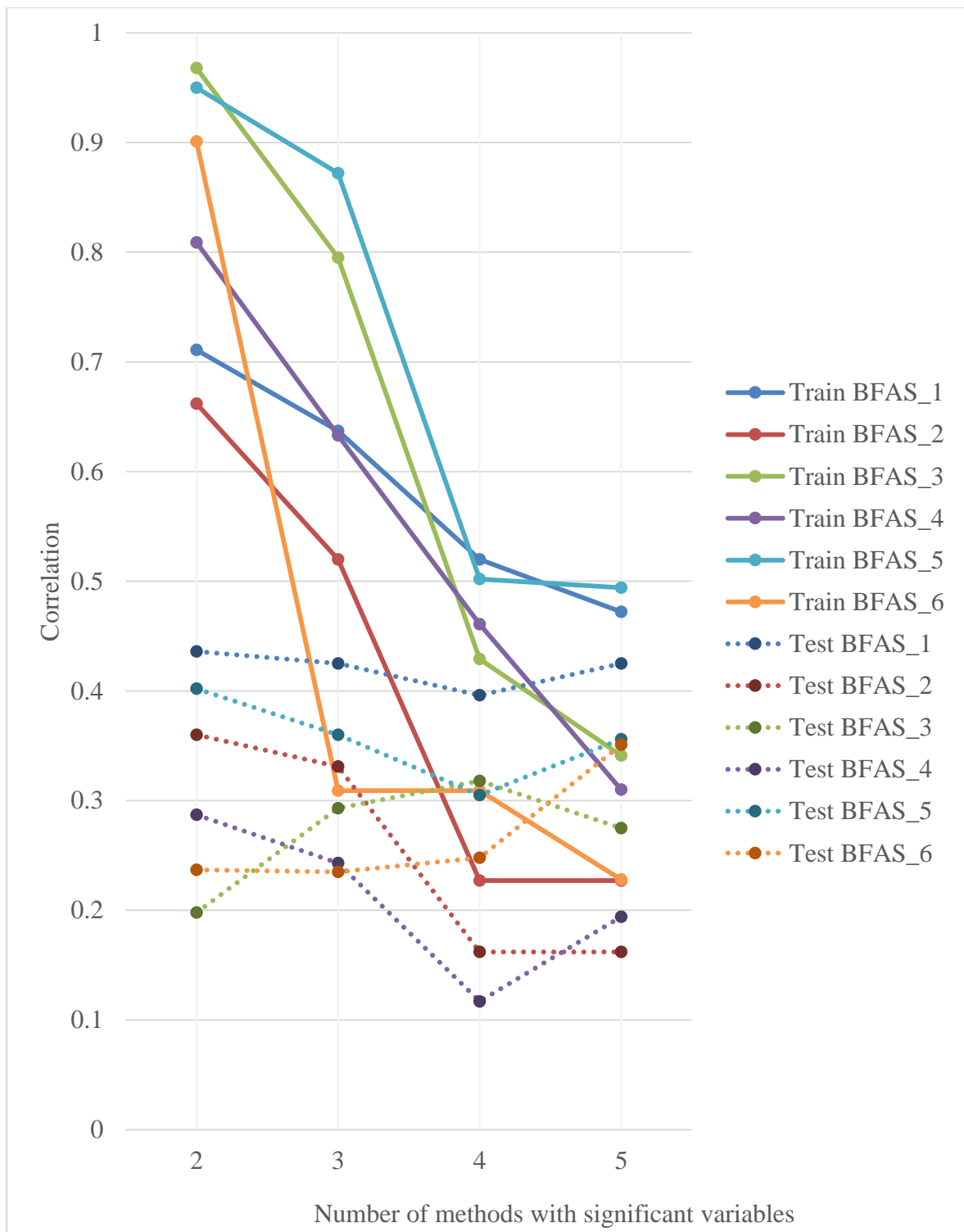
Figure 5.5 Correlation between set of selected factors and BFAS addiction components

5.5.6 Candidates of effective factors associated with addiction components

According to the evaluation results, the factors that have at least two methods with significant results were candidates of effective factors associated with addiction components. The candidates of effective factors associated with IAT addiction components are shown in Table 5.24 and the candidates of effective factors associated with BFAS addiction components are shown in Table 5.25

For the IAT addiction components, the common effective factors associated with all addiction components was length of use. The common effective factors associated with any five addiction components were viewing friend's page, usage period during 12:00-13:00, home, time spent on Facebook, and the ratio of posting status and videos.

For the BFAS addiction components, the common effective factors associated with all addiction components was time spent on Facebook. The common effective factors associated with any five addiction components were length of use, usage period during 18:00-24:00, school/university, friends, sessions, replies, and the ration of posting status and photos.

Table 5.24 Candidates of effective factors associated with IAT addiction components

Type of variables	IAT addiction components					
	Salience	Excessive use	Neglecting work	Anticipation	Lack of control	Neglecting social life
Questionnaire						
Purpose	Share experience	Share experience		Keep in touch Share experience Kill time		Play games Make new friends Share experience
SNS usage	Length of use	Time spent Length of use Frequency of use	Time spent Length of use	Length of use Frequency of use	Length of use Frequency of use	Time spent Length of use
Usage period	09:00-12:00 12:00-13:00 18:00-24:00	09:00-12:00 12:00-13:00 18:00-24:00	09:00-12:00 12:00-13:00 13:00-18:00 18:00-24:00	06:00-09:00 13:00-18:00	12:00-13:00 18:00-24:00	12:00-13:00
Location	Home School	Home	Home School Walking	Home School	Home	School
Activity	View friend's page	View friend's page Update profile Message Play games	View friend's page Update profile	View friend's page Post Comment	View friend's page	View friend's page Update profile
Facebook						
Usage	Time spent Comments	Time spent Posts	Time spent Posts	Time spent Length of use Frequency of use	Friends Posts Time spent	Friends Posts Comments Replies Sessions Length of use
Ratio of usage period	09:00-12:00 After midnight	06:00-09:00 12:00-13:00 13:00-18:00			06:00-09:00 18:00-24:00 After midnight	18:00-24:00
Type of posts		Status	Status	Videos	Status Photos	Status Links
Ratio of posts	Status Photos Videos Links	Status Links	Status Videos		Status Photos	Status Videos Links

Table 5.25 Candidates of effective factors associated with BFAS addiction components

Type of variables	BFAS addiction components					
	Salience	Mood modification	Tolerance	Withdrawal	Conflict	Relapse
Questionnaire						
Purpose	Kill time		Play games Express identity Share experiences		Play games Make new friends	Play games Share experiences
SNS usage	Length of use	Time spent Length of use	Length of use Frequency of use	Time spent	Time spent Length of use Frequency of use	Time spent Length of use
Usage period	18:00-24:00	12:00-13:00 18:00-24:00	12:00-13:00 18:00-24:00	06:00-09:00 09:00-12:00 12:00-13:00 18:00-24:00	09:00-12:00 12:00-13:00 13:00-18:00 18:00-24:00	09:00-12:00 13:00-18:00
Location	School	School	School Walking On vehicles	Home	Home School	Home School
Activity			View friend's page Update profile	View feed View friend's page Play games	Comment	Update profile Message
Facebook						
Usage	Friends Comments Replies Sessions Time spent Frequency of use Length of use	Friends Replies Sessions Time spent Length	Friends Posts Replies Session Time spent Frequency of use Length of use	Friends Comments Replies Sessions Time spent Length of use	Replies Sessions Time spent Frequency of use	Friends Posts Time spent
Ratio of usage period	06:00-09:00 09:00-12:00 12:00-13:00 13:00-18:00 18:00-24:00	06:00-09:00 After midnight	06:00-09:00 13:00-18:00 18:00-24:00	06:00-09:00 13:00-18:00 18:00-24:00		
Type of posts	Videos Links	Status Photos Videos	Status Photos	Status	Videos	
Ratio of posts	Status Photos Links	Status Photos Links	Status	Status Photos Videos	Status Photos Links	Photos Links

5.6   Discussion and Conclusion

In this chapter, I identified the effective factors associated with addiction components. Addiction components are named from associated symptoms. Several screening instruments have developed and reflected different addiction components. In this study, I employed IAT and BFAS to reflect addiction components.

In cooperation with universities in Thailand and development of data collection application (Chapter 3), I can collect data from large samples for identifying the effective factors associated with addiction components. The questionnaire and Facebook data obtained by the data collection application were statically analyzed. Literatures in addiction do exist that employs various analysis methods. Moreover, the data type of questionnaire and Facebook are different. Therefore, various analysis methods were employed in this study (T-test, ANOVA, correlation analysis, curve estimation, regression analysis, and decision tree analysis). The analytic results of each method indicated the significant variables associated with IAT and BFAS addiction components. I combined these results and selected the effective factors. Then, I clarified the relationships between the effective factors and each addiction component.

To confirm the relationships between those effective factors and each addiction component, I employed SVR classifier. The results show that the sets of selected factors that have at least two methods with significant results show the high correlation between them and each addiction component. The correlations decreased when the number of methods with significant results increased. It is better to employ all possible factors related to addiction components. Therefore, factors that have at least two methods with significant results should be candidates of effective factors associated with addiction components.

For example, the candidates of effective factors associated with "neglecting work," one of IAT addiction components were:

- SNS usage: time spent and length of use
- Usage period: 09:00-12:00, 12:00-13:00, 13:00-18:00, and 18:00-24:00
- Location: home, school, and while walking
- Activity: view friend's page and update profile

- Facebook usage: time spent on Facebook and number of posts
- Type of post: status
- Ratio of post: status and video

Because "neglecting work" refers to the decrease of work performance and productivity due to the amount of time spent online [26], the candidates of effective factors I mentioned above are about time spent online. Therefore, these effective factors can be observed to avoid the SNS usage that lead to neglecting work.

Even though, the effective factors were different for each addiction component, some were shared, and common effective factors were associated with both IAT and BFAS addiction components as follows:

- Length of use
- Time spent on Facebook
- Ratio of posting status and video on Facebook

In summary, the useful outcomes are the effective factors associated with each addiction component. Even people can spend many hours on SNSs without be addicted to them, excessive SNS usage have a possibility to become addicts. Therefore, these effective factors can be observed to avoid and prevent the excessive SNS usage that leads to addiction symptoms.

Chapter 6

Discussion

6.1 Summary of Previous Chapters

Social network sites have become an incredibly popular type of communication. Some people spend too much time on SNSs and use them in ways that are becoming excessive and addictive. Therefore, I conduct my research to design and implement the data collection application as a tool for collecting SNS usage data to identify the effective factors associated with SNS addiction and addiction components. I summarize my work in each previous chapter as follows:

- I described the motivation to set my research questions and goals in Chapter 1

- In Chapter 2, I presented the background knowledges and reviewed several researches related to my dissertation.

- Next, I designed and implemented the data collection application as a tool for collecting SNS usage data in Chapter 3.

- In Chapter 4, I clarified the SNS usage and it relationships with SNS addiction by statistically analyzed that data obtaining by the data collection (Chapter 3) and web log data.

- Finally, in Chapter 5, I identified the effective factors associated with addiction components.

This chapter discusses my research that solved all my research questions and achieved my research goals.

6.2 Data Collection Application

My first research question is "How to aggregate SNS usage data for analysis?" To answer this question, I reviewed the existing data collection methods (Chapter 2) and set the first research goal to design and implementation the data collection application (Chapter 3).

Regarding such existing data collection methods described in section 2.4, a single data collection method is not sufficient to capture all aspects of usage on SNSs. Therefore, the combinations of methods describe better SNS usage. The question is which methods should be employed. Addiction scales appeared in the literature is survey-based method. The actual SNS usage data can be retrieved via APIs. Therefore, I designed the data collection application for aggregating SNS usage data from questionnaire and SNSs (Twitter and Facebook). However, there were some issues in implementation.

First, privacy concerns should be considered. Therefore, users were notified about the obtained data then application requested their permission before the data collection. Since, there are large amount of data generated by Twitter and Facebook and limitations of APIs and PHP scripts, the whole SNS usage data cannot be retrieved at once. Therefore, I used task scheduler to solve this problem as described in section 3.3.6. Moreover, a cookie

technique (section 3.2) is employed to combined questionnaire, Facebook and Twitter from the same users.

In summary, I designed and implemented the data collection application for aggregating data for analysis from questionnaire and SNSs to achieve the first research goal. The useful outcome is the data collection application. With this application, I can collect SNS usage data from questionnaire and SNSs for analysis to achieve the second and third goals.

6.3 SNS Usage and Its Relationship with SNS addiction

The second question is "What is the relationship between SNS usage and SNS addiction?" To answer this question, I set the second research goal to clarify SNS usage and its relationship with SNS addiction (Chapter 4).

In cooperation with TNI, I experimentally collected data from undergraduate students in TNI using the data collection application. Moreover, in cooperation with Information and Communication Center of TNI, I could get a dataset of web log files. Therefore, information related to SNS usage I used in this study were questionnaire data, Facebook data, Twitter data and web log data.

I statistically analyzed those data to clarify the relationship between SNS usage and SNS addiction. Due to the different types of the obtained data, various analysis methods were employed appropriately (Chi-square, T-test, ANOVA, correlation analysis, Mann-Whitney U test, discriminant analysis, decision tree, and regression analysis). Effective factors are SNS usage variables differentiated excessive from normal users. Based on the analytic results, the followings are the candidates of effective factors associated with SNS addition:

- Activities on SNSs: commenting and messaging
- Usage periods during 09:00-12:00 and 18:00-24:00
- Daily activities on Facebook
- The ratio of posting video on Facebook
- The ratio of usage on Facebook in the 18:00-24:00 period

There results were limited to TNI students while empirical research has suggested generation and cultural differences in many aspects of SNS usage [1]. As for generation, young people tend to be more likely to engage in SNSs [1,5]. They are the majority of SNS users that I should find factors related to SNS addiction. Therefore, I firstly targeted the participants of this study to be young people. As for culture, SNS usage has been found to differ across cultures [1]. This study targeted to Thai SNS users for exploring the factors that associate with SNS addiction. Further studies will recruit participants from other areas.

In addition, SNS usages of the participants are similar to both survey of Thai SNS users with a random sample of 16,661 participants in Thailand [7] and report of global SNS users [5] in term of usage. Therefore, there is a possibility that the results obtained from this study described in Chapter 4 are broadly applicable to Thai SNS users. Further studies will include participants from other areas.

In summary, I clarified the relationship between SNS usage and SNS addiction to achieve the second research goal. The useful outcomes are the effective factors associated with SNS addiction.

6.4 Effective Factors Associated with Addiction Components

My third research question is "What is the SNS usage that correlates with addiction components?" To answer this question, I set the third research goal to identify the effective factors associated with addiction components.

In this dissertation, I focused on the addiction components of IAT and BFAS (see section 5.1). However, IAT and BFAS addiction components are different. Therefore, I performed the analysis for identifying the effective factors associated with each addiction component.

In Chapter 4, I explored the effective factors that correlate with SNS addiction that limited to TNI participants. In Chapter 5, I recruited additional participants from various universities in Thailand. In cooperation with Thai's universities and development of data collection application, I can collect the SNS usage data from large samples. I analyzed

SNS usage data from questionnaire and Facebook in detail to identify the effective factors associated with each addiction component in various ways.

There are various existing analysis methods. The question is which methods can give the good results. I employed T-test, ANOVA, correlation analysis, curve estimation, regression analysis, and decision tree for analysis. The analytic results of each analysis method indicated the significant factors associated with each addiction component. Then, I combined these results and selected the factors. After confirm the relationships between selected factors and each addiction component, the factors that have at least two methods with significant results were the candidates of effective factors associated with each addiction component.

The candidate of effective factors associated with IAT components is shown in Table 5.24 and the candidate of the effective factors associated with BFAS components is shown in Table 5.25. Regarding the analytic results, the effective factors were different for each addiction component, some were shared, and common effective factors were associated with both IAT and BFAS addiction components (section 5.6).

In summary, I identified the effective factors associated with IAT and BFAS addiction components to achieve the third research goal. The useful outcomes are effective factors associated with each addiction component. In addition, these outcomes might be useful for developing appropriate prevention strategies and treatment for addicts.

6.5 Symptoms of Excessive SNS Usage

Finally, my last research question is "How to assess the symptoms of excessive SNS usage?" To answer this question, the first, second and third goals need to be achieved.

There is a possibility for excessive SNS usage to become addiction. Then, the symptoms of excessive SNS usage resemble those of addiction. Effective factors, the outcomes of second and third research goals, are SNS usage differentiated excessive from normal users. Addiction components are named from associated symptoms. Therefore, the combination of the data collection application and those analysis methods can be applied

for assessing the symptoms of excessive SNS usage to achieve the fourth research goal.

The final goal, method used for assessing the symptom of excessive SNS usage, is the most important research goal of this dissertation. It can achieve the development of prevention strategies to increase awareness of the excessive SNS usage.

6.6 Potential of this Research

The novelties of this dissertation are as follows:

- New data collection application for aggregating SNS usage data from different sources
- Effective factors associated with SNS addiction
- Effective factors associated with each addiction component
- New method for assessing symptom of excessive SNS usage

At this state, I successfully designed and implemented the data collection application for aggregating SNS data from different sources. I also successfully identified the effective factors associated with SNS addiction and the effective factors associated with each addiction component. These results are useful for detecting the symptoms to avoid the addiction and increasing the awareness of excessive SNS usage. Even the results of this study were limited to Thai SNS users, the analysis methods can be applied to different users.

Chapter 7

Conclusion and Future Work

In this chapter, I conclude my doctoral dissertation and propose future work to expand my research and recommendations for subsequent steps of this research field.

7.1   Conclusion

This dissertation studies on user behavior for assessing symptoms of excessive SNS usage to increase awareness of the risk of excessive SNS usage. Below is a summary of each research goal.

To achieve my first research goal, I designed and implemented the data collection application. This application is a tool for aggregating SNS usage data from questionnaire and SNSs by APIs. The questionnaire gathered user experiences with SNSs. Modified IAT

and BFAS were employed as a part of questionnaire to measure SNS addiction and reflect addiction components. APIs were used for directly retrieving data from SNSs.

To achieve my second research goal, I clarified the relationship between SNS usage and SNS addiction. I experimentally collected SNS data using the data collection application from undergraduate students at Thai-Nichi Institute of Technology, Thailand. I also collected a dataset of web log from TNI. The data obtaining by the data collection application including web log data were statistically analyzed to find the effective factors associated with SNS addiction. The analytic results indicated the candidate of effective factors that differentiate excessive from normal users.

To achieve my third research goal, I identified the effective factors associated with addiction components. I recruited additional participants and statistically analyzed their data to identify the factors associated with addiction components. The analytic results indicated the candidate of effective factors for addiction components that were different for each addictive symptom.

To achieve my last research goal, I proposed a new method used for assessing symptoms of excessive SNS usage. This new method is the combinations of the data collection application used for aggregating SNS data and the analysis methods used to achieve the second and third goal.

Finally, I confirmed that I achieved all of my research goals. The last goal, method used for assessing the symptoms, is the most important research goal of this dissertation. It can be applied for developing appropriate prevention strategies for individual to increase the awareness of excessive SNS usage. Even the results of this study were limited to Thai SNS users, the analysis methods can be applied to different users.

7.2 Future Work

This dissertation has the following limitations. The employed data collection methods are not sufficient to represent all aspect of SNS user behavior. The results of this study are limited to Thai SNS users. However, the process I used to analyze and obtain factors related to SNS addiction and those associated with addiction components can be applied for further research especially in behavioral addiction fields.

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Appendix A

Experimental Materials

A.1 Questionnaire Design

Social network usage questionnaire, which was designed for gathering self-report data, has three sections: personal information, social network usage, and social network behavior. To evaluate the design of my questionnaire, I conducted a preliminary experiment of its content validity and usability. Materials of preliminary experiment are shown in A.1-A.6.

Evaluation of Questionnaire Design

Objective of research

The research aims to study Social Networking Sites (SNSs) usage by using survey based method. We design a questionnaire for gathering self-report data of SNSs user behavior. To evaluate the questionnaire design, we will ask for your help to complete the questionnaire. The result will be used for content validity and usability of the questionnaire. Your information will be kept strictly confidential.

This questionnaire has two parts as
- Social Network Usage Questionnaire
- Evaluation of Social Network Usage Questionnaire

Instruction

1. Complete the Social Network Usage Questionnaire. For each question, please select the most closely matches your own experience. The following is an example of how the questionnaire is to be answered.

   - If you do not understand the question, please circle some words that make you feel confuse.
   - In case you cannot answer the question, you can skip it by checking in skip box behind the question.

   1. How much time do you spend on SNSs in a day?
      - ☐ Less than 1 hour
      - ☐ 1-2 hours
      - ☑ 2-3 hours
      - ☐ 3-4 hours
      - ☐ 4-6 hours
      - ☐ 6-10 hours
      - ☐ More than 10 hours

      ☐ Skip Q16

   2. How long do you spend on SNSs in each time?
      - ☐ Less than 1 hour
      - ☐ 1-2 hours
      - ☐ 2-3 hours
      - ☐ 3-4 hours
      - ☐ 4-6 hours
      - ☐ 6-10 hours
      - ☐ More than 10 hours

      ☑ Skip Q17

2. Complete the Evaluation of Social Network Usage Questionnaire.

Definition
Social Networking Sites (SNSs) is platform that groups of people can meet and interact with the others who have the same interests virtually. The example of SNSs are Facebook, Twitter, Instagram, mixi, Youtube, Tumblr, Pinterest, etc.

Please write the date and time and start to answer

Date_____Time_____

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Figure A.1 Materials of preliminary experiment – cover page

1. Social Network Usage Questionnaire

Section A - Personal Information
This section contain 5 questions. Each question will ask for your personal information.

Please select the most appropriate answer.

1. Gender   □ Male   □ Female   □ Transgender

2. Year of birth (A.D.) _____ (example 1988)

3. Occupation   □ Student   □ Work   □ Housewife
                    □ Others   _____

4. Country   _____

5. Do you usually use computer and Internet in work or study?
   □ YES   □ NO

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Figure A.2   Materials of preliminary experiment – social network usage questionnaire:

section A – personal information

Section B – Social Network Usage

This section contains 10 questions. If you do not understand the question, please circle some words that make you feel confuse. In case you cannot answer the question, you can skip it by checking in the box behind the question.

[Part 1] Please select the most appropriate answer.

6. How long do you know and use SNSs?
   □ < 1 year   □ 1-2 years   □ 3-4 years   □ > 5 years   □ Skip Q6

7. Why do you use SNSs? *(You can select more than one)*
   □ To find information   □ To play games
   □ To make new friends   □ To keep in touch with friends
   □ To express your identity □ To share your experience
   □ To kill time   □ Skip Q7
   □ Other _____

8. How much time do you spend on SNSs in a day?
   □ Less than 1 hour   □ 1-2 hours
   □ 2-3 hours   □ 3-4 hours
   □ 4-6 hours   □ 6-10 hours   □ Skip Q8
   □ More than 10 hours

9. How long do you spend on SNSs in each time?
   □ Less than 1 hour   □ 1-2 hours
   □ 2-3 hours   □ 3-4 hours
   □ 4-6 hours   □ 6-10 hours   □ Skip Q9
   □ More than 10 hours

10. What is your frequency for visiting SNSs?
    □ Every 10 minutes   □ Every 30 minutes
    □ Every 1-2 hours   □ Every 3-4 hours
    □ Twice a day   □ Everyday
    □ Twice a week   □ Once a week   □ Skip Q10
    □ Once a month

11. What time do you usually visit SNSs? *(You can select more than one)*
    □ 06.00 AM – 09.00 AM   □ 09.00 AM – 12.00 AM
    □ 12.00 AM – 01.00 PM   □ 01.00 PM – 06.00 PM
    □ 06.00 PM – 12.00 PM   □ Over 12.00 PM   □ Skip Q11

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Figure A.3 Materials of preliminary experiment – social network usage questionnaire:

section B – social network usage part 1

[Part 2] Please indicate how regularly you use SNSs by marking (✓) your answer.

12. Where do you visit SNSs?

Location	Always	Often	Sometimes	Rarely	Never
At home					
At University/School					
At Work					
Outdoor (walking)					
Outdoor(on vehicles)					
Others _____					

☐ Skip Q12

13. What devices do you use to visit SNSs?

Devices	Always	Often	Sometimes	Rarely	Never
Computer					
Tablet					
Smartphone					

☐ Skip Q13

14. Which SNSs do you currently use?

SNS	Several times a day	Daily	Weekly	Monthly	Never
Facebook					
Twitter					
Google+					
Instagram					
YouTube					
mixi					
Line					
Tumblr					
Pinterest					
LinkedIn					
Ameba					
Other _____					

☐ Skip Q14

15. Which activities do you do on SNSs?

Activities	Several times a day	Daily	Weekly	Monthly	Never
Viewing feed					
Viewing friend page					
Posting					
Commenting					
Update your profile					
Sending/Responding to message					
Playing games					
Other_____					

☐ Skip Q15

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Figure A.4   Materials of preliminary experiment – social network usage questionnaire: section B – social network usage part 2

Section C – Social Network Behavior

This section contain 26 questions. If you do not understand the question, please circle some words that make you feel confuse. In case you cannot answer the question, you can skip it by checking in the box behind the question.

Please select the response that best represents the frequency of the behavior described.

0 = Not Applicable	1 = Rarely	2 = Occasionally
3 = Frequently	4 = Often	5 = Always

#	Question	5	4	3	2	1	0	Skip (✓)
1	You spend a lot of time thinking about SNSs or plan use of SNSs.							
2	You feel an urge to use SNSs more and more.							
3	You use SNSs in order to forget about personal problems.							
4	You have tried to cut down on the use of SNSs without success.							
5	You become restless or troubled if you are prohibited from using SNSs.							
6	You use SNSs so much that it has had a negative impact on your job/studies.							
7	How often do you find that you use SNSs longer than you intended?							
8	How often do you neglect household chores to spend more time on SNSs?							
9	How often do you prefer the excitement of SNSs to intimacy with your partner?							
10	How often do you form new relationships with people on SNSs?							
11	How often do others in your life complain to you about the amount of time you spend on SNSs?							
12	How often do your studies or work suffer because of the amount of time you spend on SNSs?							
13	How often do you check SNSs before something else that you need to do?							
14	How often does your job performance or productivity suffer because of SNSs?							
15	How often do you become defensive or secretive when anyone asks you what you do on SNSs?							
16	How often do you block out disturbing thoughts about your life with soothing thoughts of SNSs?							
17	How often do you find yourself anticipating when you will use SNSs again?							
18	How often do you fear that life without SNSs would be boring, empty, and joyless?							
19	How often do you snap, yell, or act annoyed if someone bothers you while you are on SNSs?							
20	How often do you lose sleep due to SNSs?							
21	How often do you feel preoccupied with SNSs, or fantasize about using SNSs?							
22	How often do you find yourself saying "just a few more minutes" when using SNSs?							
23	How often do you try to cut down the amount of time you spend on SNSs and fail?							
24	How often do you try to hide how long you spend on SNSs?							
25	How often do you choose to spend more time staying on SNSs over going out with others?							
26	How often do you feel depressed, moody, or nervous when you are not on SNSs, which goes away once you are back on SNSs?							

Please write the time of completion

Time_____

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Figure A.5 Materials of preliminary experiment – social network usage questionnaire: section C – social network behavior

2. Evaluation of Social Network Usage Questionnaire

Please indicate how you evaluate the questionnaire of the first part

#	Question	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1	Length of questionnaire is too long					
2	Time spend on answer questionnaire is too long					
3	Questions are clearly and easy to understand					
4	Questions are grammatical and not contains complicated syntax					
5	I can understand each question clearly without any confusion					

Thank you for your cooperation

Your information will be kept strictly confidential.

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Ploypailin Intapong
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Graduate School of Engineering and Science

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Figure A.6   Materials of preliminary experiment – evaluation of social network questionnaire

A.1   Data Collection Application

A data collection application is a web-based application that can be accessed through a web browser i.e., Google Chrome. The following figures are the interface of the application.

Figure A.7   Home page

Figure A.8 Questionnaire – Instruction

Figure A.9 Questionnaire – Section A: Personal Information

Figure A.10 Questionnaire – Section B: Social Network Usage (part 1)

Figure A.11 Questionnaire – Section B: Social Network Usage (part 2)

Figure A.12   Questionnaire – Section C: Social Network Behavior (1)

Figure A.13 Questionnaire – Section C: Social Network Behavior (2)

Figure A.14 Questionnaire – Section C: Social Network Behavior (2)

Figure A.15 Twitter quiz page
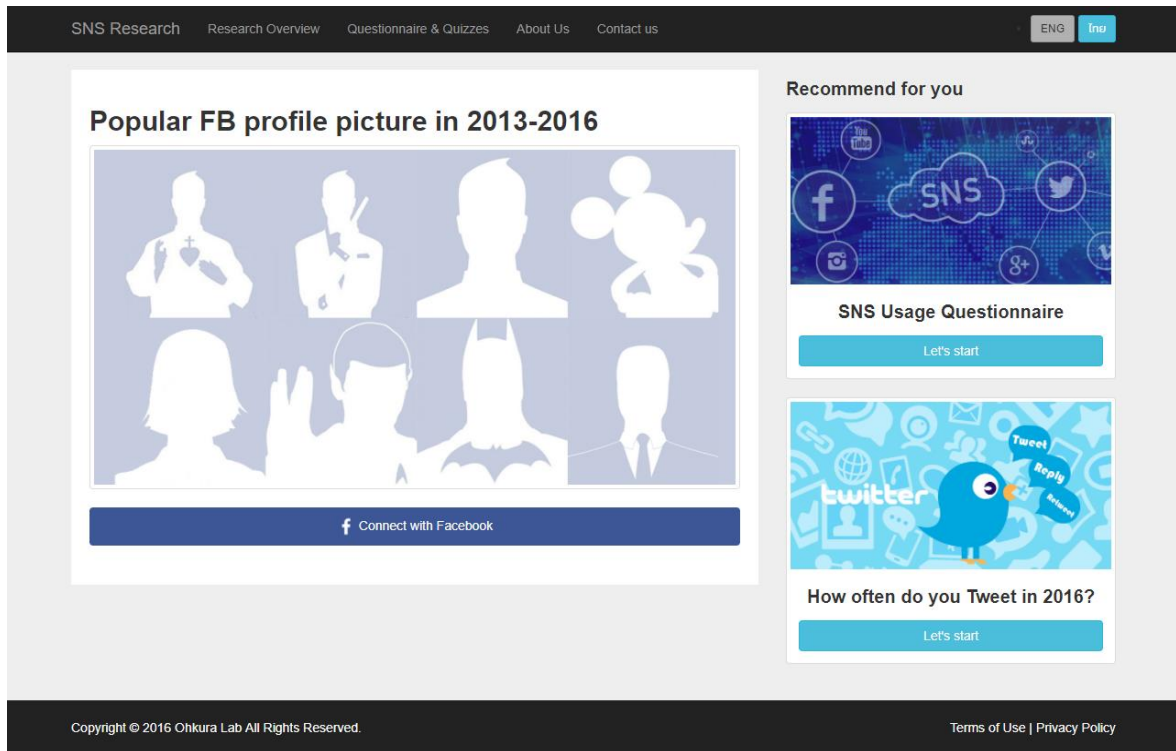
Figure A.16 Facebook quiz page
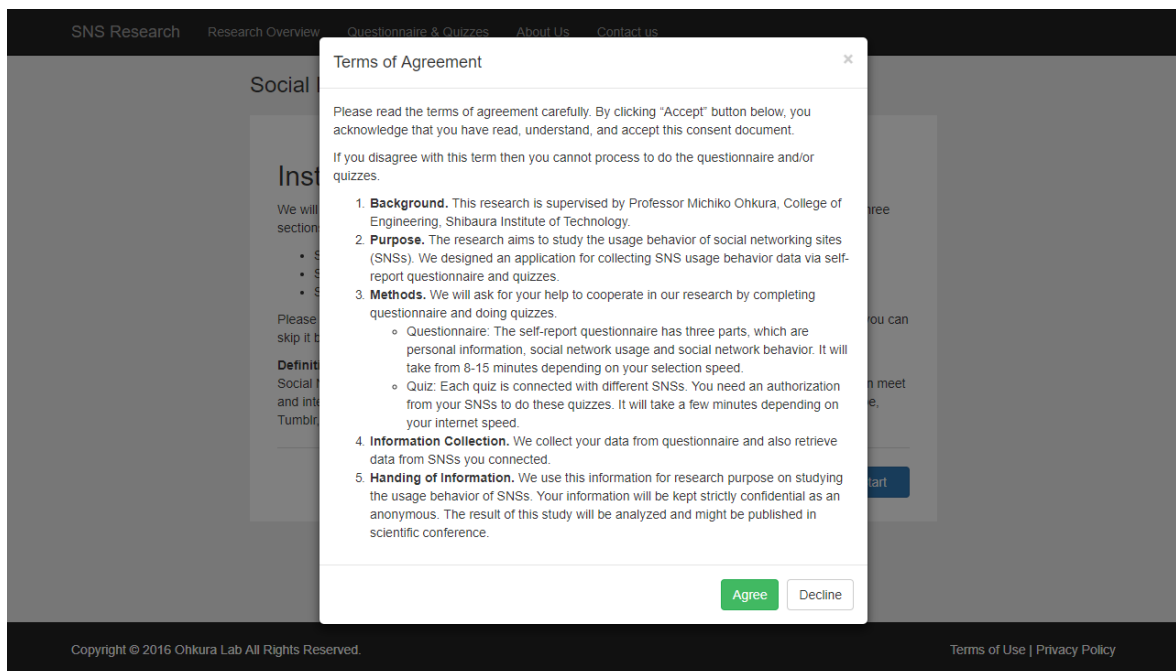
Figure A.17 term of agreement popup

Appendix B

SNS Data and Analysis Results

B.1   SNS Data

A data collection application aggregates SNS data from three sources: questionnaire, Twitter and Facebook. The SNS data obtained by the application are shown in Table B.1-B.7. From the obtained SNS data, I can get the SNS variables related to SNS addiction as shown in Table B.8-B.11.

Table B.1 Questionnaire data

Field	Description
gender	
age	
occupation	
GPA	
nationality	
familiarity	familiarity of using computer and Internet (Yes/No)
years_of_usage	
purpose_1	find information (Yes/No)
purpose_2	play games (Yes/No)
purpose_3	make new friends (Yes/No)
purpose_4	keep in touch (Yes/No)
purpose_5	express identity (Yes/No)
purpose_6	share experience (Yes/No)
purpose_7	kill time (Yes/No)
time_spent	online time per day
length	online time for each time
frequency	frequency of accessing SNS per day
period_1	06:00-09:00 (Yes/No)
period_2	09:00-12:00 (Yes/No)
period_3	12:00-13:00 (Yes/No)
period_4	13:00-18:00 (Yes/No)
period_5	18:00-24:00 (Yes/No)
period_6	after midnight (Yes/No)
location_1	home (rating)
location_2	school/university (rating)
location_3	office (rating)
location_4	walking (rating)
location_5	in vehicles (rating)
device_1	computer (rating)
device_2	tablet (rating)
device_3	smartphone (rating)
act_1	view feed (rating)
act_2	view friend's page (rating)
act_3	post (rating)
act_4	comment (rating)
act_5	update profile (rating)
act_6	message (rating)
act_7	play games (rating)

Table B.2 Questionnaire – IAT and BFAS test results

Field	Description
IAT_score	total score from 20 questions (100)
BFAS_score	total score from 6 questions (30)
IAT	test results: none, mild, moderate, and severe
BFAS	test results: normal or excessive
IAT_1	addictive symptom score – salience
IAT_2	addictive symptom score – excessive
IAT_3	addictive symptom score – neglecting work
IAT_4	addictive symptom score – anticipation
IAT_5	addictive symptom score – lack of control
IAT_6	addictive symptom score – neglecting social life
BFAS_1	addictive symptom score – salience
BFAS_2	addictive symptom score – mood modification
BFAS_3	addictive symptom score – tolerance
BFAS_4	addictive symptom score – withdrawal
BFAS_5	addictive symptom score – conflict
BFAS_6	addictive symptom score – relapse

Table B.3 Twitter user profile

Field	Description
twitter_id	unique id for each Twitter user
screen_name	display Twitter name
followers_count	number of followers
friends_count	number of friends or following
favourite_count	number of favorite/like actions
statuses_count	number of tweets (posts)
joined_date	date Twitter was joined

Table B.4 Tweet

Field	Description
tweet_id	unique id for each tweet (post)
action	tweet, retweet, reply to user, or reply to tweet
media_type	text, photo, or video
source	iphone, android, or web browser
created_at	date of tweet action

Table B.5 Facebook user profile

Field	Description
facebook_id	unique id for each user
username	displayed Facebook name
total_friends	
gender	
birthday	
location	represent nationality

Table B.6 Post

Field	Description
post_id	unique id for each post
action	post/tagged/share
media_type	status/photo/video/link
status_type	mobile_status_update, created_note, added_photos, added_video, shared_story, created_group, created_event, wall_post, app_created_story, published_story, tagged_in_photo, approved_friend
created_at	date of post action

Table B.7 Comment

Field	Description
comment_id	unique id for each comment
parent_id	unique id for parent post or comment
action	comment/reply
media	text/sticker
created_at	date of comment

Table B.8 Questionnaire variables

SNS usage	**Purpose**	**Activity**
• Time spent • Length of use • Frequency of use	• Find information • Play games • Make new friends • Keep in touch • Express identity • Share experiences • Kill time	• View feed • View friends' page • Posts • Comments • Update profile • Messages • Play games
Usage period	**Location**	**Device**
• 06:00-09:00 • 09:00-12:00 • 12:00-13:00 • 13:00-18:00 • 18:00-24:00 • After midnight	• Home • University • Walking • In vehicles	• Computer • Smartphone

Table B.9 Facebook variables

Facebook usage	**Ratio of usage period**	**Type of posts**	**Ratio of posts**
• Friends • Time spent • Length • Frequency • Sessions • Posts • Comments • Replies • Tagged posts	• 06:00-09:00 • 09:00-12:00 • 12:00-13:00 • 13:00-18:00 • 18:00-24:00 • After midnight	• Status • Photos • Videos • Links	• Status • Photos • Videos • Links

Table B.10 Twitter variables

Profile	Usage	Ratio of usage period
• Year Twitter use began	• Time spent	• 06:00-09:00
• Followers	• Length	• 09:00-12:00
• Friends	• Frequency	• 12:00-13:00
• Statistic of use	• Tweet	• 13:00-18:00
• Statistic of favorite	• Retweet	• 18:00-24:00
	• Reply	After midnight

Table B.11 Addiction variables

IAT	BFAS
• Score	• Score
• Results	• Results
• Salience	• Salience
• Excessive use	• Mood modification
• Neglecting work	• Tolerance
• Anticipation	• Withdrawal
• Lack of control	• Conflict
• Neglecting social life	• Relapse

B.2 Analysis Results

B.2.1 T-test Results

Table B.12 Results of the T-test of the differences between questionnaire variables and IAT addiction components – salience

Questionnaire Variables	t-test for Equality of Means				95% Confidence Interval of the Difference	
	t	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Purpose						
Find information	-0.276	0.783	-0.043	0.154	-0.346	0.261
Play games	-1.587	0.113	-0.180	0.113	-0.403	0.043
Make new friends	0.302	0.763	0.035	0.116	-0.193	0.263
Keep in touch	-1.590	0.113	-0.251	0.158	-0.561	0.059
Express identity	0.747	0.456	0.103	0.138	-0.168	0.373
Share experiences	-1.212	0.226	-0.132	0.109	-0.346	0.082
Kill time	-0.188	0.851	-0.020	0.108	-0.232	0.191
Activity						
View feed	-0.654	0.514	-0.112	0.171	-0.448	0.224
View friend's page	3.208	0.001	0.441	0.137	0.171	0.711
Post	1.042	0.298	0.129	0.123	-0.114	0.371
Comment	1.545	0.123	0.169	0.110	-0.046	0.385
Update profile	1.918	0.056	0.632	0.329	-0.016	1.280
Message	0.857	0.392	0.095	0.111	-0.123	0.312
Play games	1.813	0.071	0.241	0.133	-0.020	0.502
Usage period						
06:00-09:00	1.358	0.175	0.181	0.133	-0.081	0.442
09:00-12:00	2.754	0.006	0.293	0.106	0.084	0.501
12:00-13:00	2.973	0.003	0.318	0.107	0.108	0.528
13:00-18:00	1.156	0.249	0.138	0.120	-0.097	0.374
18:00-24:00	-3.498	0.001	-0.370	0.106	-0.578	-0.162
After midnight	-0.464	0.643	-0.067	0.145	-0.351	0.217
Usage						
Frequency of use	1.212	0.226	0.130	0.108	-0.081	0.342

Table B.13 Results of the T-test of the differences between questionnaire variables and IAT addiction components – excessive use

Questionnaire Variables	t-test for Equality of Means				95% Confidence Interval of the Difference	
	t	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Purpose						
Find information	-0.655	0.513	-0.095	0.144	-0.378	0.189
Play games	-1.815	0.070	-0.192	0.106	-0.400	0.016
Make new friends	0.544	0.586	0.059	0.109	-0.155	0.273
Keep in touch	-1.077	0.282	-0.159	0.148	-0.450	0.132
Express identity	0.936	0.350	0.120	0.129	-0.133	0.373
Share experiences	-0.465	0.642	-0.047	0.102	-0.248	0.153
Kill time	-0.896	0.371	-0.090	0.101	-0.288	0.108
Activity						
View feed	-0.585	0.559	-0.094	0.160	-0.408	0.221
View friend's page	2.468	0.014	0.319	0.129	0.065	0.573
Post	0.526	0.599	0.061	0.116	-0.166	0.288
Comment	1.531	0.127	0.157	0.103	-0.045	0.359
Update profile	4.000	0.000	1.212	0.303	0.616	1.808
Message	1.186	0.236	0.123	0.103	-0.081	0.326
Play games	1.488	0.138	0.185	0.124	-0.060	0.430
Usage period						
06:00-09:00	0.039	0.969	0.005	0.125	-0.241	0.250
09:00-12:00	2.628	0.009	0.261	0.099	0.066	0.457
12:00-13:00	3.453	0.001	0.343	0.099	0.148	0.539
13:00-18:00	1.257	0.210	0.141	0.112	-0.079	0.361
18:00-24:00	-2.802	0.005	-0.279	0.100	-0.474	-0.083
After midnight	1.485	0.139	0.200	0.135	-0.065	0.465
Usage						
Frequency of use	2.216	0.027	0.222	0.100	0.025	0.419

Table B.14 Results of the T-test of the differences between questionnaire variables and IAT addiction components – neglecting work

Questionnaire Variables	t-test for Equality of Means				95% Confidence Interval of the Difference	
	t	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Purpose						
Find information	-1.254	0.211	-0.202	0.161	-0.519	0.115
Play games	-1.435	0.152	-0.170	0.119	-0.403	0.063
Make new friends	0.418	0.676	0.051	0.121	-0.188	0.290
Keep in touch	-1.598	0.111	-0.263	0.165	-0.588	0.061
Express identity	1.104	0.270	0.159	0.144	-0.124	0.441
Share experiences	-0.684	0.495	-0.078	0.114	-0.302	0.146
Kill time	-0.220	0.826	-0.025	0.112	-0.246	0.196
Activity						
View feed	-0.991	0.322	-0.177	0.178	-0.528	0.174
View friend's page	2.458	0.016	0.403	0.164	0.077	0.729
Post	-0.128	0.898	-0.017	0.129	-0.271	0.238
Comment	0.532	0.595	0.061	0.115	-0.165	0.287
Update profile	3.476	0.001	1.184	0.341	0.514	1.853
Message	0.085	0.933	0.010	0.116	-0.218	0.237
Play games	1.430	0.154	0.199	0.139	-0.075	0.472
Usage period						
06:00-09:00	0.786	0.432	0.110	0.139	-0.164	0.384
09:00-12:00	2.548	0.011	0.283	0.111	0.065	0.502
12:00-13:00	2.605	0.010	0.292	0.112	0.071	0.512
13:00-18:00	0.891	0.374	0.112	0.125	-0.135	0.358
18:00-24:00	-2.727	0.007	-0.304	0.111	-0.522	-0.085
After midnight	-0.022	0.983	-0.003	0.151	-0.300	0.294
Usage						
Frequency of use	1.344	0.180	0.151	0.112	-0.070	0.372

Table B.15 Results of the T-test of the differences between questionnaire variables and IAT addiction components – anticipation

Questionnaire Variables	t-test for Equality of Means				95% Confidence Interval of the Difference	
	t	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Purpose						
Find information	0.939	0.348	0.144	0.153	-0.157	0.445
Play games	-1.202	0.230	-0.135	0.113	-0.357	0.086
Make new friends	0.875	0.382	0.100	0.115	-0.125	0.326
Keep in touch	-0.608	0.543	-0.096	0.157	-0.404	0.213
Express identity	0.859	0.391	0.117	0.137	-0.151	0.386
Share experiences	-0.960	0.337	-0.104	0.108	-0.317	0.109
Kill time	0.689	0.491	0.074	0.107	-0.136	0.283
Activity						
View feed	-0.574	0.566	-0.097	0.170	-0.431	0.236
View friend's page	2.197	0.029	0.302	0.137	0.032	0.572
Post	2.607	0.010	0.317	0.122	0.078	0.556
Comment	1.899	0.058	0.206	0.109	-0.007	0.420
Update profile	2.049	0.041	0.669	0.327	0.027	1.312
Message	0.242	0.809	0.027	0.110	-0.190	0.243
Play games	0.328	0.743	0.043	0.132	-0.217	0.304
Usage period						
06:00-09:00	1.721	0.086	0.227	0.132	-0.032	0.486
09:00-12:00	2.998	0.003	0.315	0.105	0.109	0.522
12:00-13:00	2.702	0.007	0.287	0.106	0.078	0.496
13:00-18:00	2.067	0.039	0.245	0.118	0.012	0.478
18:00-24:00	-1.809	0.071	-0.192	0.106	-0.401	0.017
After midnight	0.216	0.829	0.031	0.143	-0.251	0.313
Usage						
Frequency of use	1.664	0.097	0.177	0.107	-0.032	0.387

Table B.16 Results of the T-test of the differences between questionnaire variables and IAT addiction components – lack of control

Questionnaire Variables	t-test for Equality of Means				95% Confidence Interval of the Difference	
	t	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Purpose						
Find information	-0.794	0.428	-0.137	0.173	-0.476	0.202
Play games	-2.281	0.023	-0.288	0.126	-0.537	-0.040
Make new friends	-0.080	0.936	-0.010	0.130	-0.266	0.245
Keep in touch	-0.478	0.633	-0.085	0.177	-0.433	0.264
Express identity	1.308	0.192	0.201	0.154	-0.101	0.504
Share experiences	-0.565	0.572	-0.069	0.122	-0.309	0.171
Kill time	-0.425	0.671	-0.051	0.120	-0.288	0.186
Activity						
View feed	-0.518	0.605	-0.099	0.191	-0.475	0.277
View friend's page	3.031	0.003	0.467	0.154	0.164	0.770
Post	0.315	0.753	0.044	0.138	-0.228	0.316
Comment	0.873	0.383	0.107	0.123	-0.134	0.349
Update profile	4.246	0.001	0.893	0.210	0.428	1.357
Message	0.868	0.386	0.107	0.124	-0.136	0.351
Play games	1.236	0.217	0.184	0.149	-0.109	0.477
Usage period						
06:00-09:00	-0.074	0.941	-0.011	0.149	-0.305	0.283
09:00-12:00	1.690	0.092	0.202	0.120	-0.033	0.437
12:00-13:00	2.590	0.010	0.310	0.120	0.075	0.546
13:00-18:00	-0.012	0.990	-0.002	0.134	-0.266	0.262
18:00-24:00	-3.625	0.000	-0.429	0.118	-0.661	-0.196
After midnight	-0.248	0.804	-0.040	0.162	-0.358	0.278
Usage						
Frequency of use	2.287	0.023	0.274	0.120	0.038	0.510

Table B.17 Results of the T-test of the differences between questionnaire variables and IAT addiction components – neglecting social life

Questionnaire Variables	t-test for Equality of Means				95% Confidence Interval of the Difference	
	t	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Purpose						
Find information	-0.917	0.359	-0.150	0.164	-0.472	0.172
Play games	-1.943	0.053	-0.234	0.120	-0.470	0.003
Make new friends	2.758	0.006	0.338	0.122	0.097	0.578
Keep in touch	-0.547	0.585	-0.092	0.168	-0.422	0.239
Express identity	1.666	0.097	0.243	0.146	-0.044	0.529
Share experiences	0.686	0.493	0.079	0.116	-0.148	0.307
Kill time	-1.529	0.127	-0.174	0.114	-0.398	0.050
Activity						
View feed	-0.818	0.414	-0.148	0.181	-0.505	0.208
View friend's page	2.950	0.004	0.505	0.171	0.165	0.846
Post	2.941	0.003	0.382	0.130	0.126	0.637
Comment	3.605	0.000	0.414	0.115	0.188	0.640
Update profile	3.991	0.000	1.374	0.344	0.697	2.051
Message	0.900	0.369	0.106	0.117	-0.125	0.337
Play games	1.094	0.275	0.155	0.141	-0.123	0.433
Usage period						
06:00-09:00	-0.380	0.704	-0.054	0.142	-0.332	0.225
09:00-12:00	1.631	0.104	0.185	0.114	-0.038	0.408
12:00-13:00	2.787	0.006	0.317	0.114	0.093	0.540
13:00-18:00	1.069	0.286	0.136	0.127	-0.114	0.386
18:00-24:00	-2.099	0.036	-0.238	0.114	-0.462	-0.015
After midnight	0.659	0.511	0.101	0.153	-0.201	0.403
Usage						
Frequency of use	2.717	0.007	0.308	0.113	0.085	0.531

Table B.18 Results of the T-test of the differences between questionnaire variables and BFAS addiction components – salience

Questionnaire Variables	t-test for Equality of Means				95% Confidence Interval of the Difference	
	t	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Purpose						
Find information	-0.910	0.363	-0.137	0.150	-0.432	0.159
Play games	-1.012	0.312	-0.112	0.111	-0.329	0.105
Make new friends	0.870	0.385	0.098	0.112	-0.123	0.319
Keep in touch	-0.362	0.717	-0.056	0.154	-0.359	0.247
Express identity	0.924	0.356	0.124	0.134	-0.140	0.387
Share experiences	-0.496	0.620	-0.053	0.106	-0.262	0.156
Kill time	-2.416	0.016	-0.251	0.104	-0.455	-0.047
Activity						
View feed	-1.112	0.267	-0.185	0.166	-0.511	0.142
View friend's page	1.064	0.290	0.160	0.151	-0.139	0.459
Post	1.656	0.099	0.198	0.120	-0.037	0.434
Comment	1.467	0.143	0.157	0.107	-0.053	0.367
Update profile	1.211	0.227	0.390	0.322	-0.243	1.022
Message	0.223	0.824	0.024	0.108	-0.188	0.236
Play games	1.344	0.180	0.174	0.130	-0.081	0.429
Usage period						
06:00-09:00	-0.330	0.742	-0.043	0.130	-0.298	0.212
09:00-12:00	1.722	0.086	0.179	0.104	-0.025	0.384
12:00-13:00	2.269	0.024	0.237	0.104	0.032	0.442
13:00-18:00	0.817	0.414	0.095	0.117	-0.134	0.325
18:00-24:00	-2.795	0.005	-0.290	0.104	-0.493	-0.086
After midnight	0.882	0.379	0.124	0.141	-0.152	0.400
Usage						
Frequency of use	2.578	0.010	0.268	0.104	0.064	0.473

Table B.19 Results of the T-test of the differences between questionnaire variables and BFAS addiction components – mood modification

Questionnaire Variables	t-test for Equality of Means				95% Confidence Interval of the Difference	
	t	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Purpose						
Find information	0.317	0.752	0.046	0.145	-0.239	0.330
Play games	-0.592	0.554	-0.063	0.107	-0.273	0.146
Make new friends	1.119	0.264	0.121	0.108	-0.092	0.334
Keep in touch	-0.818	0.414	-0.121	0.148	-0.413	0.170
Express identity	0.974	0.330	0.126	0.129	-0.128	0.379
Share experiences	0.293	0.770	0.030	0.102	-0.171	0.231
Kill time	-0.840	0.401	-0.085	0.101	-0.283	0.114
Activity						
View feed	0.615	0.539	0.099	0.160	-0.216	0.414
View friend's page	3.086	0.002	0.398	0.129	0.144	0.652
Post	2.537	0.012	0.292	0.115	0.066	0.517
Comment	3.018	0.003	0.307	0.102	0.107	0.508
Update profile	1.981	0.048	0.612	0.309	0.004	1.219
Message	0.317	0.751	0.033	0.104	-0.171	0.237
Play games	2.645	0.009	0.328	0.124	0.084	0.571
Usage period						
06:00-09:00	0.753	0.452	0.094	0.125	-0.152	0.340
09:00-12:00	2.309	0.022	0.231	0.100	0.034	0.427
12:00-13:00	3.883	0.000	0.386	0.099	0.190	0.581
13:00-18:00	2.505	0.013	0.279	0.112	0.060	0.499
18:00-24:00	-1.988	0.047	-0.199	0.100	-0.397	-0.002
After midnight	0.768	0.443	0.104	0.135	-0.162	0.370
Usage						
Frequency of use	1.949	0.052	0.196	0.101	-0.002	0.394

Table B.20 Results of the T-test of the differences between questionnaire variables and BFAS addiction components – tolerance

Questionnaire Variables	t-test for Equality of Means				95% Confidence Interval of the Difference	
	t	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Purpose						
Find information	-0.027	0.978	-0.005	0.173	-0.346	0.336
Play games	-0.228	0.819	-0.029	0.128	-0.280	0.222
Make new friends	-0.164	0.870	-0.021	0.130	-0.278	0.235
Keep in touch	-0.049	0.961	-0.009	0.178	-0.358	0.341
Express identity	2.469	0.014	0.379	0.153	0.077	0.680
Share experiences	0.731	0.465	0.090	0.123	-0.151	0.330
Kill time	-0.189	0.851	-0.023	0.121	-0.260	0.215
Activity						
View feed	0.562	0.576	0.088	0.156	-0.225	0.400
View friend's page	3.111	0.002	0.480	0.154	0.177	0.784
Post	2.183	0.030	0.301	0.138	0.030	0.572
Comment	3.872	0.000	0.469	0.121	0.231	0.707
Update profile	2.075	0.039	0.767	0.370	0.040	1.494
Message	0.777	0.437	0.097	0.124	-0.148	0.341
Play games	1.788	0.075	0.267	0.149	-0.027	0.560
Usage period						
06:00-09:00	1.139	0.257	0.183	0.161	-0.136	0.502
09:00-12:00	1.237	0.217	0.149	0.120	-0.088	0.385
12:00-13:00	2.126	0.034	0.256	0.121	0.019	0.493
13:00-18:00	1.967	0.050	0.264	0.134	0.000	0.527
18:00-24:00	-1.990	0.047	-0.239	0.120	-0.475	-0.003
After midnight	0.571	0.568	0.093	0.162	-0.226	0.412
Usage						
Frequency of use	2.426	0.016	0.291	0.120	0.055	0.528

Table B.21 Results of the T-test of the differences between questionnaire variables and BFAS addiction components – withdrawal

Questionnaire Variables	t-test for Equality of Means				95% Confidence Interval of the Difference	
	t	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Purpose						
Find information	-0.600	0.549	-0.098	0.163	-0.419	0.223
Play games	-2.609	0.009	-0.311	0.119	-0.546	-0.077
Make new friends	-0.667	0.505	-0.082	0.123	-0.324	0.160
Keep in touch	-1.492	0.136	-0.249	0.167	-0.578	0.079
Express identity	0.093	0.926	0.013	0.146	-0.273	0.300
Share experiences	-0.837	0.403	-0.097	0.115	-0.324	0.130
Kill time	-1.024	0.307	-0.116	0.114	-0.340	0.107
Activity						
View feed	-0.994	0.321	-0.180	0.181	-0.535	0.176
View friend's page	2.393	0.017	0.350	0.146	0.062	0.638
Post	0.980	0.328	0.128	0.131	-0.129	0.385
Comment	1.250	0.212	0.145	0.116	-0.083	0.374
Update profile	1.050	0.295	0.367	0.350	-0.321	1.055
Message	0.244	0.808	0.029	0.117	-0.202	0.259
Play games	-0.319	0.750	-0.045	0.141	-0.323	0.233
Usage period						
06:00-09:00	-1.410	0.162	-0.212	0.150	-0.510	0.086
09:00-12:00	1.455	0.147	0.165	0.113	-0.058	0.387
12:00-13:00	1.941	0.053	0.221	0.114	-0.003	0.445
13:00-18:00	1.305	0.193	0.165	0.127	-0.084	0.414
18:00-24:00	-3.307	0.001	-0.368	0.111	-0.588	-0.149
After midnight	-0.038	0.969	-0.006	0.153	-0.307	0.295
Usage						
Frequency of use	0.961	0.337	0.109	0.114	-0.115	0.334

Table B.22 Results of the T-test of the differences between questionnaire variables and
BFAS addiction components – conflict

Questionnaire Variables	t-test for Equality of Means				95% Confidence Interval of the Difference	
	t	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Purpose						
Find information	0.368	0.713	0.062	0.168	-0.269	0.393
Play games	-3.060	0.002	-0.374	0.122	-0.615	-0.134
Make new friends	-0.167	0.867	-0.020	0.119	-0.254	0.214
Keep in touch	-0.194	0.846	-0.034	0.172	-0.373	0.306
Express identity	1.359	0.175	0.203	0.150	-0.091	0.498
Share experiences	0.798	0.426	0.095	0.119	-0.139	0.328
Kill time	-0.064	0.949	-0.007	0.117	-0.238	0.223
Activity						
View feed	1.235	0.217	0.230	0.186	-0.136	0.595
View friend's page	2.079	0.038	0.314	0.151	0.017	0.610
Post	1.263	0.207	0.170	0.134	-0.094	0.434
Comment	2.373	0.018	0.282	0.119	0.048	0.516
Update profile	1.430	0.153	0.514	0.360	-0.193	1.221
Message	1.446	0.149	0.174	0.120	-0.063	0.411
Play games	1.271	0.205	0.184	0.145	-0.101	0.469
Usage period						
06:00-09:00	0.234	0.815	0.034	0.145	-0.252	0.320
09:00-12:00	1.323	0.187	0.154	0.117	-0.075	0.383
12:00-13:00	2.636	0.009	0.307	0.117	0.078	0.537
13:00-18:00	1.999	0.046	0.260	0.130	0.004	0.515
18:00-24:00	-2.169	0.031	-0.253	0.116	-0.481	-0.024
After midnight	-0.046	0.964	-0.007	0.157	-0.317	0.302
Usage						
Frequency of use	1.687	0.092	0.197	0.117	-0.033	0.427

Table B.23 Results of the T-test of the differences between questionnaire variables and BFAS addiction components – relapse

Questionnaire Variables	t-test for Equality of Means				95% Confidence Interval of the Difference	
	t	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Purpose						
Find information	0.039	0.969	0.006	0.150	-0.289	0.301
Play games	-1.743	0.082	-0.192	0.110	-0.408	0.025
Make new friends	-0.955	0.340	-0.108	0.113	-0.330	0.114
Keep in touch	-0.274	0.784	-0.042	0.154	-0.344	0.260
Express identity	0.102	0.919	0.014	0.134	-0.249	0.277
Share experiences	-0.562	0.574	-0.060	0.106	-0.268	0.149
Kill time	-0.177	0.860	-0.018	0.104	-0.224	0.187
Activity						
View feed	0.231	0.817	0.038	0.166	-0.288	0.365
View friend's page	1.141	0.254	0.154	0.135	-0.111	0.420
Post	-0.557	0.578	-0.067	0.120	-0.303	0.169
Comment	0.295	0.768	0.031	0.107	-0.178	0.241
Update profile	2.413	0.016	0.769	0.319	0.142	1.397
Message	0.151	0.880	0.017	0.112	-0.203	0.237
Play games	0.472	0.637	0.061	0.129	-0.194	0.316
Usage period						
06:00-09:00	0.988	0.324	0.128	0.129	-0.127	0.382
09:00-12:00	2.252	0.025	0.233	0.103	0.030	0.436
12:00-13:00	0.920	0.358	0.096	0.105	-0.110	0.302
13:00-18:00	2.001	0.046	0.232	0.116	0.004	0.460
18:00-24:00	-0.868	0.386	-0.091	0.104	-0.296	0.115
After midnight	0.500	0.618	0.070	0.140	-0.206	0.346
Usage						
Frequency of use	1.383	0.168	0.144	0.104	-0.061	0.350

B.2.2 ANOVA Results

Table B.24 ANOVA between questionnaire variables and IAT addiction components – salience

Questionnaire Variables	Sum of Squares	df	Mean Square	F	Sig.
Usage					
Time spent	8.347	3	2.782	2.65	0.049
Length of use	14.239	5	2.848	2.74	0.019
Location					
Home	3.322	3	1.107	1.041	0.374
University	4.637	3	1.546	1.458	0.226
Walking	6.063	3	2.021	1.914	0.127
In vehicles	1.371	3	0.457	0.428	0.733

Table B.25 ANOVA between questionnaire variables and IAT addiction components – excessive use

Questionnaire Variables	Sum of Squares	df	Mean Square	F	Sig.
Usage					
Time spent	3.285	3	1.095	1.179	0.317
Length of use	14.895	5	2.979	3.302	0.006
Location					
Home	2.229	3	0.743	0.798	0.496
University	4.527	3	1.509	1.631	0.182
Walking	5.649	3	1.883	2.042	0.108
In vehicles	1.442	3	0.481	0.515	0.672

Table B.26 ANOVA between questionnaire variables and IAT addiction components – neglecting work

Questionnaire Variables	Sum of Squares	df	Mean Square	F	Sig.
Usage					
Time spent	3.955	3	1.318	1.135	0.335
Length of use	10.947	5	2.189	1.906	0.092
Location					
Home	4.779	3	1.593	1.374	0.25
University	3.546	3	1.182	1.017	0.385
Walking	3.864	3	1.288	1.109	0.345
In vehicles	0.271	3	0.09	0.077	0.972

Table B.27 ANOVA between questionnaire variables and IAT addiction components – anticipation

Questionnaire Variables	Sum of Squares	df	Mean Square	F	Sig.
Usage					
Time spent	9.424	3	3.141	3.048	0.029
Length of use	12.952	5	2.59	2.523	0.029
Location					
Home	2.115	3	0.705	0.671	0.57
University	3.685	3	1.228	1.174	0.319
Walking	0.197	3	0.066	0.062	0.98
In vehicles	6.328	3	2.109	2.03	0.109

Table B.28 ANOVA between questionnaire variables and IAT addiction components – lack of control

Questionnaire Variables	Sum of Squares	df	Mean Square	F	Sig.
Usage					
Time spent	6.335	3	2.112	1.592	0.191
Length of use	18.065	5	3.613	2.776	0.018
Location					
Home	5.471	3	1.824	1.373	0.251
University	3.665	3	1.222	0.916	0.433
Walking	1.825	3	0.608	0.455	0.714
In vehicles	0.908	3	0.303	0.226	0.879

Table B.30 ANOVA between questionnaire variables and BFAS addiction components – salience

Questionnaire Variables	Sum of Squares	df	Mean Square	F	Sig.
Usage					
Time spent	8.615	3	2.872	2.893	0.035
Length of use	6.386	5	1.277	1.272	0.275
Location					
Home	10.05	3	3.35	3.388	0.018
University	2.156	3	0.719	0.712	0.546
Walking	2.442	3	0.814	0.806	0.491
In vehicles	0.071	3	0.024	0.023	0.995

Table B.29 ANOVA between questionnaire variables and IAT addiction components – neglecting social life

Questionnaire Variables	Sum of Squares	df	Mean Square	F	Sig.
Usage					
Time spent	7.18	3	2.393	2.011	0.112
Length of use	15.12	5	3.024	2.574	0.026
Location					
Home	2.481	3	0.827	0.688	0.56
University	6.46	3	2.153	1.807	0.146
Walking	6.121	3	2.04	1.711	0.164
In vehicles	0.3	3	0.1	0.083	0.969

Table B.31 ANOVA between questionnaire variables and BFAS addiction components – mood modification

Questionnaire Variables	Sum of Squares	df	Mean Square	F	Sig.
Usage					
Time spent	16.213	3	5.404	6.013	0.001
Length of use	18.115	5	3.623	4.032	0.001
Location					
Home	2.421	3	0.807	0.862	0.461
University	3.178	3	1.059	1.134	0.335
Walking	6.083	3	2.028	2.189	0.089
In vehicles	1.85	3	0.617	0.658	0.579

Table B.32 ANOVA between questionnaire variables and BFAS addiction components – tolerance

Questionnaire Variables	Sum of Squares	df	Mean Square	F	Sig.
Usage					
Time spent	5.849	3	1.95	1.459	0.225
Length of use	10.815	5	2.163	1.626	0.152
Location					
Home	1.833	3	0.611	0.454	0.715
University	8.795	3	2.932	2.207	0.087
Walking	11.053	3	3.684	2.787	0.041
In vehicles	6.764	3	2.255	1.691	0.169

Table B.34 ANOVA between questionnaire variables and BFAS addiction components – conflict

Questionnaire Variables	Sum of Squares	df	Mean Square	F	Sig.
Usage					
Time spent	15.351	3	5.117	4.158	0.006
Length of use	8.975	5	1.795	1.43	0.212
Location					
Home	7.184	3	2.395	1.912	0.127
University	7.841	3	2.614	2.089	0.101
Walking	13.464	3	4.488	3.632	0.013
In vehicles	4.492	3	1.497	1.188	0.314

Table B.33 ANOVA between questionnaire variables and BFAS addiction components – withdrawal

Questionnaire Variables	Sum of Squares	df	Mean Square	F	Sig.
Usage					
Time spent	6.736	3	2.245	1.898	0.130
Length of use	12.794	5	2.559	2.181	0.056
Location					
Home	5.304	3	1.768	1.489	0.217
University	1.607	3	0.536	0.447	0.719
Walking	3.852	3	1.284	1.078	0.358
In vehicles	1.918	3	0.639	0.535	0.659

Table B.35 ANOVA between questionnaire variables and BFAS addiction components – relapse

Questionnaire Variables	Sum of Squares	df	Mean Square	F	Sig.
Usage					
Time spent	3.916	3	1.305	1.305	0.272
Length of use	13.322	5	2.664	2.719	0.02
Location					
Home	0.378	3	0.126	0.125	0.945
University	4.358	3	1.453	1.454	0.227
Walking	2.471	3	0.824	0.82	0.483
In vehicles	0.76	3	0.253	0.251	0.86

B.2.3 Spearman's Correlation Analysis Results

Table B.36 Spearman's correlation coefficient between Facebook variables and IAT addiction components

Facebook variables	Spearman's correlation coefficient (r)					
	Salience	Excessive use	Neglecting work	Anticipation	Lack of control	Neglecting social life
Facebook usage						
Friends	0.135*	0.179**	0.044	0.069	0.183**	0.217**
Time spent	0.129	0.131	0.136	0.141*	0.052	0.135
Length	0.117	0.125	0.123	0.141*	0.028	0.150*
Frequency	0.060	0.075	0.057	0.072	-0.028	0.128
Sessions	0.106	0.112	0.091	0.104	0.070	0.226**
Posts	0.074	0.100	0.100	0.089	0.040	0.208**
Comments	0.049	0.050	0.073	0.060	0.022	0.138*
Replies	0.121	0.145*	0.109	0.101	0.078	0.231**
Ratio of usage period						
06:00-09:00	0.117	0.082	0.044	0.072	0.102	0.108
09:00-12:00	0.049	0.003	0.035	-0.013	0.027	-0.068
12:00-13:00	0.076	0.141*	0.068	0.051	0.086	0.070
13:00-18:00	-0.030	-0.046	0.001	-0.016	-0.030	-0.015
18:00-24:00	0.086	0.090	0.079	0.010	0.109	0.119
After midnight	-0.102	-0.018	-0.022	-0.008	-0.083	-0.039
Type of posts						
Status	0.136*	0.153*	0.140*	0.082	0.080	0.290**
Photos	0.048	0.071	0.079	0.061	0.024	0.147*
Videos	-0.045	-0.010	-0.032	0.032	-0.030	0.021
Links	-0.051	0.009	0.082	0.070	-0.038	0.052
Ratio of posts						
Status	0.201**	0.205**	0.196**	0.091	0.177*	0.320**
Photos	-0.009	-0.003	-0.011	-0.017	0.022	-0.089
Videos	-0.142*	-0.088	-0.098	-0.035	-0.079	-0.143*
Links	-0.133	-0.088	0.043	0.012	-0.073	-0.116

*significant at p<0.05, **significant at p<0.01*

Table B.37 Spearman's correlation coefficient between Facebook variables and BFAS addiction components

Facebook variables	Spearman's correlation coefficient					
	Salience	Mood modification	Tolerance	Withdrawal	Conflict	Relapse
Facebook usage						
Friends	0.0194**	0.120	0.149*	0.164*	0.141*	0.017
Time spent	0.267**	0.143*	0.169*	0.085	0.109	0.055
Length	0.259**	0.170*	0.180**	0.088	0.093	0.042
Frequency	0.155*	0.126	0.117	0.050	0.031	0.017
Sessions	0.255**	0.207**	0.169*	0.208**	0.202**	0.046
Posts	0.217**	0.187**	0.173**	0.176**	0.194**	0.080
Comments	0.171*	0.116	0.125	0.143*	0.074	0.046
Replies	0.293**	0.208**	0.183**	0.220**	0.156*	0.054
Ratio of usage period						
06:00-09:00	0.128	.193**	.183**	0.114	0.100	0.020
09:00-12:00	-0.015	0.081	-0.011	-0.023	0.095	0.019
12:00-13:00	0.012	0.077	0.004	0.084	0.102	0.039
13:00-18:00	-0.075	0.030	0.022	0.017	-0.017	0.063
18:00-24:00	.214**	0.028	0.050	0.128	0.082	-0.004
After midnight	-0.074	-0.017	-0.099	-0.040	-0.023	0.023
Type of posts						
Status	0.219**	0.194**	0.186**	0.165*	0.193**	0.094
Photos	0.212**	0.194**	0.138*	0.169*	0.166*	0.061
Videos	0.108	0.110	0.055	0.113	0.100	0.019
Links	0.066	0.099	0.032	0.086	0.067	0.013
Ratio of posts						
Status	0.143*	0.167*	0.150*	0.151*	0.170*	0.126
Photos	0.002	0.039	-0.040	-0.003	0.009	0.022
Videos	-0.021	0.018	-0.083	0.025	0.001	0.012
Links	-0.063	-0.020	-0.120	-0.045	-0.054	-0.079

*significant at p<0.05, **significant at p<0.01

B.2.4 Regression Analysis Results

B.2.4.1 AICC criteria

A. Questionnaire

Table B.38 Regression analysis with AICC criteria of questionnaire for IAT_1

Model Term	Coefficient	Sig	Importance
Intercept	2.319	0	
Length	0.499	0	0.381
View friend's page	-0.502	0.006	0.225
18:00-24:00	0.359	0.011	0.192
Home	-0.301	0.032	0.137
12:00-13:00	-0.209	1.35	0.066

Table B.39 Regression analysis with AICC criteria of questionnaire for IAT_2

Model Term	Coefficient	Sig	Importance
Intercept	3.017	0	
Length of use	0.403	0.003	0.346
Update profile	-0.974	0.043	0.157
12:00-13:00	-0.256	0.061	0.135
Frequency of use	-0.244	0.073	0.123
18:00-24:00	0.246	0.075	0.122
Home	-0.239	0.081	0.117

Table B.40 Regression analysis with AICC criteria of questionnaire for IAT_3

Model Term	Coefficient	Sig	Importance
Intercept	3.529	0	
Home	-0.467	0.001	0.263
Length of use	0.726	0.002	0.255
View friend's page	-0.482	0.016	0.147
09:00-12:00	-0.288	0.049	0.099
12:00-13:00	-0.265	0.072	0.082
Time spent	-0.257	0.075	0.08
Update profile	-0.913	0.09	0.073

Table B.41 Regression analysis with AICC criteria of questionnaire for IAT_4

Model Term	Coefficient	Sig	Importance
Intercept	3.331	0	
13:00-18:00	-0.319	0.04	0.246
Length of use	-0.55	0.045	0.235
View friend's page	-0.335	0.063	0.201
On vehicles	-0.27	0.078	0.181
Frequency of use	-0.216	0.124	0.138

Table B.42 Regression analysis with AICC criteria of questionnaire for IAT_5

Model Term	Coefficient	Sig	Importance
Intercept	2.399	0	
Length of use	0.582	0	0.388
12:00-13:00	-0.367	0.018	0.146
Home	0.455	0.023	0.137
View friend's page	-0.448	0.024	0.134
18:00-24:00	0.333	0.029	0.126
Frequency of use	-0.247	0.106	0.068

Table B.43 Regression analysis with AICC criteria of questionnaire for IAT_6

Model Term	Coefficient	Sig	Importance
Intercept	3.435	0	
Length of use	0.421	0.006	0.276
View friend's page	-0.513	0.016	0.211
Play games	0.373	0.021	0.193
12:00-13:00	-0.292	0.056	0.131
University	-0.263	0.085	0.106
Update profile	-0.86	0.13	0.082

Table B.44 Regression analysis with AICC criteria of questionnaire for BFAS_1

Model Term	Coefficient	Sig	Importance
Intercept	3.365	0	
Length of use	0.323	0.039	0.333
purpose	0.256	0.061	0.274
University	-0.223	0.108	0.201
18:00-24:00	0.216	0.116	0.192

Table B.45 Regression analysis with AICC criteria of questionnaire for BFAS _2

Model Term	Coefficient	Sig	Importance
Intercept	3.698	0	
Length of use	-0.0394	0.005	0.51
12:00-13:00	-0.271	0.035	0.282
University	0.3	0.07	0.208

Table B.46 Regression analysis with AICC criteria of questionnaire for BFAS _3

Model Term	Coefficient	Sig	Importance
Intercept	3.713	0	
Length of use	0.57	0.005	0.301
Comment	-0.414	0.009	0.256
University	-0.431	0.013	0.232
Frequency of use	-0.299	0.062	0.13
On vehicles	-0.293	0.139	0.082

Table B.47 Regression analysis with AICC criteria of questionnaire for BFAS _4

Model Term	Coefficient	Sig	Importance
Intercept	3.682	0	
University	-0.578	0.004	0.501
View friend's page	-0.353	0.081	0.185
Time spent	0.394	0.1	0.164
12:00-13:00	-248	0.117	0.149

Table B.48 Regression analysis with AICC criteria of questionnaire for BFAS _5

Model Term	Coefficient	Sig	Importance
Intercept	3.141	0	
Play games	0.522	0.001	0.289
Length of use	-0.375	0.016	0.161
Home	-0.446	0.024	0.139
12:00-13:00	-0.337	0.03	0.129
University	-0.316	0.059	0.098
Time spent	-0.446	0.062	0.096
09:00-12:00	-0.275	0.072	0.088

Table B.49 Regression analysis with AICC criteria of questionnaire for BFAS _6

Model Term	Coefficient	Sig	Importance
Intercept	3.84	0	
Length of use	0.38	0.094	0.285
Play games	0.367	0.011	0.196
Update profile	-1.189	0.014	0.182
09:00-12:00	-0.309	0.023	0.154
13:00-18:00	-0.28	0.06	0.105
University	0.258	0.105	0.078

B.   Facebook

Table B.50 Regression analysis with AICC criteria of Facebook for IAT_1

Model Term	Coefficient	Sig	Importance
Intercept	1.242	0	
Ratio of posting status	1.27	0.001	0.422
After midnight	-1.972	0.04	0.169
Time spent	0.029	0.047	0.158
Comments	-0.007	0.058	0.144
Ratio of posting photos	0.599	0.102	0.107

Table B.53 Regression analysis with AICC criteria of Facebook for IAT_4

Model Term	Coefficient	Sig	Importance
Intercept	2.021	0	
Time spent	0.031	0.02	

Table B.51 Regression analysis with AICC criteria of Facebook for IAT_2

Model Term	Coefficient	Sig	Importance
Intercept	1.124	0	
Ratio of posting status	0.977	0.009	0.538
Time spent	0.026	0.055	0.288
Ratio of posting photos	0.528	0.134	0.175

Table B.54 Regression analysis with AICC criteria of Facebook for IAT_5

Model Term	Coefficient	Sig	Importance
Intercept	1.295	0	
Ratio of posting status	2.356	0	0.348
Type of posting status	-0.017	0.002	0.203
Ratio of posting photos	0.1355	0.004	0.178
Posts	0.006	0.011	0.14
Type of posting photos	-0.009	0.069	0.071
After midnight	-1.753	0.098	0.059

Table B.52 Regression analysis with AICC criteria of Facebook for IAT_3

Model Term	Coefficient	Sig	Importance
Intercept	1.176	0	
Time spent	0.038	0.008	0.646
Ratio of posting videos	-1.268	0.049	0.354

Table B.55 Regression analysis with AICC criteria of Facebook for IAT_6

Model Term	Coefficient	Sig	Importance
Intercept	1.601	0	
Ratio of posting status	1.355	0	0.744
Sessions	0.002	0.036	0.256

Table B.56 Regression analysis with AICC criteria of Facebook for BFAS _1

Model Term	Coefficient	Sig	Importance
Intercept	2.804	0	
Replies	0.003	0	0.259
18:00-24:00	1.788	0.003	0.183
Time spent	0.034	0.014	0.124
06:00-09:00	3.707	0.014	0.124
Frequency	-0.69	0.03	0.095
Comments	-0.008	0.041	0.085
Type of posting videos	0.009	0.06	0.072
Ratio of posting links	-0.845	0.09	0.058

Table B.59 Regression analysis with AICC criteria of Facebook for BFAS _4

Model Term	Coefficient	Sig	Importance
Intercept	3.682	0	
University	-0.578	0.004	0.501
View friend's page	-0.353	0.081	0.185
Time spent	0.394	0.1	0.164
12:00-13:00	-248	0.117	0.149

Table B.57 Regression analysis with AICC criteria of Facebook for BFAS _2

Model Term	Coefficient	Sig	Importance
Intercept	2.18	0	
Ratio of posting photos	0.977	0.003	0.303
Ratio of posting status	0.985	0.005	0.276
06:00-09:00	3.154	0.029	0.166
Type of posting videos	0.01	0.038	0.149
Time spent	0.022	0.079	0.107

Table B.60 Regression analysis with AICC criteria of Facebook for BFAS _5

Model Term	Coefficient	Sig	Importance
Intercept	3.141	0	
Play games	0.522	0.001	0.289
Length of use	-0.375	0.016	0.161
Home	-0.446	0.024	0.139
12:00-13:00	-0.337	0.03	0.129
University	-0.316	0.059	0.098
Time spent	-0.446	0.062	0.096
09:00-12:00	-0.275	0.072	0.088

Table B.58 Regression analysis with AICC criteria of Facebook for BFAS _3

Model Term	Coefficient	Sig	Importance
Intercept	1.119	0.107	
06:00-09:00	6.594	0.001	0.442
18:00-24:00	1.977	0.033	0.176
Replies	0.001	0.034	0.173
Friends	0	0.083	0.116

Table B.61 Regression analysis with AICC criteria of Facebook for BFAS _6

Model Term	Coefficient	Sig	Importance
Intercept	3.84	0	
Length of use	0.38	0.094	0.285
Play games	0.367	0.011	0.196
Update profile	-1.189	0.014	0.182
09:00-12:00	-0.309	0.023	0.154
13:00-18:00	-0.28	0.06	0.105
University	0.258	0.105	0.078

B.2.4.2 F statistics criteria

A. Questionnaire

Table B.62 Regression analysis with F-statistics criteria of questionnaire for IAT_1

Model Term	Coefficient	Sig	Importance
Intercept	2.214	0	
Length	0.484	0.001	0.37
View friend's page	-0.534	0.003	0.265
18:00-24:00	0.389	0.006	0.235
Home	-0.29	0.39	0.13

Table B.65 Regression analysis with F-statistics criteria of questionnaire for IAT_4

Model Term	Coefficient	Sig	Importance
Intercept	2.988	0	
Length of use	-0.63	0.021	0.407
13:00-18:00	-0.317	0.044	0.31
On vehicles	-0.298	0.054	0.282

Table B.63 Regression analysis with F-statistics criteria of questionnaire for IAT_2

Model Term	Coefficient	Sig	Importance
Intercept	2.728	0	
Length of use	0.411	0.003	0.398
18:00-24:00	0.317	0.021	0.234
Frequency of use	-0.284	0.038	0.188
Update profile	-0.988	0.042	0.18

Table B.66 Regression analysis with F-statistics criteria of questionnaire for IAT_5

Model Term	Coefficient	Sig	Importance
Intercept	2.308	0	
Length of use	0.599	0	0.398
12:00-13:00	-0.404	0.009	0.174
Home	0.504	0.011	0.165
View friend's page	-0.458	0.021	0.136
18:00-24:00	0.342	0.025	0.128

Table B.64 Regression analysis with F-statistics criteria of questionnaire for IAT_3

Model Term	Coefficient	Sig	Importance
Intercept	2.616	0	
Length of use	0.743	0.001	0.279
View friend's page	-0.587	0.003	0.251
Home	-0.443	0.003	0.248
09:00-12:00	-0.299	0.043	0.112
12:00-13:00	-0.298	0.045	0.11

Table B.67 Regression analysis with F-statistics criteria of questionnaire for IAT_6

Model Term	Coefficient	Sig	Importance
Intercept	2.552	0	
View friend's page	-0.627	0.002	0.354
Length of use	0.426	0.006	0.287
Play games	0.365	0.024	0.189
12:00-13:00	-0.328	0.033	0.17

Table B.68 Regression analysis with F-statistics criteria of questionnaire for BFAS_1

Model Term	Coefficient	Sig	Importance
Intercept	3.308	0	
Length of use	0.336	0.033	0.509
Kill time	0.288	0.036	0.491

Table B.71 Regression analysis with F-statistics criteria of questionnaire for BFAS _4

Model Term	Coefficient	Sig	Importance
Intercept	3.44	0	
Home	-0.529	0.009	0.606
12:00-13:00	-0.328	0.036	0.394

Table B.69 Regression analysis with F-statistics criteria of questionnaire for BFAS _2

Model Term	Coefficient	Sig	Importance
Intercept	3.601	0	
Length of use	-0.405	0.004	1

Table B.72 Regression analysis with F-statistics criteria of questionnaire for BFAS _5

Model Term	Coefficient	Sig	Importance
Intercept	2.601	0	
Play games	0.569	0	0.401
09:00-12:00	-0.358	0.019	0.177
Length of use	-0.348	0.027	0.159
Time spent	0.493	0.038	0.138
University	-0.335	0.048	0.126

Table B.70 Regression analysis with F-statistics criteria of questionnaire for BFAS _3

Model Term	Coefficient	Sig	Importance
Intercept	3.501	0	
Comment	-0.444	0.005	0.31
Length of use	0.559	0.006	0.3
University	-0.43	0.013	0.239
Frequency of use	-0.315	0.05	0.15

Table B.73 Regression analysis with F-statistics criteria of questionnaire for BFAS _6

Model Term	Coefficient	Sig	Importance
Intercept	3.959	0	
Length of use	0.363	0.111	0.279
Play games	0.374	0.009	0.203
09:00-12:00	-0.347	0.01	0.2
Update profile	-1.204	0.013	0.187
13:00-18:00	-0.31	0.037	0.131

B. Facebook

Table B.74 Regression analysis with F-statistics criteria of Facebook for IAT_1

Model Term	Coefficient	Sig	Importance
Intercept	1.877	0	
Ratio of posting status	1.007	0.003	0.663
After midnight	-2.012	0.036	0.337

Table B.77 Regression analysis with F-statistics criteria of Facebook for IAT_4

Model Term	Coefficient	Sig	Importance
Intercept	2.021	0	
Time spent	0.031	0.02	1

Table B.75 Regression analysis with F-statistics criteria of Facebook for IAT_2

Model Term	Coefficient	Sig	Importance
Intercept	1.358	0	
Time spent	0.03	0.024	0.516
Ratio of posting status	0.735	0.029	0.484

Table B.78 Regression analysis with F-statistics criteria of Facebook for IAT_5

Model Term	Coefficient	Sig	Importance
Intercept	1.471	0	
Ratio of posting status	1.86	0	0.558
Ratio of posting photos	0.953	0.016	0.253
Type of posting status	-0.007	0.037	0.189

Table B.76 Regression analysis with F-statistics criteria of Facebook for IAT_3

Model Term	Coefficient	Sig	Importance
Intercept	1.176	0	
Time spent	0.038	0.008	0.646
Ratio of posting videos	-1.268	0.049	0.354

Table B.79 Regression analysis with F-statistics criteria of Facebook for IAT_6

Model Term	Coefficient	Sig	Importance
Intercept	1.601	0	
Ratio of posting status	1.355	0	0.744
Sessions	0.002	0.036	0.256

Table B.80 Regression analysis with F-statistics criteria of Facebook for BFAS_1

Model Term	Coefficient	Sig	Importance
Intercept	1.942	0	
Replies	0.002	0.002	0.283
18:00-24:00	1.845	0.002	0.273
06:00-09:00	3.919	0.01	0.188
Time spent	0.031	0.029	0.133
Comments	-0.008	0.036	0.123

Table B.83 Regression analysis with F-statistics criteria of Facebook for BFAS _4

Model Term	Coefficient	Sig	Importance
Intercept	3.44	0	
Home	-0.529	0.009	0.606
12:00-13:00	-0.328	0.036	0.394

Table B.81 Regression analysis with F-statistics criteria of Facebook for BFAS _2

Model Term	Coefficient	Sig	Importance
Intercept	2.549	0	
06:00-09:00	4.372	0.0003	0.408
Time spent	0.035	0.003	0.389
Friends	0	0.034	0.203

Table B.84 Regression analysis with F-statistics criteria of Facebook for BFAS _5

Model Term	Coefficient	Sig	Importance
Intercept	2.601	0	
Play games	0.569	0	0.401
09:00-12:00	-0.358	0.019	0.177
Length of use	-0.348	0.027	0.159
Time spent	0.493	0.038	0.138
University	-0.335	0.048	0.126

Table B.82 Regression analysis with F-statistics criteria of Facebook for BFAS _3

Model Term	Coefficient	Sig	Importance
Intercept	2.667	0	
Replies	0.002	0.003	0.573
06:00-09:00	4.599	0.01	0.42

Table B.85 Regression analysis with F-statistics criteria of Facebook for BFAS _6

Model Term	Coefficient	Sig	Importance
Intercept	3.959	0	
Length of use	0.363	0.111	0.279
Play games	0.374	0.009	0.203
09:00-12:00	-0.347	0.01	0.2
Update profile	-1.204	0.013	0.187
13:00-18:00	-0.31	0.037	0.131

B.2.4.3 Adjusted R-squared criteria

A. Questionnaire

Table B.86 Regression analysis with adjusted R-square criteria of questionnaire for IAT_1

Model Term	Coefficient	Sig	Importance
Intercept	2.429	0	
Length of use	0.508	0	0.41
View friend's page	-0.488	0.008	0.22
Home	-0.321	0.023	0.159
18:00-24:00	0.292	0.055	0.113
12:00-13:00	-0.187	0.185	0.054
09:00-12:00	-0.179	0.233	0.044

Table B.87 Regression analysis with adjusted R-square criteria of questionnaire for IAT_2

Model Term	Coefficient	Sig	Importance
Intercept	3.103	0	
Length of use	0.39	0.004	0.325
Home	-0.272	0.048	0.15
12:00-13:00	-0.231	0.092	0.109
Frequency of use	-0.224	0.1	0.104
18:00-24:00	0.219	0.114	0.096
Update profile	-0.777	0.122	0.092
Time spent	-0.182	0.179	0.069
View friend's page	-0.221	0.233	0.055

Table B.88 Regression analysis with adjusted R-square criteria of questionnaire for IAT_3

Model Term	Coefficient	Sig	Importance
Intercept	3.54	0	
Length of use	0.753	0.001	0.272
Home	-0.453	0.002	0.247
View friend's page	-0.479	0.017	0.146
09:00-12:00	-0.265	0.071	0.083
12:00-13:00	-0.248	0.092	0.072
Time spent	-0.239	0.098	0.069
Update profile	-0.887	0.1	0.069
Frequency of use	-0.194	0.188	0.044

Table B.89 Regression analysis with adjusted R-square criteria of questionnaire for IAT_4

Model Term	Coefficient	Sig	Importance
Intercept	3.331	0	
13:00-18:00	-0.319	0.04	0.246
Length of use	-0.55	0.045	0.235
View friend's page	-0.335	0.063	0.201
On vehicles	-0.27	0.078	0.181
Frequency of use	-0.216	0.124	0.138

Table B.90 Regression analysis with adjusted R-square criteria of questionnaire for IAT_5

Model Term	Coefficient	Sig	Importance
Intercept	2.465	0	
Length of use	0.575	0	0.381
Home	0.464	0.02	0.143
12:00-13:00	-0.359	0.022	0.14
View friend's page	-0.445	0.025	0.134
18:00-24:00	0.345	0.039	0.112
Frequency of use	-0.231	0.131	0.06
Time spent	-0.161	0.283	0.03

Table B.91 Regression analysis with adjusted R-square criteria of questionnaire for IAT_6

Model Term	Coefficient	Sig	Importance
Intercept	3.185	0	
Length of use	0.423	0.006	0.272
Play games	0.401	0.014	0.212
University	-0.26	0.087	0.102
View friend's page	-0.375	0.095	0.097
12:00-13:00	-0.243	0.116	0.086
Time spent	0.208	0.167	0.066
Update profile	-0.785	0.17	0.066
Walking	0.313	0.217	0.053
Make new friends	-0.193	0.25	0.046

Table B.92 Regression analysis with adjusted R-square criteria of questionnaire for BFAS_1

Model Term	Coefficient	Sig	Importance
Intercept	3.365	0	
Length of use	0.323	0.039	0.333
Kill time	0.256	0.061	0.274
University	-0.223	0.108	0.201
18:00-24:00	0.216	0.116	0.192

Table B.95 Regression analysis with adjusted R-square criteria of questionnaire for BFAS _4

Model Term	Coefficient	Sig	Importance
Intercept	3.735	0	
Home	-0.556	0.006	0.481
View friend's page	-0.332	0.102	0.17
Time spent	0.358	0.137	0.14
12:00-13:00	-0.214	0.182	0.113
09:00-12:00	-0.192	0.218	0.096

Table B.93 Regression analysis with adjusted R-square criteria of questionnaire for BFAS _2

Model Term	Coefficient	Sig	Importance
Intercept	3.642	0	
Length of use	-0.368	0.009	0.478
12:00-13:00	-0.233	0.077	0.216
University	0.274	0.1	0.188
Time spent	0.267	0.19	0.118

Table B.96 Regression analysis with adjusted R-square criteria of questionnaire for BFAS _5

Model Term	Coefficient	Sig	Importance
Intercept	3.141	0	
Play games	0.522	0.001	0.289
Length of use	-0.375	0.016	0.161
Home	-0.446	0.024	0.139
12:00-13:00	-0.337	0.03	0.129
University	-0.316	0.059	0.098
Time spent	0.446	0.062	0.096
09:00-12:00	-0.275	0.072	0.088

Table B.94 Regression analysis with adjusted R-square criteria of questionnaire for BFAS _3

Model Term	Coefficient	Sig	Importance
Intercept	3.944	0	
Length of use	0.577	0.004	0.314
University	-0.415	0.017	0.218
Comment	-0.358	0.026	0.187
Frequency of use	-0.259	0.108	0.098
On vehicles	-0.266	0.179	0.068
Express identity	-0.254	0.199	0.062
12:00-13:00	-0.183	0.239	0.052

Table B.97 Regression analysis with adjusted R-square criteria of questionnaire for BFAS _6

Model Term	Coefficient	Sig	Importance
Intercept	3.739	0	
Length of use	0.363	0.109	0.289
Play games	0.397	0.006	0.234
09:00-12:00	-0.269	0.05	0.118
Update profile	-0.951	0.061	0.108
13:00-18:00	-0.258	0.085	0.091
View friend's page	-0.235	0.208	0.048
University	0.203	0.212	0.047
On vehicles	0.376	0.293	0.034
Walking	0.315	0.312	0.031

B.   Facebook

Table B.98 Regression analysis with adjusted R-square criteria of Facebook for IAT_1

Model Term	Coefficient	Sig	Importance
Intercept	3.027	0.004	
Ratio of posting status	1.261	0.001	0.282
After midnight	-3.426	0.008	0.188
Time spent	0.034	0.019	0.148
13:00-18:00	-2.779	0.034	0.121
Comments	-0.007	0.061	0.094
Ratio of posting photos	0.585	0.109	0.069
18:00-24:00	-1.871	0.11	0.069
09:00-12:00	-1.911	0.3	0.029

Table B.99 Regression analysis with adjusted R-square criteria of Facebook for IAT_2

Model Term	Coefficient	Sig	Importance
Intercept	1.579	0	
Time spent	0.039	0.006	0.244
Ratio of posting status	1.111	0.031	0.147
Type of posting status	-0.01	0.035	0.14
Posts	0.003	0.045	0.127
Ratio of posting links	-1.038	0.072	0.102
13:00-18:00	-1.199	0.117	0.077
12:00-13:00	4.093	0.126	0.073
Comments	-0.005	0.217	0.048
Ratio of posting videos	-0.704	0.252	0.041

Table B.100 Regression analysis with adjusted R-square criteria of Facebook for IAT_3

Model Term	Coefficient	Sig	Importance
Intercept	0.912	0.001	
Time spent	0.037	0.016	0.306
Ratio of posting status	1.226	0.028	0.254
Type of posting status	-0.01	0.061	0.183
Ratio of posting videos	-1.063	0.114	0.13
Posts	0.002	0.118	0.127

Table B.101 Regression analysis with adjusted R-square criteria of Facebook for IAT_4

Model Term	Coefficient	Sig	Importance
Intercept	1.928	0	
Time spent	0.031	0.019	0.825
06:00-09:00	1.745	0.277	0.175

Table B.102 Regression analysis with adjusted R-square criteria of Facebook for IAT_5

Model Term	Coefficient	Sig	Importance
Intercept	1.403	0.001	
Ratio of posting status	2.334	0	0.331
Type of posting status	-0.017	0.003	0.191
Ratio of posting photos	1.192	0.013	0.129
Posts	0.006	0.024	0.107
After midnight	-2.045	0.055	0.077
Time spent	0.026	0.112	0.052
13:00-18:00	-1.312	0.131	0.047
Type of posting photos	-0.007	0.171	0.039
Comments	-0.005	0.266	0.026

Table B.103 Regression analysis with adjusted R-square criteria of Facebook for IAT_6

Model Term	Coefficient	Sig	Importance
Intercept	1.494	0	
Type of posting links	0.021	0.002	0.347
Ratio of posting status	1.218	0.004	0.311
Ratio of posting links	-1.598	0.032	0.167
Ratio of posting videos	-1.048	0.123	0.086
18:00-24:00	0.785	0.241	0.049
Friends	0	0.288	0.041

Table B.104 Regression analysis with adjusted R-square criteria of Facebook for BFAS_1

Model Term	Coefficient	Sig	Importance
Intercept	2.631	0	
Replies	0.003	0.001	0.211
Type of posting videos	0.015	0.005	0.146
Ratio of posting photos	0.912	0.009	0.124
Ratio of posting status	0.905	0.019	0.1
Comments	-0.009	0.021	0.097
18:00-24:00	1.422	0.029	0.086
Frequency	-0.679	0.031	0.084
Time spent	0.025	0.068	0.06
06:00-09:00	2.312	0.165	0.035
12:00-13:00	-3.418	0.2	0.03

Table B.107 Regression analysis with adjusted R-square criteria of Facebook for BFAS _4

Model Term	Coefficient	Sig	Importance
Intercept	3.735	0	
Home	-0.556	0.006	0.481
View friend's page	-0.332	0.102	0.17

Table B.105 Regression analysis with adjusted R-square criteria of Facebook for BFAS _2

Model Term	Coefficient	Sig	Importance
Intercept	2.133	0	
Ratio of posting photos	0.915	0.007	0.226
Ratio of posting status	1.232	0.008	0.216
Type of posting videos	0.012	0.021	0.161
Time spent	0.026	0.043	0.124
06:00-09:00	3.048	0.05	0.117
Friends	0	0.14	0.066
Type of posting status	-0.004	0.163	0.059
After midnight	-0.933	0.299	0.032

Table B.108 Regression analysis with adjusted R-square criteria of Facebook for BFAS _5

Model Term	Coefficient	Sig	Importance
Intercept	3.141	0	
Play games	0.522	0.001	0.289
Length of use	-0.375	0.016	0.161
Home	-0.446	0.024	0.139
12:00-13:00	-0.337	0.03	0.129
University	-0.316	0.059	0.098
Time spent	0.446	0.062	0.096
09:00-12:00	-0.275	0.072	0.088

Table B.106 Regression analysis with adjusted R-square criteria of Facebook for BFAS _3

Model Term	Coefficient	Sig	Importance
Intercept	1.535	0.071	
06:00-09:00	6.689	0.001	0.279
Posts	0.008	0.006	0.19
18:00-24:00	2.242	0.018	0.138
Replies	0.003	0.038	0.106
13:00-18:00	2.165	0.06	0.086
Sessions	-0.005	0.108	0.063
Type of posting links	-0.01	0.176	0.044
Type of posting photos	-0.004	0.249	0.032
Friends	0	0.25	0.032
Frequency	-0.453	0.266	0.03

Table B.109 Regression analysis with adjusted R-square criteria of Facebook for BFAS _6

Model Term	Coefficient	Sig	Importance
Intercept	3.739	0	
Length of use	0.363	0.109	0.289
Play games	0.397	0.006	0.234
09:00-12:00	-0.269	0.05	0.118
Update profile	-0.951	0.061	0.108
13:00-18:00	-0.258	0.085	0.091
View friend's page	-0.235	0.208	0.048
University	0.203	0.212	0.047
On vehicles	0.376	0.293	0.034
Walking	0.315	0.312	0.031

B.2.4.4 ASE criteria

A. Questionnaire

Table B.110 Regression analysis with ASE criteria of questionnaire for IAT_1

Model Term	Coefficient	Sig	Importance
Intercept	2.352	0	
Length of use	0.497	0	0.402
View friend's page	-0.514	0.005	0.253
Home	-0.314	0.027	0.156
18:00-24:00	0.308	0.043	0.13
09:00-12:00	-0.206	0.169	0.06

Table B.113 Regression analysis with ASE criteria of questionnaire for IAT_4

Model Term	Coefficient	Sig	Importance
Intercept	3.031	0	
Frequency of use	-0.271	0.053	0.353
On vehicles	-0.289	0.063	0.326
13:00-18:00	-0.29	0.065	0.321

Table B.111 Regression analysis with ASE criteria of questionnaire for IAT_2

Model Term	Coefficient	Sig	Importance
Intercept	3.089	0	
Length of use	0.4	0.003	0.332
Update profile	-0.956	0.047	0.148
Home	-0.258	0.06	0.132
12:00-13:00	-0.247	0.071	0.122
Frequency of use	-0.226	0.098	0.102
18:00-24:00	0.224	0.106	0.097
Time spent	-0.181	0.181	0.067

Table B.114 Regression analysis with ASE criteria of questionnaire for IAT_5

Model Term	Coefficient	Sig	Importance
Intercept	2.1	0	
Length of use	0.588	0	0.502
18:00-24:00	0.368	0.017	0.196
12:00-13:00	-0.34	0.028	0.167
Frequency of use	-0.306	0.047	0.136

Table B.112 Regression analysis with ASE criteria of questionnaire for IAT_3

Model Term	Coefficient	Sig	Importance
Intercept	3.477	0	
Length of use	0.727	0.002	0.267
Home	-0.456	0.002	0.26
View friend's page	-0.475	0.024	0.138
09:00-12:00	-0.297	0.044	0.111
Update profile	-0.952	0.079	0.084
Time spent	-0.251	0.085	0.081
Frequency of use	-0.208	0.161	0.053
Walking	0.124	0.611	0.007

Table B.115 Regression analysis with ASE criteria of questionnaire for IAT_6

Model Term	Coefficient	Sig	Importance
Intercept	1.993	0	
Length of use	0.41	0.009	0.489
University	-0.306	0.051	0.272
Time spent	0.285	0.067	0.239

Table B.116 Regression analysis with ASE criteria of questionnaire for BFAS_1

Model Term	Coefficient	Sig	Importance
Intercept	3.546	0	
Kill time	0.281	0.042	0.558
University	-0.254	0.069	0.442

Table B.119 Regression analysis with ASE criteria of questionnaire for BFAS _4

Model Term	Coefficient	Sig	Importance
Intercept	3.016	0	
University	-0.209	0.188	0.35
Time spent	0.319	0.195	0.338
12:00-13:00	-0.197	0.214	0.311

Table B.117 Regression analysis with ASE criteria of questionnaire for BFAS _2

Model Term	Coefficient	Sig	Importance
Intercept	3.698	0	
Length of use	-0.394	0.005	0.51
12:00-13:00	-0.271	0.035	0.282
University	0.3	0.07	0.208

Table B.120 Regression analysis with ASE criteria of questionnaire for BFAS _5

Model Term	Coefficient	Sig	Importance
Intercept	3.06	0	
Home	-0.517	0.011	0.266
Length of use	-0.368	0.022	0.216
Time spent	0.529	0.031	0.191
12:00-13:00	-0.335	0.037	0.179
18:00-24:00	0.269	0.085	0.122
Frequency of use	-0.123	0.429	0.026

Table B.118 Regression analysis with ASE criteria of questionnaire for BFAS _3

Model Term	Coefficient	Sig	Importance
Intercept	3.79	0	
Length of use	0.417	0.038	0.314
On vehicles	-0.393	0.052	0.275
View friend's page	-0.369	0.079	0.226
12:00-13:00	-0.254	0.111	0.185

Table B.121 Regression analysis with ASE criteria of questionnaire for BFAS _6

Model Term	Coefficient	Sig	Importance
Intercept	3.669	0	
Play games	0.376	0.011	0.345
Update profile	-1.241	0.012	0.336
09:00-12:00	-0.339	0.014	0.319

B. Facebook

Table B.122 Regression analysis with ASE criteria of Facebook for IAT_1

Model Term	Coefficient	Sig	Importance
Intercept	1.759	0	
Ratio of posting links	-2.102	0.009	0.281
Ratio of posting videos	-1.602	0.011	0.261
Time spent	0.033	0.019	0.223
09:00-12:00	2.131	0.112	0.101
Type of posting photos	0	0.171	0.075
Type of posting links	0.011	0.234	0.057
Ratio of posting photos	-0.093	0.798	0.003

Table B.123 Regression analysis with ASE criteria of Facebook for IAT_2

Model Term	Coefficient	Sig	Importance
Intercept	1.324	0.029	
Time spent	0.036	0.01	0.235
Type of posting status	-0.013	0.014	0.213
Ratio of posting status	1.096	0.038	0.152
Posts	0.004	0.079	0.109
Ratio of posting links	-1.088	0.086	0.104
12:00-13:00	4.333	0.123	0.084
Type of posting videos	-0.008	0.261	0.044
13:00-18:00	-0.946	0.332	0.033
Type of posting photos	-0.003	0.427	0.022
18:00-24:00	0.294	0.715	0.005

Table B.124 Regression analysis with ASE criteria of Facebook for IAT_3

Model Term	Coefficient	Sig	Importance
Intercept	0.909	0.007	
Time spent	0.038	0.013	0.304
Ratio of posting status	1.12	0.051	0.185
Type of posting status	-0.01	0.066	0.163
Ratio of posting videos	-1.218	0.088	0.14
Posts	0.004	0.111	0.123
Type of posting photos	0.004	0.352	0.042
Friends	0	0.476	0.024
09:00-12:00	0.869	0.534	0.019

Table B.125 Regression analysis with ASE criteria of Facebook for IAT_4

Model Term	Coefficient	Sig	Importance
Intercept	2.072	0	
Time spent	0.028	0.045	0.489
Type of posting links	0.013	0.19	0.208
Posts	-0.001	0.307	0.126
Ratio of posting videos	-0.553	0.386	0.091
Ratio of posting status	0.297	0.465	0.064
Ratio of posting links	-0.344	0.663	0.023

Table B.126 Regression analysis with ASE criteria of Facebook for IAT_5

Model Term	Coefficient	Sig	Importance
Intercept	1.379	0.009	
Type of posting status	-0.019	0.001	0.348
Ratio of posting status	1.447	0.02	0.17
Posts	0.005	0.045	0.127
Time spent	0.028	0.079	0.097
Ratio of posting links	-1.264	0.089	0.09
Ratio of posting videos	-1.135	0.141	0.068
18:00-24:00	0.861	0.242	0.043
Type of posting photos	-0.005	0.274	0.037
12:00-13:00	2.584	0.415	0.021

Table B.127 Regression analysis with ASE criteria of Facebook for IAT_6

Table B.128 Regression analysis with ASE criteria of Facebook for BFAS_1

Model Term	Coefficient	Sig	Importance
Intercept	2.376	0	
Replies	0.003	0	0.323
18:00-24:00	1.692	0.005	0.175
Ratio of posting photos	0.865	0.015	0.129
06:00-09:00	3.582	0.019	0.119
Ratio of posting status	0.794	0.046	0.086
Comments	-0.008	0.061	0.076
Frequency	-0.494	0.114	0.054
Ratio of posting videos	0.818	0.184	0.038

Table B.129 Regression analysis with ASE criteria of Facebook for BFAS _2

Model Term	Coefficient	Sig	Importance
Intercept	2.635	0	
Time spent	0.035	0.004	0.537
06:00-09:00	3.368	0.3	0.3
Ratio of posting links	-0.552	0.296	0.069
Ratio of posting status	0.29	0.388	0.047
09:00-12:00	1.043	0.396	0.046

Table B.130 Regression analysis with ASE criteria of Facebook for BFAS _3

Model Term	Coefficient	Sig	Importance
Intercept	2.782	0	
Ratio of posting links	-1.091	0.075	0.683
18:00-24:00	0.89	0.242	0.293
09:00-12:00	0.521	0.737	0.024

Table B.131 Regression analysis with ASE criteria of Facebook for BFAS _4

Model Term	Coefficient	Sig	Importance
Intercept	3.016	0	
University	-0.209	0.188	0.35
Time spent	0.319	0.195	0.338

Table B.132 Regression analysis with ASE criteria of Facebook for BFAS _5

Model Term	Coefficient	Sig	Importance
Intercept	3.06	0	
Home	-0.517	0.011	0.266
Length of use	-0.368	0.022	0.216
Time spent	0.529	0.031	0.191
12:00-13:00	-0.335	0.037	0.179
18:00-24:00	0.269	0.085	0.122
Frequency of use	-0.123	0.429	0.026

Table B.133 Regression analysis with ASE criteria of Facebook for BFAS _6

Model Term	Coefficient	Sig	Importance
Intercept	3.669	0	
Play games	0.376	0.011	0.345
Update profile	-1.241	0.012	0.336
09:00-12:00	-0.339	0.014	0.319