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# The development of a situational smartphone addiction scale for students in the Faculty of Education using Multidimensional Item Response Theory

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## Abstract

This study aimed to develop a situational test for smartphone addiction among students in the Faculty of Education using Multidimensional Item Response Theory (MIRT). Qualitative data were gathered through interviews with 18 students at risk of smartphone addiction. Insights from these interviews were used to construct situational items that reflect realistic challenges aligned with the daily lives, developmental stage, and decision-making context of late adolescents. These scenarios were then used to collect quantitative data from 2,186 students across four regions of Thailand. The test's psychometric quality was examined using Classical Test Theory (CTT), while structural validity was assessed via Item Response Theory using ConQuest 2.0. The findings revealed that most at-risk students lacked control over smartphone use, leading to interpersonal issues, health concerns, and reduced academic performance. The finalized test comprises 13 age-appropriate situational scenarios covering three components: Overuse, Daily-Life Disturbance, and Withdrawal. It employs a 4-point rating scale (0–3), with discrimination indices ranging from 0.366 to 0.614 and a reliability coefficient of 0.828. Internal construct validity assessment indicated that the multidimensional model provided a significantly better fit than the unidimensional one ($\chi^2$ = 161.6025, df = 5, $p$ < .05). Weighted MNSQ values ranged from 0.75 to 1.33, and no disordered thresholds were found. The use of MIRT enabled more accurate analysis of students' responses across multiple behavioral dimensions. These findings support the scale's structural validity and the relevance of using situational questions tailored to the context and developmental stage of the target population.

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## Introduction

The rapid advancements of society and technology in the digital era have caused an increasing role of smartphones as an integral part of daily life. Smartphones facilitate seamless and instantaneous global connectivity, enabling individuals to interact and meet their needs efficiently while streamlining various tasks in modern life (Gündoğdu et al., 2021). However, substantial research has highlighted smartphone usage's detrimental effects, including its association with interpersonal relationships, mental health, cognitive functioning, and lowered academic performance. These findings indicated that smartphone use can have significant adverse impacts on certain individuals (Billieux, 2012). Extensive research has shown that excessive smartphone use is associated with psychological issues such as low self-esteem (Hong et al., 2012), depression, anxiety (Abid et al., 2020; Kalyani et al., 2019), and poor sleep quality (Gündoğdu et al., 2021; Kalyani et al., 2019), especially among adolescents and young adults. It also correlates negatively with academic performance (Alosaimi et al., 2016; Chaudhury & Tripathy, 2018; Khan et al., 2019) and can lead to physical problems such as eye strain and hearing impairment from prolonged gaming and frequent headphone use (Costa et al., 2019).

This study population focuses on students in the Faculty of Education, representing adolescents who require holistic development to prepare themselves for future roles as qualified educational personnel. Excessive smartphone usage among these students not only negatively affects their well-being but may also limit their working effectiveness in fostering student development and achieving the professional standards expected of educators. Given their critical role in shaping student behavior, teachers influence both directly and indirectly the regulation and reduction of excessive smartphone use among students. Teachers who hold negative beliefs regarding the behavioral, social, and academic impacts of smartphone use are more likely to implement stricter classroom smartphone policies, which in turn help mitigate smartphone addiction and promote face-to-face social interactions among students (Aloteibi et al., 2024). In addition, Shi et al. (2023) found that positive teacher–student relationships are directly associated with lower levels of smartphone addiction among college students. This relationship operates through psychological mechanisms, including enhanced achievement goal orientation and greater psychological resilience.

The Smartphone Addiction Scale (SAS) and the Smartphone Addiction Scale - Short Version (SAS-SV), developed by Kwon et al. (2013a, 2013b), have been widely applied in research across several countries. These tools will be translated into multiple languages, including Thai. It was named the Smartphone Addiction Scale - Short Version - Thai (SAS-SV-TH) by Charoenwanit and Soonthornchaiya (2019). While some researchers determined to develop smartphone addiction measurement tools based on specific theoretical frameworks and beliefs, Harris et al. (2020) reviewed 78 assessment tools for smartphone addiction developed over the past 13 years. Their findings revealed that most evaluation tools relied on self-report rating scale formats. Although many tools included structural validation, they often lacked internal consistency and test-retest reliability. Similarly, the Smartphone Addiction Scale (SAS-SV-TH) comprised certain development limitations, and there was no continuous development of the instrument to identify appropriate cut-off scores for the Thai population or individuals of varying age groups (Charoenwanit & Soonthornchaiya, 2019). The use of cut-off scores is especially relevant for pre-service teachers, as they are expected to demonstrate responsible digital behavior and help guide students in managing smartphone use. Clearly defining levels of addiction severity helps identify those at risk early on, supports the development of appropriate interventions, and allows for a more structured approach to prevention. In addition, categorizing individuals into levels enhances score interpretation, enables tracking of behavioral changes over time, and informs data-driven educational policies (Hidalgo et al., 2015; Tiratira, 2009).

Additionally, there was no sufficient theoretical foundation supporting the evaluation of these measurements. Consequently, future studies should more comprehensively focus on identifying problematic patterns of smartphone usage in order to enhance the effectiveness and reliability of the assessment tools for smartphone addiction. The use of Multidimensional Item Response Theory (MIRT) addresses the limitations of Classical Test Theory (CTT) in analyzing situational questionnaires. By allowing the simultaneous assessment of multiple latent traits, MIRT enhances the precision of ability estimation and item analysis. It also better reflects the inherently multidimensional nature of such questionnaires (Adams et al., 1997). Therefore, to better capture the multidimensional characteristics of smartphone addiction and enhance measurement accuracy, this study employs MIRT as the primary framework.

Therefore, this study aims to develop a situational test for smartphone addiction among students in the Faculty of Education using multidimensional item response theory. The theories of measurement and evaluation, as well as psychological theories, including empirical evidence, were also applied in this study to receive the ensured instrument, which is reliable and contextually appropriate for the target sample.

## Literature Review

### *The Definition of Smartphone Addiction*

The term smartphone refers to a mobile phone equipped with advanced functionalities that differentiate them from traditional mobile phones. Smartphones represent a new generation of mobile devices that comprehensively provide services and diverse features, including messaging, storing personal data, and various applications. However, excessive smartphone usage can potentially lead to addictive behaviour, which is associated with several adverse health outcomes, such as neck pain, accidents, anxiety, depression, and sleep disturbances, et al. (Kalyani et al., 2019). Billieux et al. (2015) identified that inappropriate smartphone use is linked to several types of disorders, primarily characterized by the incapability to regulate or control one's mobile phone usage. This lack of control ultimately results in negative consequences in the user's daily life (Harris et al., 2020; Lee et al., 2014). Consequently, smartphone addiction is defined as the behavior of individuals who have prolonged, repetitive, and uncontrollable smartphone usage. Despite being aware of its adverse effects on themselves and others, these individuals cannot control or limit their smartphone usage across various situations.

### *The Smartphone Addiction Evaluation*

Studies over the past decade have illustrated an increasing interest among researchers and psychologists, both domestically and internationally. This research tendency aimed to develop and validate tools to assess smartphone addictive behaviors and mobile phone usage problems, which is called *nomophobia*. For example, Kwon et al. (2013a) designed the Smartphone Addiction Scale (SAS) owing to the increasing risks of smartphone addiction among South Korean kids and teenagers. The SAS is a self-report instrument containing a six-point Likert scale ranging from 1 = strongly disagree to 6 = strongly agree. The 33 questions are included in this instrument to evaluate smartphone addiction across six dimensions: 1) Daily-Life Disturbance, 2) Positive Anticipation, 3) Withdrawal, 4) Cyberspace-Oriented Relationship, 5) Overuse, and 6) Tolerance. Data were collected from the sample of 64 males and 133 females aged 18–53 years to evaluate its reliability. However, the imbalance in the male-to-female proportion limited the tool's utility for gender comparisons. Consequently, Kwon and colleagues did not recommend using cut-off scores to assess the level of smartphone addiction. Nonetheless, the SAS demonstrated high internal consistency, with Cronbach's alpha coefficient of 0.967. Kwon et al. (2013b) subsequently developed the Smartphone Addiction Scale – Short Version (SAS-SV) with the specific goal of evaluating adolescent's addiction behaviour. This tool was carefully designed by removing gender-related values and simplifying its structure to give a clear, practical, and accessible measure of smartphone addiction in this age group. This redefined tool can efficiently be used as a screening tool for smartphone addiction in actual social practice.

The screening capability of the SAS-SV was analyzed using ROC analysis (Receiver Operating Characteristic) by sampling from 90 male and 60 female secondary school students who had received psychological counselling. For males, the tool demonstrated an Area Under the Curve (AUC) value of 0.963 (0.888–1.000), with a cut-off score of 31, a sensitivity of 0.867, and a specificity of 0.893. For females, the AUC was 0.947 (0.887–1.000), with a cut-off score of 0, a sensitivity of 33.0, and a specificity of 0.875. These results indicate that the SAS-SV is an efficient instrument for assessing smartphone addiction.

Besides, Lopez-Fernandez (2015) employed the SAS-SV in a cross-cultural study dealing with samples from Spain and France, and its findings revealed that the SAS-SV is capable for a single dimension measure, which is excessive smartphone use. The study also suggested that confirmatory factor analysis (CFA) should be incorporated for the development of smartphone addiction assessments in the future. Alternatively, other tools should be used to better correspond with smartphone addiction. Moreover, more applications of new indicators and techniques are also recommended to enhance such tools' reliability and validity.

The development of a smartphone addiction assessment focused on designing and constructing a situational test that reflects the context and lifestyle of the target age group. To ensure the psychometric quality of the instrument, several technical analyses were conducted, including Item Response Theory (IRT), the establishment of cut-off criteria, and interpretation of scoring results. In particular, the use of Multidimensional Item Response Theory (MIRT) provided a robust analytical framework for evaluating the internal structure of the test. MIRT is especially effective for instruments that assess multiple latent traits, as it models interrelated constructs simultaneously. This approach enhances construct validity, improves score interpretation, and allows for more precise diagnostics compared to unidimensional models. Furthermore, MIRT supports the evaluation of complex factor structures and has practical applications in adaptive testing and psychological assessment (Immekus et al., 2019).

## Research Objectives

This research aimed to develop a situational test for smartphone addiction among students in the Faculty of Education using multidimensional item response theory.

## Methodology

### *Phase 1: The Investigation of Smartphone Usage Behaviour Among Education Faculty Students*

A semi-structured interview was employed. The informants come from 10 universities across four regions of Thailand: North, Northeast, Central, and South to ensure that this qualitative data collection yielded information on smartphone use across a variety of contexts and levels of intensity. Later, 18 participants were selected using purposive sampling based on their high-risk screening scores from the SAS-SV-TH software and their willingness to participate in research. The interview questions were validated by five experts specializing in educational measurement, psychology, and counselling fields. The Index of Item-Objective Congruence (IOC) values ranged from 0.80 to 1.00, demonstrating the acceptable standard for all items. The data collected from the online interviews were analysed using content analysis.

### *Phase 2: The Development of Smartphone Addiction Scale for Education Faculty Students*

This study population was composed of 90,448 students enrolling in education faculties across 56 Thai higher education institutions, including Public universities, Rajabhat universities, and Technological universities. A sample of 700 students was also used to assess the instrument's quality using Classical Test Theory (CTT). In comparison, an additional 1,486 students were included for quality evaluation based on Item Response Theory (IRT). This sample size aligns with the minimum requirement of 300 and 500 participants for CTT and IRT analysis respectively (Kanjanawasee, 2012).

The situational smartphone addiction scale was developed from the interpretation or qualitative findings acquired from Phase 1 and a revision of relevant literature and research. The scale consists of 13 items, with a four-point scale ranging from 0 to 3. Respondents are required to assess their behaviors or feelings related to smartphone use in various situations.

The quality of the instrument was evaluated for content validity by five experts. The results showed Item-Level Content Validity Index (I-CVI) values ranging from 0.80 to 1.00 and a Scale-Level Content Validity Index (S-CVI) of 0.985. These figures came from two quantitative data collection rounds. The first time, the reliability quality was analyzed by internal consistency using Cronbach's Alpha coefficient, which should be greater than 0.7, and the Discrimination value was analyzed by Item total correlation to choose only items with values above 0.2. The second round of data collection was conducted to analyze the instrument's quality using Item Response Theory (IRT).

## Results

### *The Findings on Smartphone Usage Among Education Faculty Students*

The impact of the COVID-19 pandemic caused teachers to assign tasks online and encouraged students to access information through digital media while the students used their smartphones for entertainment, most involving social media engagement such as Line, Facebook, TikTok, X, and Instagram, watching series through Netflix or videos on YouTube, playing games, and listening to music. The students reflected that smartphones were important in their daily lives. When their smartphone ran out of battery, or they forgot to bring their phone, or there was no signal, they reported feeling irritated and unhappy. To deal with this situation, they attempted to have a usable smartphone in every possible way.

*"I felt irritated when I realized I forgot it. It's like, why didn't I bring it? But when I could do nothing about it, I just had to sit there and stare at nothing…"*

*(female, senior in a public university, north-eastern region)*

*"I'd ride back home to get it—I couldn't manage without it. No matter what, I have to get it. These days, I carry a charger with me every single day..."*

*(female, freshman in a Rajabhat University, central region)*

Excessive smartphone use has significant impact on students' physical health. The most outstanding issue is the visual problem caused by prolonged screen exposure, resulting in excessive light intake. Another problem is maintaining the same posture while using smartphones for long periods. This behaviour leads to physical discomfort, including wrist, neck, and back pain. Moreover, students experience poor sleep quality due to insufficient rest, which affects their overall well-being in the future.

*"... Most of the time, I stay up late, and when I stay up late, I can't sleep. It also affects my eyesight... If I use my phone too much, my eyes hurt. Mostly, it's eye strain..."*

*(female, freshman in a Rajabhat University, northern region)*

*"I didn't use my phone in a well-lit area, so I got too much light from the screen, which irritated my eyes or even inflamed them. Also, I had back pain because I'd sit and use my phone for hours without moving at all…"*

*(female, junior in a Rajabhat University, southern region)*

While students use smartphones, they often isolate themselves in their world, focusing on the information and content displayed on their screens. This behaviour negatively affects social interactions, particularly with family members and friends, because the students will have less attention to those around them. This lack of engagement often leads to misunderstandings and weakened relationships. Besides, excessive smartphone use impacts students' academic performance. Many students tried to manage their time or control their smartphone usage, which sometimes led to incomplete tasks . Some students become severe smartphone addicts, resulting in class absences or poor concentration on study. Moreover, some students reported heightened irritability, impatience, and a lower tolerance for delays from excessive smartphone usage.

*"...When I'm looking at my phone, I'm so focused on it that I don't hear my friends calling me or responding to them. Then they get upset and stop talking to me. And when we're eating, my mom always tells me, 'Can you put your phone down first? Finish your meal and then use it…"*

*(female, junior in a Rajabhat University, northern region)*

*"…When it came to studying, I didn't really pay much attention. Sometimes I was on my phone, sometimes I watched the teacher, but did not actually focus that much..."*

*(male, freshman in a Rajabhat University, north-eastern region)*

These findings corresponded with numerous abroad studies (Alosaimi et al., 2016; Khan et al., 2019). These scholars identified a negative correlation between smartphone usage and academic progression, academic performance, and study results. Excessive smartphone usage has also been associated with adverse physical effects, such as eye irritation caused by long gaming sessions and hearing problems from frequent headphone use (Costa et al., 2021). Likewise, Elsayed et al. (2021) found that smartphone addiction involves spending longer time on smartphones, which often causes interpersonal ignorance with surrounding people, including other essential activities. Smartphone addiction is generally characterized by excessive smartphone usage and an inability to control its use.

In Thailand, excessive smartphone usage or smartphone addiction is increasingly receiving public attention due to its widespread negative effects on physical, emotional, social, and cognitive well-being. These effects include depression, anxiety, stress, irritability, eye strain, hearing problems, memory impairment, and reduced concentration (Chuemongkon et al., 2021). The contributing factors to smartphone addiction arise from both internal and external influences. These include a lack of self-regulation, limited media literacy regarding new trendy technologies, and lack of social support (Prasittichok et al., 2021).

Smartphone addiction can be defined as a pattern of behaviours characterized by prolonged time-consuming, repetitive, and continuous smartphone use, causing daily life disturbance, from the qualitative study. Individuals with smartphone addiction often feel isolated or bored when not using their devices. Moreover, they are unable to control or reduce their smartphone usage behaviour. They show great attempts to ensure smartphone accessibility, even when aware of its potential negative consequences for themselves and others, including negative impacts on work or academic performance. Additionally, smartphone addiction may lead to undesirable personality traits or characteristics. Smartphone addiction is combined from three primary components.

### *Component 1: Overuse*

This component refers to prolonged time-consuming, repetitive, and continuous smartphone use

### *Component 2: Daily-Life Disturbance*

This means negative impacts on daily life caused by smartphones, such as feelings of loneliness or boredom, disrupted interpersonal relationships, health problems, and adverse effects on work or academic performance, including undesirable personality traits or characteristics.

### *Component 3: Withdrawal*

This component refers to the inability to control, quit, or reduce smartphone use in various situations. Individuals may try every possible way to access a smartphone without concern about its potential negative consequences for themselves and others.

## *The Results of Smartphone Addiction Scale Development for Education Faculty Students*

The smartphone addiction scale, developed for education faculty students, is a situational test form consisting of 13

items. Each item includes four response options. The item structure of the scale is presented in Table 1.

**Table 1** Item structure of the smartphone addiction scale

| No. | Component of Smartphone Addiction | Total Item | List No. |
|---|---|---|---|
| 1 | Overuse | 3 | 1–3 |
| 2 | Daily-life disturbance | 7 | 4–10 |
| 3 | Withdrawal | 3 | 11–13 |

## *Example*

### *Overuse*

How would you describe your smartphone usage in daily life? Choose the option that best represents your typical behavior.

a. I check my phone regularly throughout the day, even during other ongoing activities. *(3 points)*
b. I check my phone frequently when I have free time or during breaks. *(2 points)*
c. I occasionally check my phone when I feel bored or have nothing else to do. *(1 point)*
d. I check my phone only when necessary. *(0 points)*

### *Daily-life disturbance*

Does smartphone usage ever interfere with your relationships or responsibilities? Please select one.

a. My parents or guardians have often warned me because I tend to isolate myself and do not interact with them. *(3 points)*
b. My phone usage causes occasional conflicts, but I can still maintain relationships with family members. *(2 points)*
c. My phone usage causes slight annoyance to family members but does not lead to significant conflict. *(1 point)*
d. My smartphone usage does not disturb or affect my family interactions. *(0 points)*

### *Withdrawal*

If you forget your smartphone at home and only realize it after you have arrived at school or work, how would you react?

a. I would return home immediately to get it, even if it causes inconvenience or delay. *(3 points)*
b. I would feel highly anxious and distracted for the rest of the day. *(2 points)*
c. I would feel uneasy at first but gradually adapt and carry on with the day. *(1 point)*
d. I would be indifferent and continue the day without concern. *(0 points)*

The analysis of item discrimination power using the Corrected Item-Total Correlation showed values ranging from 0.366 to 0.614. The instrument's reliability was assessed through Cronbach's Alpha coefficient, indicating a value of 0.828.

The construct validity of the measurement model was assessed through model comparison using the Likelihood Ratio Test (LRT). The multidimensional model (Deviance = 37377.64, df = 45) showed a significantly better fit to the data than the unidimensional model (Deviance = 37539.24, df = 40), yielding a chi-square difference of 161.60 with 5 degrees of freedom ($p < .05$). This statistical evidence supports the use of a multidimensional model to represent the structure of smartphone addiction behavior. Therefore, the scale structure is best characterized as a Between-Item Multidimensional Model, as illustrated in Table 2 and Figure 1.

The analysis results of item difficulties and item threshold using the Wright map, along with validity evidence based on internal structure evaluated through the Weighted Mean Square (Weighted MNSQ) statistic, revealed that the weighted MNSQ values ranged from 0.75 to 1. These values fall within the acceptable range based on designated criteria, indicating that 33 items align properly with the measurement structure. While the item thresholds were ordered from low to high difficulty across all items, no regularities were detected, and this confirmed the appropriateness of the items for the measurement structure. Nevertheless, when evaluation was taken against criteria items 1.1, 2.1, 12.3, and 13.3, items no. 1 and 2, which measure the overuse component, lacked respondents at the lowest scoring levels. Similarly, items 12 and 13, which measure the withdrawal component, lacked respondents at the highest scoring levels.

**Table 2** Comparison of model fit using the Likelihood Ratio Test (LRT)

| Model Type | Deviance | Parameters | df | $\chi^2$ Difference | *p*-value | Interpretation |
|---|---|---|---|---|---|---|
| Unidimensional Model | 37539.24 | 40 | — | — | — | Baseline model |
| Multidimensional Model | 37377.64 | 45 | 5 | 161.60 | < .05 | Significantly better fit (preferred) |

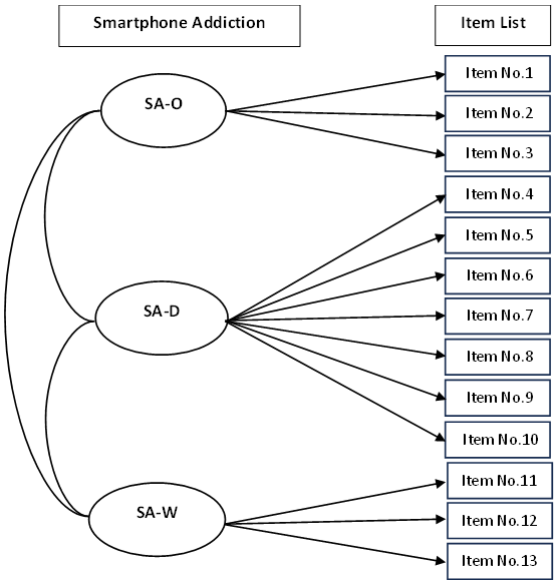



**Figure 1** Between-item multidimensional model

Furthermore, the withdrawal component showed a wider distribution of abilities than other components. To address these gaps, future data collection took place to include participants with extreme behaviours, such as individuals exhibiting the high difficulty of smartphone withdrawal, either who do not use smartphones or use them minimally. This inclusion would enhance the completeness of the Wright map.

In this study, the smartphone addiction scale scoring utilized a multi-point system (0, 1, 2, 3). Accordingly, the Wright Map has to be analysed for threshold level. Overall, the results indicated that the developed scale can effectively measure a range of abilities across respondents, corresponding to a normal curve, and this scale meets quality standards within acceptable criteria. While the distribution resembled a normal curve, this was not the sole criterion used to evaluate the scale's quality. More importantly, Expected A Posteriori (EAP) reliability values were examined to assess the precision of ability estimation. These values reflect the proportion of variance in the estimated abilities explained by the model, providing robust evidence for the measurement reliability across the three components.

The scale reliability was further validated using EAP Reliability, and their values for the three components were as follows: Overuse (0.651), Daily-Life Disturbance (0.793), and Withdrawal (0.759), as presented in Table 3, Table 4 and Figure 2.1 and Figure 2.2

Figure 2.2 Wright map displaying the threshold distribution of all items across three dimensions—Overuse (SA-O), Daily-Life Disturbance (SA-D), and Withdrawal (SA-W)—based on a Between-Item Multidimensional Model. Each item loads on a single latent trait, and item thresholds are plotted together to provide an integrated view of item difficulty across the construct space. Item labels indicate their associated dimension.To enhance interpretability, three cut-off points were determined within each dimension based on cumulative item threshold levels, using ability estimates derived from MLE. These levels were aligned with observable behavioral patterns of smartphone use (e.g., inability to stop, daily-life impact, withdrawal), supporting a construct-referenced interpretation. This method reflects a construct-referenced standard-setting approach, in which cut-off points are derived from latent trait estimates and linked to increasing behavioral intensity across each dimension. The four levels—ranging from Very Low Risk to High Risk—enable meaningful interpretation while avoiding diagnostic labeling.

**Table 3** The values of weighted MNSQ, Item Thresholds, and EAP reliability of smartphone addiction scale

| Component | Item No. | weighted MNSQ | Item Thresholds | | |
|---|---|---|---|---|---|
| | | | Level 1 | Level 2 | Level 3 |
| SA-O: Overuse | 1 | 0.98 | -5.81 | -0.96 | 2.63 |
| EAP RELIABILITY: 0.651 | 2 | 0.98 | -5.08 | -1.08 | 1.78 |
| | 3 | 1.02 | 0.73 | 1.89 | 2.59 |
| SA-D: Daily-life disturbance | 4 | 1.03 | -0.86 | 0.91 | 2.12 |
| EAP RELIABILITY: 0.793 | 5 | 0.97 | 0.88 | 1.95 | 2.76 |
| | 6 | 1.28 | -1.38 | 0.34 | 0.77 |
| | 7 | 0.96 | -0.65 | 1.30 | 2.34 |
| | 8 | 0.92 | 0.30 | 1.36 | 2.39 |
| | 9 | 0.96 | 0.52 | 1.01 | 2.33 |
| | 10 | 0.90 | -0.61 | 1.03 | 3.01 |
| SA-W: Withdrawal | 11 | 0.90 | -0.13 | 1.74 | 3.50 |
| EAP RELIABILITY:0.759 | 12 | 1.06 | -0.38 | 0.63 | 4.07 |
| | 13 | 1.07 | -2.18 | 1.55 | 4.08 |

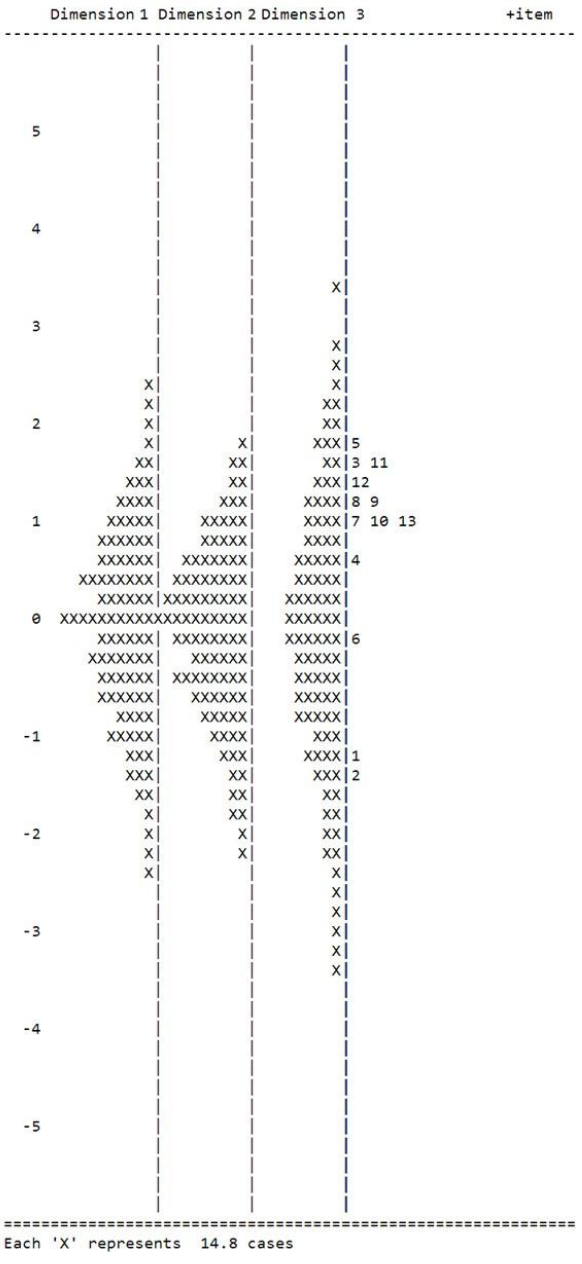



**Figure 2.1** Wright Map: The average difficulty value for each question

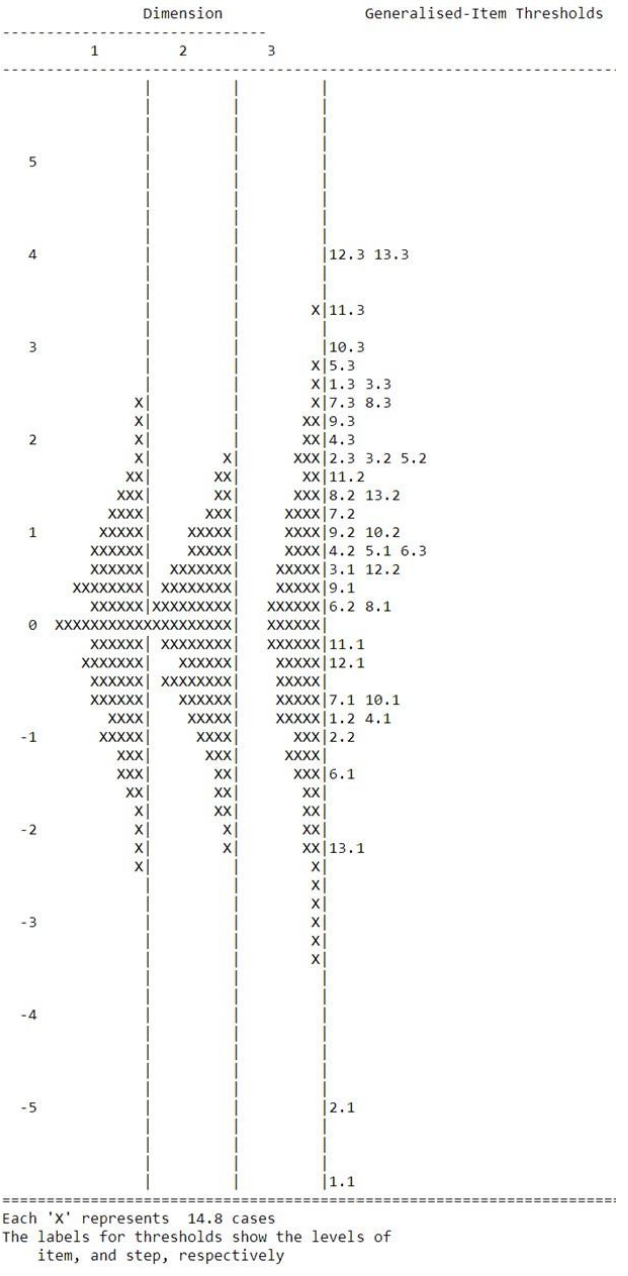



**Figure 2.2** Wright Map: The average difficulty value for each step of the answer

This approach is grounded in latent trait theory, where item thresholds and raw score estimates are jointly used to classify respondents into meaningful behavioral categories. Table 4 presents this mapping between item thresholds and respondent levels and was designed to operate the interpretation of scores in real-world educational settings, as presented in Table 4.

Figure 2.1 Wright map displaying the average item difficulty of each item across the full scale. This figure provides a general overview of how items are distributed along the latent trait continuum.

**Table 4** The respondent level and alignment with the cut-off points in the Wright map for structural validity assessment

| Component | Respondent level | Item no. ranged in the same respondent level | The total value of threshold in the same respondent level | Item Amount | Cut-off points for thresholds /total item | Raw score from MLE estimation |
|---|---|---|---|---|---|---|
| SA-O Overuse | 1 | 1.1 | -5.81 | 3 | -3.387 | 2 |
| | | 2.1 | -5.08 | | | |
| | | 3.1 | 0.73 | | | |
| | 2 | 1.2 | -0.96 | 3 | -0.050 | 4 |
| | | 2.2 | -1.08 | | | |
| | | 3.2 | 1.89 | | | |
| | 3 | 1.3 | 2.63 | 3 | 2.333 | 7 |
| | | 2.3 | 1.78 | | | |
| | | 3.3 | 2.59 | | | |
| SA-D Daily-life disturbance | 1 | 4.1 | -0.86 | 7 | -0.257 | 4 |
| | | 5.1 | 0.88 | | | |
| | | 6.1 | -1.38 | | | |
| | | 7.1 | -0.65 | | | |
| | | 8.1 | 0.30 | | | |
| | | 9.1 | 0.52 | | | |
| | | 10.1 | -0.61 | | | |
| | 2 | 4.2 | 0.91 | 7 | 1.129 | 11 |
| | | 5.2 | 1.95 | | | |
| | | 6.2 | 0.34 | | | |
| | | 7.2 | 1.30 | | | |
| | | 8.2 | 1.36 | | | |
| | | 9.2 | 1.01 | | | |
| | | 10.2 | 1.03 | | | |
| | 3 | 4.3 | 2.12 | 7 | 2.246 | 16 |
| | | 5.3 | 2.76 | | | |
| | | 6.3 | 0.77 | | | |
| | | 7.3 | 2.34 | | | |
| | | 8.3 | 2.39 | | | |
| | | 9.3 | 2.33 | | | |
| | | 10.3 | 3.01 | | | |
| SA-W Withdrawal | 1 | 11.1 | -0.13 | 3 | -0.897 | 2 |
| | | 12.1 | -0.38 | | | |
| | | 13.1 | -2.18 | | | |
| | 2 | 11.2 | 1.74 | 3 | 1.307 | 4 |
| | | 12.2 | 0.63 | | | |
| | | 13.2 | 1.55 | | | |
| | 3 | 11.3 | 3.50 | 3 | 3.883 | 7 |
| | | 12.3 | 4.07 | | | |
| | | 13.3 | 4.08 | | | |

*Note:* Mapping items thresholds and cut-off points across dimensions for classification of smartphone addiction levels. This table provides a basis for interpreting latent traits in practical screening contexts.

The Respondents' scores on the Overuse and Withdrawal components of the smartphone addiction scale showed cut-off points at 2, 4, and 7. Meanwhile, the cut-off points of Daily-Life Disturbance component were set at 4, 11, and 16. These results indicated that the three cut-off points from four levels are appropriate for assessing smartphone addiction among education faculty students. The distribution of the Wright map demonstrates clear differentiation.

The selection of cut-off scores in this study used Maximum Likelihood Ability Estimation (MLE) instead of Expected Posterior Ability Estimation (EAP) as individuals with equal ability levels should achieve the same raw scores, whereas,

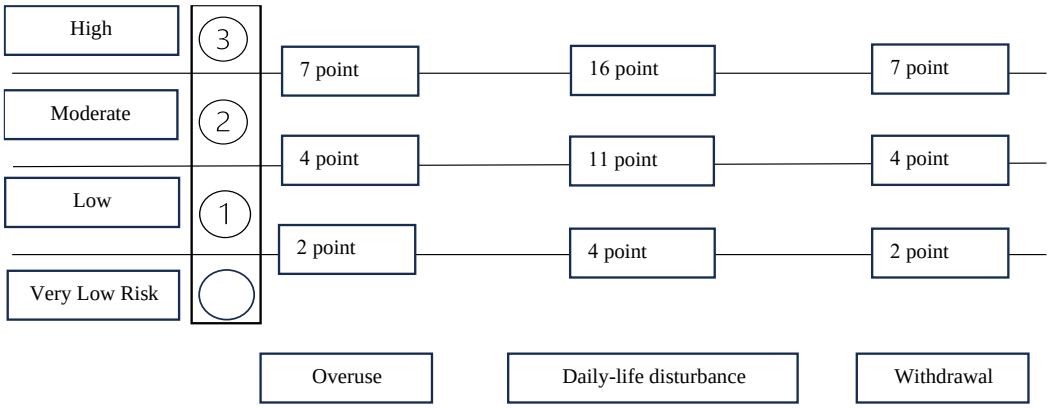



**Figure 3** The Specification of cut-off points for three components in smartphone addiction scale

under EAP, individuals with identical raw scores may have differing ability estimates (Bock & Aitken, 1981; Bock & Mislevy, 1981).

Based on the study by Phaniew et al. (2023), this dual method comparison revealed that EAP provided lower standard error of measurement (SEM), while MLE had higher SEM values. However, both methods remain within acceptable ranges. EAP focused on individual response patterns and produced wider intervals of ability estimates for identical raw scores, while MLE offered greater simplicity and practicality in calculating cut-off scores.

MLE shows more advantages due to its clarity, appropriateness, and feasibility for implementation in real-world contexts. Moreover, it aligns with the three evaluation standards of the Joint Committee on Standards for Educational Evaluation**:** validity, utility, and feasibility. The results are illustrated in Figure 3

Interpretation framework for categorizing respondents into four levels across three dimensions of smartphone addiction. Cut-off points reflect cumulative item thresholds derived from MLE estimates. The figure illustrates behavioral classification levels based on the structure shown in Wright maps, without assuming direct comparability between dimensions.

## Conclusion and Recommendation

The findings of this study consist of two key aspects. Firstly, behavioral characteristics of smartphone addiction among education faculty students; this adolescent group will play a significant role in improving the quality of Thai education in the future and the meaning of smartphone addiction aligned with the contextual situations in Thailand. The study also defined three components of smartphone addiction: Overuse, Daily-Life Disturbance, and Withdrawal, which correspond to standardized international smartphone addiction scales. Secondly, the Situational Smartphone Addiction Scale was developed and validated under measurement and evaluation theories, Respond Theory, including analytical techniques to specify cut-off points in order to improve limitations in previous smartphone addiction measurement tools. The development of a context-specific situational test for smartphone addiction represents an innovative advancement beyond traditional self-report rating scales, reflecting the real-life behaviors and emotions of the target population. The Situational Smartphone Addiction Scale was specifically designed for support behavioral classification and decision-making related to digital well-being in educational settings.

The quality of the scale was verified using Classical Test Theory (CTT) and Multidimensional Item Response Theory (MIRT), which enhanced the precision of measurement by accommodating the complex structure of smartphone addiction behaviors, leading to better diagnostic capability compared to unidimensional models. where item discrimination and internal consistency reliability met the required standards. The developed smartphone addiction scale showed more appropriate internal construct validity with the multidimensional model than the single-dimensional one. All 13 items fit with the measurement structure and comprehensively covered all levels of smartphone addiction behaviors among respondents. Therefore, the scale meets acceptable quality standards and explicitly demonstrates accuracy, consistency, and stability for measurement.

Moreover, the establishment of cut-off points based on Maximum Likelihood Estimation (MLE) offered a practical

framework for classifying respondents into meaningful levels of addiction severity, facilitating real-world application in educational settings. The distribution of respondents across the Overuse, Daily-Life Disturbance, and Withdrawal components showed clear differentiation through Wright map analysis, and the scale demonstrated strong reliability across these dimensions. These findings collectively underscore that the developed scale effectively captures the multidimensional nature of smartphone addiction behaviors among education faculty students and provides a reliable, valid, and contextually appropriate tool for assessment. The four risk levels—Very Low, Low, Moderate, and High—derived from the Wright map and threshold estimates, were not developed for diagnostic purposes, but rather for screening, early identification, and targeted support planning. It can thus be stated that making the four levels with three cut-off points appeared appropriate. Therefore, the university instructors who are responsible for training and developing education faculty students can use this smartphone addiction scale to evaluate their students and consider the scores for each component based on defined scores in this study for further classification in smartphone addiction, and identify appropriate solutions.

However, other additional pieces of evidence for instrument validity, such as criterion-related validity, have not yet been shown in this study. Thus, there should be developments in smartphone addiction assessment tools that incorporate other validation instruments as benchmarks for quality verification. Likewise, the validation of internationalized assessment instruments can be further conducted by integrating cross-cultural validation methods. Expanding the sample to include broader groups beyond education students would enhance the generalizability of findings. Furthermore, developing norm-referenced scores could provide more nuanced interpretation and application of results in various educational and clinical contexts.

In conclusion, the Situational Smartphone Addiction Scale developed through this study offers a scientifically rigorous, practically applicable, and contextually relevant instrument that holds substantial promise for advancing both research and practice in the assessment and management of smartphone addiction behaviors.

## Conflict of Interest

There is no conflict of interest.

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