BMC Psychology

RESEARCH

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From social media addiction to information literacy: unravelling the underlying mechanism of critical thinking and cognitive flexibility

Emre Toprak[1*], Gülşah Taşçı[2] and Mustafa Çelebi[3]

Abstract

Background This study aims to investigate the relationship between social media addiction (in a non-clinical sense) and information literacy (access, evaluation, and use), with a focus on the mediating roles of critical thinking and cognitive flexibility among university students.

Methods This study employed a correlational research design. Data were collected from 1,669 university students studying at seven universities in Türkiye, selected using convenience sampling. 1,104 (66.1%) of the sample group are female, while the remaining 565 (33.9%) are male students. Regression-based and bootstrap methods were used to determine the sequential multiple mediation effect of critical thinking and cognitive flexibility between social media addiction and information literacy.

Results The study's results indicated a moderate negative relationship between social media addiction and information literacy. This suggests that increased social media usage harms levels of information literacy. Furthermore, critical thinking and cognitive flexibility partially mediated this relationship. This emphasises that social media addiction has negative cognitive effects on individuals' ability to evaluate and process information.

Conclusions The results are consistent with previous studies and highlight the potential adverse effects of excessive social media addiction on critical thinking and cognitive flexibility. The findings indicate that increased social media addiction undermines information literacy by weakening higher-order cognitive processes, and the proposed model explains approximately 39% of the variance.

Keywords Critical thinking, Cognitive flexibility, Information literacy, Social media addiction

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Introduction

In recent decades, the development of digital technologies has continued to fundamentally transform the global information ecosystem and the processes of accessing information in education [1]. This change is based not only on students' ability to access knowledge quickly, but also on their ability to separate reliable sources of information and analyse the information obtained from these sources through a critical thinking (CT) filter [2–4] and cognitive flexibility (CF) [5]. Information literacy (IL) is a multi-dimensional umbrella concept encompassing the competence to access accurate information, critically analyze it, and ethically transform it into a solution [6, 7]. Especially considering that the uncontrolled use of social media tools leads to social media addiction (SMA) [8], it is vital for individuals to have information literacy skills in order to cope with the risks brought by the digital age, not to get lost in the huge amount of information, and to access accurate information while protecting themselves from manipulative content [9]. Indeed, students who can analytically analyse information in digital environments achieve stronger academic outcomes and maintain their motivation for lifelong learning [10]. Furthermore, it is predicted that students with high CF and CT will be protected from the SMA by using their IL abilities more effectively, and will improve their academic success [4–6, 11]. Therefore, CT [4] and CF [5], which enable university students to cope with misinformation and overcome their mental limitations, serve as key 'buffers' against SMA. Previous studies have frequently examined the relationships between some dimensions of IL and SMA [8, 12, 13]. Despite this, it is seen that there are very limited studies in the literature addressing the mediating role of these two higher-orders thinking skills in the relationship between SMA and IL. Therefore, this study examines the mediating role of CT and CF in the relationship between SMA and IL.

This study examines how SMA affects IL among students, while also investigating the mediating effects of SMA abilities and CF on this relationship, as this has several important implications. Students with high levels of IL can make the right decisions by identifying trusted sources and critically evaluating information [3, 14]. These skills are closely related to CT and CF [15, 16]. CT enables students to question assumptions and analyse multiple perspectives, while CF strengthens the ability to adapt to changing conditions. Improving IL contributes to academic achievement and student well-being by reducing SMA [17]. Therefore, it is thought that the effects of SMA on IL can be explained through CT and CF.

Conceptual framework

In this study, we focused on two theoretical frameworks relevant to the purpose of the research. First, we used the I-PACE model to explain how SMA causes cognitive erosion in university students; particularly how impairment in executive functions such as cognitive flexibility and critical thinking undermines information literacy [18]. Addiction initially develops from habit. In the case of SMA, individuals' habitual use of social media can gradually transform into an addiction [19]. Secondly, we used Critical Thinking Theory. According to Facione [4], analytical, evaluative, and self-regulatory skills function as cognitive brakes that prevent impulsive information consumption triggered by addiction. According to Tanhan et al. [12], the Critical Thinking Theory explains how people adjust to new situations and different thoughts and problems through multiple approaches. Thus, switching between CF can help students defend themselves against the risks of social media and improve their IL abilities. In practical terms, a student with a high level of CT, even if they enter the SMA cycle predicted by the I-PACE model, can mitigate the negative impact of SMA on IL through CT and CF in the digital content they encounter. Therefore, these two theoretical approaches offer a comprehensive roadmap on how the cognitive contraction created by SMA can be managed through higher-order thinking skills.

Social Media Addiction (SMA)

Social media platforms serve multiple entertainment and social functions because people use them to play games and spend leisure time communicating and sharing photos [20]. According to Greenhow and Lewin [21] and Tanhan et al. [12], social media functions beyond communication by providing entertainment, social interaction, and information acquisition. Specifically, in this study, we used the term SMA in a non-clinical sense. SMA represents a behavioural addiction that causes cognitive, emotional, and social damage when people use digital platforms without control or compulsively [22]. SMA refers to an excessive love for social media, an unrelenting need to stay online, and uncontrollable motivations that negatively affect important life domains [23]. SMA is the process of weakening control over the executive functions of the individual and the impulsive system dominating [24]. SMA has negative implications for information-related processing abilities through symptoms such as attention problems and reduced cognitive awareness [25]. Based on prior research on SMA, this phenomenon is becoming an increasingly common issue globally [26] and SMA has an estimated impact on 12% of users of these platforms [27].

Information Literacy (IL)

IL defines the human ability to establish their information requirements and successfully find information and evaluate its worth before applying ethical standards to use it effectively [6, 28]. The educational process of IL requires individuals to follow these fundamental steps as defined by ACRL [29]. The first steps of IL require users to determine their information needs followed by selecting appropriate information retrieval methods and suitable search approaches. The core competences of IL include identifying information needs and gathering and assessing relevant information that should be used in an ethical manner [28]. Existing studies on IL points to its emerging importance for the digital age [30, 31]. IL goes beyond basic search competences and includes both accuracy and source verification and critical information evaluation [2] and enables people to make more informed and adaptive decisions in digital spaces [6]. Thus, thanks to this skill, users are protected from misinformation and digital deception [32]. However, some studies in the literature also reveal that high technical skills do not always imply qualified IL. The digital environment demands students to conduct technical searches, critically evaluate sources and think analytically while confirming the accuracy of information [2, 10].

Critical Thinking (CT)

CT competence includes advanced cognitive abilities including analysis and evaluation, inference, judgement and problem solving [4, 33]. Previous research on university students' CT skills provides evidence of positive and significant relationships between CT dispositions and academic achievement, problem solving skills and creativity [4, 11]. For example, students' CT levels increase significantly in educational environments where active learning methods are used [34]. Therefore, the literature reveals that CT is a dynamic structure that is shaped by the educational process and indirectly affects students' psychological well-being rather than a process that develops spontaneously [4, 17].

Cognitive Flexibility (CF)

CF refers to as the individual's ability to adapt to changing conditions in the environment, to develop alternative strategies instead of being stuck in a single solution to the problems encountered, and to restructure one's perspective in difficult situations [5, 35, 36]. A multifaceted mental strategy consists of three basic elements: identifying multiple solutions in challenging times, demonstrating the ability to adapt to changing situations, and having self-efficacy [37]. There is evidence on the positive outcomes of previous research focussing on CF in university students. For example, while some studies have found that individuals with high levels of CF have more developed stress coping skills, show higher tolerance for uncertainty, and exhibit fewer depressive symptoms [38], some studies have empirically demonstrated that CF positively predicts students' problem-solving skills [39]; or that this skill has a direct effect on students' management of perceived stress and maintenance of psychological well-being [38, 40].

Therefore, the literature positions CF not only as a mental skill, but also as a fundamental psychological resource that strengthens students' academic and social adaptation. Previous research indicates that CF enables people to adjust their responses when dealing with new circumstances [16]. The ability to adapt to changing situations directly relates to creativity and problem-solving and multitasking and decision-making [16]. People who demonstrate high CF levels effectively process new information while creating innovative solutions and adapting well to changes [39] but excessive social media usage hampers CF by promoting impulsive responses and inflexible thinking [41]. According to Cañas et al. [42] the inability to adapt to new situations directly corresponds to low CF.

Present study

The literature emphasises that high levels of SMA weaken users' information evaluation skills [25] and erode their CT capacity [4, 15]. Therefore, this cognitive damage caused by SMA also restricts CF [43], which has a strong positive relationship with CT [44]. Research supporting this situation shows that CF plays a decisive role in both dependency processes [12, 45] and increases IL performance. In this context, CT and CF function as key mediating mechanisms that absorb the destructive effect of SMA on IL and regulate the process by directing individuals to advanced methods such as detecting false news and analytical questioning [14, 46].

Literature has primarily examined the direct relationships between these variables, but studies testing mediation effects are limited. Given this, the passive flow of information on social media users' CT tendencies by weakening their analytical questioning reflexes, which in turn disrupts IL processes that require questioning the accuracy and validity of information [6]. Simultaneously, repetitive behavioural patterns and mental rigidity inherent in addiction reduce CF, which is the individual's ability to adapt to changing situations [47]. IL abilities, which requires the ability to switch between different search strategies in a complex information ecosystem, is damaged due to decreased CF. In the light of this theoretical framework, it is assumed that CT. Therefore, this study investigates the mediating effect of CT and CF on the relationship between SMA and IL among students. However, the direct relationships between these variables have typically been studied in literature, and no studies

testing their mediating roles have been encountered. Therefore, in this study, we argue that CT and CF mediate the relationship between SMA and IL. In this context, the study's second aim is to test the mediating effects of CT and CF in the relationship between SMA and IL in the study conducted with students. Therefore, the following are hypotheses for the current study:

- There will be a statistically significant relationship between SMA, IL, CT, and CF (H1).
- There will be a statistically significant mediating role of CT and CF in the relationship between SMA and IL (H2).

Method

This study uses the relational research model to investigate the relationships between CT, CF, SMA, and IL. Related studies emerge by distributing the relationship or effect between two or more variables without any relevant intervention [48]. In this case, an attempt is made to describe the developments between the variables in question, in other words, whether the variables change together or not, and if so, in what way. The relational screening model has two types of relationships between variables: examination and comparison. A correlational-type relationship test model examines whether the variables change together. In the comparative type of relationship test model, while there are at least two variables in a group according to one of the variables (the independent variable to be tested), it is not tested whether there is a significant difference according to the other variable (the dependent variable) [49]. What is presented here is a model that includes such a comparison between four different variables.

Participants and procedures

The universe of the study consists of 3,740,171 university students studying in Türkiye in the 2024–2025 academic year, and the sample group consists of 1,669 students studying at seven different universities selected using the convenience sampling method. 1,104 (66.1%) of the sample group are female, while the remaining 565 (33.9%) are male students. The university students participating in the study have different levels in terms of variables such as academic success and socioeconomic status. The convenience sampling method can be used due to the difficulty of random or systematic sample selection, especially in research in the field of educational sciences. The main drawback of convenience sampling is that it selects participants based on ease of access, but this method may introduce bias in the selected sample [48]. Ethical approval for the study was obtained from the Scientific Research and Publication Ethics Board of İstanbul 29 Mayıs University under application number 12.

Measures

This study used the "Personal Information Form" prepared by researchers and the SMA, IL, CT, and CF scales as data collection tools. Detailed information about the data collection tools in question is provided below.

Social media addiction scale

The SMA scale adult form was developed by Şahin and Yağcı [50], consisting of 46 items, 41 positive and five negatives, scored on a five-point Likert scale. Scale has two sub-dimensions. These are virtual tolerance and virtual communication. The scale ranges from a minimum score of 46 to a maximum of 230. A higher score indicates that a person sees themselves as a SMA. The Cronbach's alpha reliability coefficient calculated for the total score of the original scale was 0.94, for the virtual tolerance dimension. 92, and for the virtual communication dimension, 0.91. The coefficients calculated in the current study were 0.89, 0.85, and 0.83, respectively.

Information literacy scale

The IL scale, developed by Adıgüzel [51], has four subdimensions that are graded on a five-point Likert scale. The scale consists of 29 items. The sub-dimensions of the scale are determined as follows: defining information need, accessing information, using information, and considering ethical and legal regulations in using information.

The lowest score that can be obtained from the scale is 29, while the highest score that can be obtained is 145. As the score obtained from the scale increases, the level of having the measured feature increases. The Cronbach's alpha reliability coefficient calculated for the total score of the original scale was 0.93, for the defining information need subscale, 0.80, for the accessing information subscale, 0.87., for the using information subscale, 0.85. for the considering ethical and legal regulations in using information subscale, 0.83. The coefficients calculated in the current study were 0.88, 0.80, 0.82, 0.81, and 0.79, respectively.

Cognitive flexibility scale

Martin and Rubin [5] developed a self-report scale, which Çelikkaleli [52] adapted into Turkish. The scale consists of 11 items that use a 6-point Likert scale to measure a single dimension. While the Cr α reliability coefficient in the original scale was 0.80 in this study, Cr α was reported as 0.76 for the scale.

Critical thinking disposition scale

The scale, developed by Irani et al. [53], was adapted to Turkish by Ertaş-Kılıç and Şen [54] and consists of 25 Likert-type questions. The scale has three subdimensions: participation, cognitive maturity, and innovation.

Table 1 Descriptive statistics and the relationships for the variables

Variables	M	SD	Min.	Max.	1	2	3	4
1. IL	82.40	6.75	54.00	132.00	1			
2. SMA	124.20	9.48	63.00	194.00	– 0.26*	1		
3. CT	72.50	7.78	68.00	126.00	0.48*	– 0.43*	1	
4. CF	61.50	5.62	49.00	88.00	0.42*	– 0.35*	0.67*	1

The score ranges of the scales: (1) 29–145; (2) 41–205; (3) 26–130; (4) 20–100

Note: N = 1669; *$p < .01$

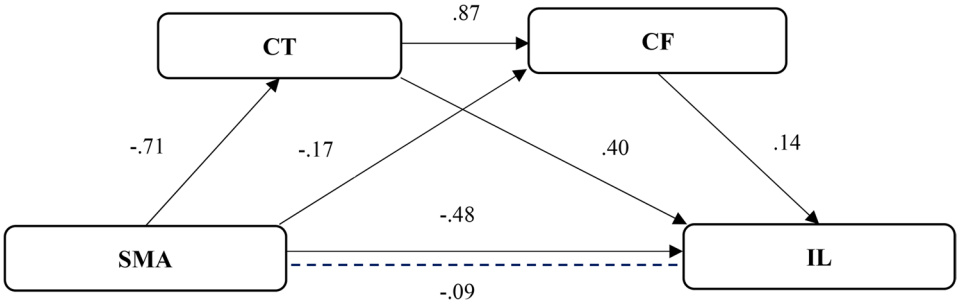


Fig. 1 Serial-multiple mediation of CT and CF in the relationship between SMA and IL, with unstandardized β values

As the score obtained from the scale increases, the level of having the measured feature increases. The Cronbach alpha reliability scores of the original version were found to be 0.88, 0.70, and 0.73 for the sub-dimensions, respectively, and 0.91 for the overall scale. This study reached reliability scores of 0.79, 0.71, and 0.73 for the sub-dimensions, respectively, and 0.86 for the overall scale.

Analytical approach

To test the hypothesized serial multiple mediation model in the study, a regression-based mediation analysis was performed using Hayes' PROCESS macro (Model 6) in SPSS. The model was estimated using ordinary least squares (OLS) regression with 10,000 bootstrap resamplings to obtain bias-corrected 95% confidence intervals for indirect effects. Mediation effects were considered statistically significant if the confidence intervals did not include zero.

Before the mediation analysis, descriptive statistics (means and standard deviations) and Pearson correlation coefficients were calculated to examine the relationships between SMA, CT, CF, and IL. All analyses were performed using SPSS with a significance level of 0.05. Before conducting the mediation analysis, regression assumptions were evaluated. The sample size ($N = 1,669$) was considered sufficient for regression-based mediation analysis. Multicollinearity diagnoses showed no serious multicollinearity issues among the predictor variables.

In the serial multiple mediation model, SMA was defined as the independent variable, IL as the dependent variable, and CT and CF as sequential mediators. Specific indirect effects were examined using bootstrap estimations. A comparison test was conducted to compare the magnitude of specific indirect effects and determine which mediation path showed the strongest effect. In line with recommendations in the mediation literature, 10,000 bootstrap samples were used to improve the stability and accuracy of confidence interval estimations.

Results

Descriptive statistics for the variables in the study and the relationship between the variables are given in Table 1. Table 1 shows negative and moderate relationships between SMA and CT, CF, and IL, and positive and moderate relationships between CT, CF, and IL.

Figure 1 presents unstandardized beta values for the mediating effects of CT and CF, and unstandardized beta values for the mediating effects of CT and CF variables on the relationship between IL and SMA.

Unstandardized beta coefficients were calculated to reduce Type 1 error [55]. Figure 1 shows that SMA had a significant direct effect on IL (β = – 0.48, SE = 0.05, t = -10.71, p <. 01). In addition, the effects of SMA, CT (β = – 0.71, SE = 0.04, t = -19.39, $p < .01$) and CF (β= – 0.17; SE = 0.05, t = -3.71, $p < .01$) on the mediating variables were also significant. In addition, the effect of the first mediating variable CT on the second variable CF was also significant (β = 0.67, SE = 0.03, t = 21.26, $p < .01$). The IL effect of the mediator variables CT (β = 0.40, SE = 0.03, t = 11.51, $p < .01$) and CF (β = 0.14, SE = 0.02, t = 5.69, $p < .01$) is still significant.

The relationship between SMA and IL remained significant when the model included the mediator variables. However, the level of relationship decreased (β = – 0.09, SE = 0.04, t = -1.97, $p < .01$). According to these findings, it was determined that the CT and CF variables had a

Table 2 Comparison of indirect effects and specific indirect effects of SMA on IL via CT and CF

Effects	Product of coefficients		Bootstrapping 95% BCa confidence interval	
	Point estimate	SE	Lower	Upper
Total indirect effects	−0.3930	0.0287	−0.4507	−0.3383
SMA→CT→IL	−0.2835	0.0376	−0.3624	−0.2152
SMA→CF→IL	−0.0235	0.0116	−0.0495	−0.0052
SMA→CT→CF→IL	−0.0860	0.0166	−0.1167	−0.0515
Contrasts				
Model 1 and Model 2	−0.2599	0.0463	−0.3525	−0.1716
Model 1 and Model 3	−0.1975	0.0480	−0.3004	−0.1139
Model 2 and Model 3	0.0624	0.0140	0.0350	0.0899

Note: Model 1: SMA→CT→IL; Model 2: SMA→CF→IL; Model 3: SMA→CT→CF→IL

"partial mediation" effect on the relationship between IL and SMA. It was also seen that the model was generally significant ($F_{(1,1619)} = 114.63$, $p < .01$) and explained 39% of the total variance in IL. The indirect effects and comparison of SMA's specific effects on adolescents' IL levels according to CT and CF are given in Table 2.

The overall indirect effect of SMA on IL via CT and CF (the difference between the total and direct effects) was statistically significant (point estimate = -0.3930 [-0.4507, -0.3383]). In the model, the mediating variables associated with the indirect effects of SMA on IL were considered separately and together. The single mediation effect of CT (point estimate = -0.2835 [-0.3624, -0.2152]), the single mediation effect of CF (point estimate = -0.0235 [-0.0495, -0.0052]), and the multiple serial mediation effect of CT and CF (point estimate = -0.0860 [-0.1167, -0.0515]) were statistically significant. Pairwise comparisons examined the strength of the specific indirect effects of the mediating variables. Three statistically significant contrasts not at the zero-point estimate based on 95% confidence intervals are presented in Table 1. When specific direct effects were examined, CT was found to have stronger mediation.

Discussion and conclusion

This study examined the relationship between SMA and IL and the mediating roles of CT and CF between these variables. The findings of this research offer significant data regarding the relationship between SMA and IL. The findings supported the two hypotheses tested in the study.

First, the study's findings revealed a moderately negative correlation between SMA and IL. This suggests that as individuals' SMA increases, their IL abilities may be adversely affected. In other words, individuals with limited information literacy may exhibit increased susceptibility to addiction, as they are more vulnerable to the manipulative qualities of social media content. This finding is consistent with the literature, which argues that uncontrolled SMA can weaken the ability to critically filter information. This finding is consistent with similar studies in the literature [13, 56] and indicates that uncontrolled and SMA can weaken individuals' ability to select, evaluate and ethically use information in the digital world [25, 57]. Research findings from Korkmaz and Çolak-Kılıç [13] and Puspitasari et al. [2] confirm that higher social media usage results in decreased IL levels. This result coincides with the findings of Turel and Qahri-Saremi [25], who stated that SMA pushes users away from in-depth information processing processes and pushes them towards more superficial and skimming behaviours. As emphasised by Cheng et al. [15] and Thomas [56] in the literature, uncontrolled use of social media platforms causes a significant erosion in university students' competencies (IL) to access academic information and use this information ethically. However, the moderate strength of this correlation indicates that other environmental and individual factors influencing information literacy should also be considered.

Second, the most striking finding of the study is the partial mediating role of CT and CF in this relationship. This finding indicates that social media addiction not only directly affects IL but also has an indirect effect through these cognitive mechanisms. The intense information bombardment and "echo chambers" on social media can dull individuals' CT tendencies [14, 15, 46] and restrict CF, the ability to adapt to new situations [41, 47]. In particular, low CF can make individuals more susceptible to SMA [45], while also leading to adaptation problems in complex problem-solving and information processing processes [42]. On the other hand, CT's strong and positive influence on CF suggests that cognitive processes operate in a mutually reinforcing, patterned structure.

Our model explains approximately 39% of the total variance in IL. In the field of education, this rate demonstrates the strong explanatory power of the model [48, 49]. However, the remaining 61% of the variance may be due to other factors not addressed in this study (e.g., quality of formal education, family environment, or digital self-efficacy) [2, 31]. This proves that SMA is not the sole determinant of information literacy, but a significant risk factor. Furthermore, social media use, with its repetitive nature, according to Sagar [45] endangers CF because this ability helps people adjust their thinking and behaviour to new situations. Social media platforms create echo chambers and filter bubbles which harm CT skills because they block users from encountering different viewpoints and reinforce their existing biases [14]. The research supports previous studies that investigated the relationship between CF and CT [43, 44, 58]. The research demonstrates that SMA users face cognitive difficulties which make it challenging for them to use their

attention span and CT [14]. Social media platforms provide users with non-stop information streams which prevent them from conducting proper content evaluation. University students need to monitor their time spent online because it affects their CT skills [15]. A similar study demonstrates that SMA [45] negatively affects CF which decreases the ability to adapt to new situations and solve problems [12]. Research indicates that students who spend too much time on social media develop impaired IL abilities when they need to assess academic resources [2]. The results indicated that SMA primarily targets individuals' systematic reasoning and bias recognition skills [4], while weakened CT skills negatively affect the process of detecting fake news and accessing accurate information [46]. Similarly, the mental rigidity created by addiction [12] indirectly undermines IL by reducing the CF capacity [43] that enables individuals' openness to new information and conceptual adaptation. In this context, our findings support the theoretical framework proposed by Galindo-Domínguez et al. [14] and Zhang et al. [59] and prove that CT and CF are cognitive mechanisms that can filter the harmful effects of digital behaviours before they are carried over to IL.

Implications for theory and practice

The research provides comprehensive results about the effects of SMA on IL and CF and CT abilities. The study uses the I-PACE model [18]; the results show that SMA leads to different personal problems by affecting how people gather and use information. The research shows that SMA generates multiple personal problems because it affects both information acquisition and evaluation and utilization processes. The study confirms previous research which shows that social media usage negatively affects IL [2, 3]. A key theoretical contribution of this work is the demonstration that CF and CT serve as pivotal mediating mechanisms between SMA and IL, underscoring the tenets of Critical Thinking Theory [4]. The research demonstrates that CF and CT function as linking elements between SMA and IL which proves their fundamental importance. This research provides foundational evidence for future studies to analyse the complex relationships between SMA and IL and their cognitive functions.

The research results provide strategic and functional recommendations for different target audiences who need to manage SMA to improve IL abilities. In this perspective, educational institutions need to establish qualified educational programs which teach students about SMA risks and IL value. The training program should teach students to evaluate social media content critically while showing them how to find trustworthy sources and build resistance against false information. The curriculum needs to include teaching methods which develop both CF and CT abilities. The development of digital literacy skills needs to be fully addressed in educational policies [2]. Policymakers should support social media platforms to create tools that assist users in improving their IL abilities. Finally, in the Turkish context, it is essential for university administrations to integrate 'IL' courses into the curriculum and provide students with digital self-regulation and SMA strategies through intervention centers on campus to mitigate the devastating impact of SMA on academic competencies. Such interventions can enhance students' ability to cope with misinformation while minimizing the negative impact of SMA on IL.

Limitations and future research

The research delivers important findings, but readers must understand its multiple limitations. Firstly, the study design is cross-sectional; therefore, the cause-and-effect relationship between variables should be evaluated as a statistical predictor, not with absolute certainty [48]. The study employs a cross-sectional approach to analyse data from a single time point in Türkiye. The study design prevents researchers from establishing cause-and-effect relationships between the measured variables. Burooj [60] emphasizes the need for longitudinal studies to track how these relationships transform across time. The research should use longitudinal studies to determine causal relationships between variables while evaluating the extended impact of SMA on cognitive development and IL abilities [61]. Furthermore, the moderate strength of this correlation indicates that other environmental and individual factors influencing information literacy should also be considered. Although variables such as family environment and quality of education were not controlled for in this study, the potential impact of these factors on IL should not be ignored. It is suggested that future studies include additional psychosocial factors such as self-regulation, family support, or academic self-efficacy. Secondly, the data are based on self-report scales, which may have led participants to respond with social desirability concerns [50, 52]. Finally, the model explains 39% of the total variance, indicating that SMA, CF, and CT are key determinants of IL, but other factors also contribute to the process. The model's 39% variance explanation highlights the need for longitudinal studies and larger samples including different demographic groups to explore the remaining 61% [2, 16]. Future research should investigate how cultural elements and environmental conditions affect the relationship between SMA and IL.

Acknowledgements

'Not applicable' for that section.

Authors' contributions
Toprak, Taşçı, and Çelebi devised the study design, extracted, screened, and analyzed the data to finalize the article for review, and wrote the manuscript. All authors read and approved the final manuscript.

Funding
'Not applicable' for that section.

Data availability
The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
We obtained ethical approval for this study from the İstanbul 29 Mayıs University Scientific Research and Publication Ethics Board under application number 12. The study was conducted in accordance with the principles outlined in the Declaration of Helsinki. Informed consent was obtained from all participants.

Consent for publication
'Not applicable' for that section.

Competing interests
The authors declare no competing interests.

Received: 16 January 2026 / Accepted: 6 March 2026
Published online: 12 March 2026

References

1. López-Carril S, Glebova E, Bae D, González-Serrano MH. Social media as a teaching-learning tool to enhance students' professional profile: The case of LinkedIn. Eur J Educ. 2025;60(1):12862. https://doi.org/10.1111/ejed.12862.
2. Puspitasari D, Weng C, Chu RJC, Chen AZC. Modeling the relationship between internet epistemic belief, digital literacy and social media engagement of adult social media users: A practical implication for education. Interact Learn Environ. 2025;33(1):726–41. https://doi.org/10.1080/10494820.2024.2354434.
3. Trixa J, Kaspar K. Information literacy in the digital age: Information sources, evaluation strategies, and perceived teaching competences of pre-service teachers. Front Psychol. 2024;15:1336436. https://doi.org/10.3389/fpsyg.2024.1336436.
4. Facione PA. Critical thinking: What it is and why it counts. Millbrae (CA): Measured Reasons & California Academic; 2011.
5. Martin MM, Rubin RB. A new measure of cognitive flexibility. Psychol Rep. 1995;76(2):623–6. https://doi.org/10.2466/pr0.1995.76.2.623.
6. Association of College and Research Libraries (ACRL). Framework for information literacy for higher education. Chicago: American Library Association. 2016. https://www.ala.org/acrl/standards/ilframework. Accessed 25 Feb 2025.
7. Özel N. Üniversite öğrencilerinin bilgi okuryazarlığı becerilerinin değerlendirilmesi: Ankara Üniversitesi örneği. Bilgi Dünyası. 2016;17(2):247–64. https://doi.org/10.15612/BD.2016.525.
8. Yurter E, Duğan Ö. Sosyal medya bağımlılığı ile dijital okuryazarlık arasındaki ilişkinin lise öğrencileri üzerinden incelenmesi. SDÜ İFADE Dergisi. 2024;6(2):95–110. https://doi.org/10.70627/sduifade.1604042.
9. Langarizadeh M, et al. Prediction of internet addiction based on information literacy among students of Iran University of Medical Sciences. Electron Physician. 2018;10(2):6333–40. https://doi.org/10.19082/6333.
10. Head AJ, Eisenberg MB. Truth be told: How college students evaluate and use information in the digital age. Project Information Literacy Progress Report. Seattle (WA): University of Washington, Information School; 2010.
11. Aslan I, Polat H. Investigating social media addiction and impact of social media addiction, loneliness, depression, life satisfaction and problem-solving skills on academic self-efficacy and academic success among university students. Front Public Health. 2024;12:1359691. https://doi.org/10.3389/fpubh.2024.1359691.
12. Tanhan F, Özok HI, Kaya A, Yıldırım M. Mediating and moderating effects of cognitive flexibility in the relationship between social media addiction and phubbing. Curr Psychol. 2023;42:12538–47. https://doi.org/10.1007/s12144-023-04242-8.
13. Korkmaz Ö, Çolak-Kılıç H. Secondary school students' digital literacy skills, social media addictions and attitudes to social media use. Int J Technol Educ. 2024;7(4):883–902. https://doi.org/10.46328/ijte.809.
14. Galindo-Domínguez H, Bezanilla MJ, Campo L. Relationship between social media use and critical thinking in university students. Educ Inf Technol. 2025;30:6641–65. https://doi.org/10.1007/s10639-024-12953-z.
15. Cheng L, Fang G, Zhang X, Lv Y, Liu L. Impact of social media use on critical thinking ability of university students. Libr Hi Tech. 2024;42(2):642–69. https://doi.org/10.1108/LHT-11-2021-0393.
16. Uras MC, Kaya S, Kaya A, Yıldırım M. Unveiling risk profiles: A latent profile analysis of 21st-century skills, resistance to change, and cognitive flexibility. Brain Behav. 2025;15(1):e70167. https://doi.org/10.1002/brb3.70167.
17. Angwaomaodoko EA. The impact of social media on youth education and well-being. Path Sci. 2024;10(2):1010. https://doi.org/10.22178/pos.103-8.
18. Brand M, Potenza MN, King DL et al. The Interaction of Person-Affect-Cognition-Execution (I-PACE) model for addictive behaviors: Update, generalization to addictive behaviors beyond internet-use disorders, and specification of the process character of addictive behaviors. Neurosci Biobehav Rev. 2019;104:1–10. https://doi.org.10.1016/j.neubiorev.2019.06.032.
19. Wang C, Lee MKO, Hua Z. A theory of social media dependence: Evidence from microblog users. Decis Support Syst. 2014;69:40–9. https://doi.org/10.1016/j.dss.2014.11.002.
20. Cho GY, Kim YH. Factors affecting smartphone addiction among university students. J Korea Acad Ind Coop Soc. 2014;15(3):1632–40. https://doi.org/10.5762/kais.2014.15.3.1632.
21. Greenhow C, Lewin C. Social media and education: Reconceptualizing the boundaries of formal and informal learning. Learn Media Technol. 2016;41(1):6–30. https://doi.org/10.1080/17439884.2015.1064954.
22. Andreassen CS, Pallesen S, Griffiths MD. The relationship between addictive use of social media, narcissism, and self-esteem: Findings from a large national survey. Addict Behav. 2017;64:287–93. https://doi.org/10.1016/j.addbeh.2016.03.006.
23. Andreassen CS, Pallesen S. Social network site addiction–An overview. Curr Pharm Des. 2014;20(25):4053–61. https://doi.org/10.2174/13816128113199990616.
24. Brand M, Young KS, Laier C, Wölfling K, Potenza MN. Integrating psychological and neurobiological considerations regarding the development and maintenance of specific internet-use disorders: An I-PACE model. Neurosci Biobehav Rev. 2016;71:252–66. https://doi.org/10.1016/j.neubiorev.2016.08.033.
25. Turel O, Qahri-Saremi H. Problematic use of social networking sites: Antecedents and consequence from a dual-system theory perspective. J Manag Inf Syst. 2016;33(4):1087–116. https://doi.org/10.1080/07421222.2016.1267529.
26. Yıldırım M, Çiçek İ, Öztekin GG, Aziz IA, Hu J. Associations between problematic social media use and psychological adjustment in Turkish adolescents: Mediating roles of family relationships. Int J Ment Health Addict. 2025;23:811–29. https://doi.org/10.1007/s11469-023-01138-3.
27. Güldal ŞT, Kılıçoğlu NA, Kasapoğlu F. Psychological flexibility, coronavirus anxiety, humor and social media addiction during COVID-19 pandemic in Turkey. Int J Adv Couns. 2022;44(2):220–41. https://doi.org/10.1007/s10447-021-09461-x.
28. Belland BR, Kim NJ. Predicting high school students' argumentation skill using information literacy and trace data. J Educ Res. 2021;114(3):211–21. https://doi.org/10.1080/00220671.2021.1897967.
29. Association of College and Research Libraries. Information literacy competency standards for higher education. Chicago: American Library Association. 2003. http://www.ala.org/acrl/standards Accessed 20 Nov 2025.
30. Klucevsek KM, Brungard AB. Information literacy in science writing: How students find, identify, and use scientific literature. Int J Sci Educ. 2016;38(17):2573–95. https://doi.org/10.1080/09500693.2016.1253120.
31. Chan AJ, Hooi LW, Ngui KS. Do digital literacies matter in employee engagement in digitalised workplace? J Asia Bus Stud. 2021;15(3):523–40. https://doi.org/10.1108/JABS-08-2020-0318.
32. Wineburg S, McGrew S. Lateral reading: Reading less and learning more when evaluating digital information. Teach Coll Rec. 2017;121(11):1–40. https://doi.org/10.1177/016146811912101102.
33. Lipman M. Critical thinking: What can it be? Educ Leadersh. 1988;46(1):38–43.
34. Behar-Horenstein LS, Niu L. Teaching critical thinking skills in higher education: A review of the literature. J Coll Teach Learn. 2011;8(2). https://doi.org/10.19030/tlc.v8i2.3554.

35. Martin MM, Anderson CM. The cognitive flexibility scale: Three validity studies. Commun Rep. 1998;11(1):1–9.
36. Savaş G, Kılınç AÇ, Palaz T, Çepni O, Aydın F. Promoting teacher reflective practice in Turkish schools: The roles of teacher self-efficacy, cognitive flexibility and trust. Camb J Educ. 2025;55(6):765–87. https://doi.org/10.1080/0305764X.2025.2580649.
37. Wolff N, Zink N, Stock AK, Beste C. On the relevance of the alpha frequency oscillation's small-world network architecture for cognitive flexibility. Sci Rep. 2017;7:13910. https://doi.org/10.1038/s41598-017-14490-x.
38. Johnson BT. The relationship between cognitive flexibility, coping and symptomatology in psychotherapy [master's thesis]. Milwaukee (WI): Marquette University; 2016. https://www.proquest.com/dissertations-theses/relationship-between-cognitive-flexibility-coping/docview/1784011416/se-2
39. Sugilar H, Nuraida I, Habeeb G. Cognitive flexibility in terms of mathematics education student learning outcomes. Numerical: Jurnal Matematika dan Pendidikan Matematika. 2022;6(1):49–58. https://doi.org/10.25217/numerical.v6i1.1844.
40. Odaci H, Celik CB. Who are problematic internet users? An investigation of the correlations between problematic internet use and shyness, loneliness, narcissism, aggression and self-perception. Comput Hum Behav. 2013;29:2382–7. https://doi.org/10.1016/j.chb.2013.05.026.
41. Turel O, He Q, Xue G. The role of cognitive flexibility in social media addiction: A network neuroscience perspective. J Behav Addict. 2021;10(4):941–51. https://doi.org/10.1556/2006.2021.00071.
42. Cañas J, Quesada JF, Antolí A, Fajardo I. Cognitive flexibility and adaptability to environmental changes in dynamic complex problem-solving tasks. Ergonomics. 2003;46(5):482–501. https://doi.org/10.1080/0014013031000061640.
43. Toprak E, Metin A, Ünalan D. The mediating role of cognitive flexibility and critical thinking in the relationship between academic motivation and fear of negative evaluation. Psychol Sch. 2024;61(3):727–38. https://doi.org/10.1002/pits.23080.
44. Demirtaş Z, Takunyacı M, Yeşil R. Investigation of religious education teacher candidates' cognitive flexibility levels and critical thinking tendencies. Hitit J Theol. 2023;22(1):723–44. https://doi.org/10.14395/hid.1334350.
45. Sagar ME. Predictive role of cognitive flexibility and self-control on social media addiction in university students. Int Educ Stud. 2021;14(4):1–10. https://doi.org/10.5539/ies.v14n4p1.
46. Orhan A. Fake news detection on social media: The predictive role of university students' critical thinking dispositions and new media literacy. Smart Learn Environ. 2023;10:29. https://doi.org/10.1186/s40561-023-00248-8.
47. Dong G, Lin X, Zhou H, Lu Q. Cognitive flexibility in internet addicts: fMRI evidence from difficult-to-easy and easy-to-difficult switching situations. Addict Behav. 2014;39(3):677–83. https://doi.org/10.1016/j.addbeh.2013.11.028.
48. Fraenkel JR, Wallen N, Hyun H. How to design and evaluate research in education. New York: McGraw-Hill; 2011.
49. Crano WD, Brewer MB. Principles and methods of social research. 2nd ed. Mahwah (NJ): Lawrence Erlbaum Associates; 2002.
50. Şahin C, Yağcı M. Sosyal medya bağımlılığı ölçeği–yetişkin formu: Geçerlilik ve güvenirlik çalışması. Ahi Evran Univ Kırşehir Eğit Fak Derg. 2017;18(1):523–38.
51. Adıgüzel A. Bilgi okuryazarlığı ölçeğinin geliştirilmesi. Dicle Univ Ziya Gökalp Eğit Fak Derg. 2011;17:15–28.
52. Çelikkaleli Ö. Bilişsel esneklik ölçeğinin geçerlik ve güvenirliği. Eğitim ve Bilim. 2014;39(176):339–46.
53. IraniT, Rudd R, Gallo M, Ricketts J, Friedel C, Rhodes E. Critical thinking instrumentation manual. Gainesville (FL): University of Florida; 2007. 2025. http://aec.ifas.ufl.edu/abrams/step/ctmanual.pdf. Accesed 16 Sept.
54. Ertaş-Kılıç H, Şen Al. Turkish adaptation study of UF/EMI critical thinking disposition instrument. Eğitim ve Bilim. 2014;39(176):1–12.
55. Hayes AF, Scharkow M. The relative trustworthiness of inferential tests of the indirect effect in statistical mediation analysis. Psychol Sci. 2013;24(10):1918–27. https://doi.org/10.1177/0956797613480187.
56. Thomas D. Social media addiction, critical thinking and achievement emotions among EFL students in Thailand. Asia Pac J Educ Educ. 2020;35(1):157–71.
57. Polanco-Levicán K, Salvo-Garrido S. Understanding social media literacy: A systematic review of the concept and its competences. Int J Environ Res Public Health. 2022;19(14):8807. https://doi.org/10.3390/ijerph19148807.
58. Orakcı Ş, Khalili T. The impact of cognitive flexibility on prospective EFL teachers' critical thinking disposition: The mediating role of self-efficacy. Cogn Process. 2025;26(1):59–73.
59. ZhangY, Wen G, Binbin J. Hui S. An exploratory case study of Chinese college students' critical thinking skills through interactive independent courses: evidence from behavioral and brain imaging. Thinking Skills and Creativity. 2025:101867. https://doi.org/10.1016/j.tsc.2025.101867.
60. Burooj A. Social media – Boon or bane? Open Health. 2024;5(1):20230038. https://doi.org/10.1515/openhe-2023-0038.
61. Liu X, Wang J, Luo Y. Acceptance and use of technology on digital learning resource utilization and digital literacy among Chinese engineering students: A longitudinal study based on the UTAUT2 model. Behav Sci. 2025;15(6):728. https://doi.org/10.3390/bs15060728.

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