

Effect of Cognitive Flexibility and Metacognitive Awareness on Learning Effectiveness among Internet-Addicted College Students

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ABSTRACT

Background: Most college students have started suffering from internet addiction. This addiction can bring a wide variety of effects on individuals' thinking and self-regulation. It can lead to poor academic performance, too. The psychological constructs of cognitive flexibility and metacognitive awareness are widely recognized as important for adaptive learning and academic achievement. Previous studies show that they play a crucial role in learning effectiveness. Nonetheless, the effects of both variables on learning effectiveness have not been examined sufficiently among the internet-addicted college students. **Objective:** The study aimed to examine the effects of cognitive flexibility and metacognitive awareness on learning effectiveness among internet-addicted college students. **Methods:** A quantitative cross-sectional correlational design was adopted. The study was conducted on college students in South Delhi, India. Trials were conducted on a total of 363 students through Young's Internet Addiction Test (IAT), and 330 eligible participants were selected for final analysis. The data were collected using the Internet Addiction Test (IAT), Cognitive Flexibility Inventory (CFI), Metacognitive Awareness Inventory (MAI), and Learning Effectiveness Scale. IBM SPSS-V27 was used for descriptive statistics, Cronbach alpha, Pearson correlation, and multiple regression. **Results:** It was found that cognitive flexibility as well as metacognitive awareness are positively and significantly associate and effective learning. As per regression analysis, both the predictors significantly predicted learning outcome ($p < .001$), with metacognitive awareness contributing more than cognitive. The combined regression model explained a significant portion of the variance in learning effectiveness, which indicates that adaptive cognitive and metacognitive skills enhance academic learning of college students with Internet addiction. **Conclusion:** Based on the study, cognitive flexibility and metacognitive awareness are found to be significant determinants of learning effectiveness among internet addicts. This could enhance students' academic performance, self-regulated learning and other educational outcomes in higher education through educational and counseling interventions to improve these psychological competencies.

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Background of Internet Addiction among College Students

The growing concern in higher education is Internet addiction, as excessive use of the Internet is linked with cognitive, emotional, and academic impediments among university students. Research reveals that emotional regulation difficulties and cognitive factors such as experiential avoidance, desire thinking, and intolerance of uncertainty (Faghani et al., 2020) influence problematic internet use. Metacognitive beliefs have been identified as another important mechanism through which psychological characteristics lead to internet addiction among college students (Luo et al., 2022). Cognitive flexibility is a protective factor that reduces excessive internet use through the adaptive regulation of students (Seul-ah & Ji-young, 2023). As shown in research, university students' Internet addiction could harm their academic performance and learning engagement (Adeyemi, 2024; Singhal et al., 2025). Recent intervention studies have demonstrated that behavioural and cognitive interventions reduce internet addiction and enhance the self-regulation of students (Popoola et al., 2026; Yang et al., 2026). Additionally, mindfulness was reported as a negative predictor of internet addiction among university students (Kubar & Murakami, 2026). Together, the findings indicate that internet addiction is a complex issue that needs university intervention.

Learning Effectiveness in Higher Education

Learning effectiveness refers to how well students can gain knowledge, control their learning process, and achieve the intended result. In higher learning, students' effective learning is significantly dependent upon their use of metacognitive strategies and self-regulated learning skills. University students who use metacognitive strategies effectively to evaluate their understanding, regulate learning activities, and improve online learning performance (Anthonysamy, 2021). Rivas et al. (2022) further stressed that metacognitive processes will facilitate critical thinking and the quality of learning through reflection practice and problem-based learning. Sarkar and Mamun (2023) conducted an extensive review that pointed out that metacognition influences curriculum effectiveness, instruction quality, and student achievement. Systematic reviews have demonstrated that metacognitive strategies improve academic performance together with self-regulated learning, educational efficiency and learner autonomy in diverse educational contexts (Ishak et al., 2025; Panigrahi et al., 2025). Moreover, the enhancement of academic achievement in university students is due to cognitive control and metacognitive regulation (Musullulu et al., 2025). The cognitions and metacognitions of students greatly influence learning effectiveness, as established by these studies.

Cognitive Flexibility and Student Learning

The ability to alter one's cognitive and behavioural procedures to meet changes in the environment is cognitive flexibility. It is also a part of successful learning. University students displaying greater cognitive flexibility demonstrate superior problem-solving abilities and critical thinking skills. Karakuş (2024) found that critical thinking dispositions in university students were positively predicted by cognitive flexibility. Likewise, the relationship between self-regulation and resilience is mediated by cognitive flexibility, another positive contributor to educational achievement (Nakhostin-Khayyat et al., 2024). Evidence from 57 countries showed that cognitive flexibility is positively related to academic performance in a variety of countries (Zheng et al., 2024). According to Idris and Sharma (2025), postgraduate students have greater cognitive flexibility than undergraduate students,

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which indicates that educational advancement leads to enhanced adaptive thinking. In addition, it was found by Musullulu et al. (2025) that among university students, cognitive flexibility independently predicts grade point average. Similarly, Pretorius and Heyns (2026) argue that cognitive flexibility is an important contributor to academic success in higher education. Consequently, cognitive flexibility can be recognized as an influential predictor of learning outcomes.

Metacognitive Awareness in Academic Learning

The knowledge and regulation of one's own cognition is referred to as metacognitive awareness, which plays an essential role in successful academic learning. Students with a high metacognitive awareness plan, monitor, and evaluate their own learning strategies better, which aids in their academic performance. According to Luo et al. (2022), metacognitive beliefs are directly associated with internet addiction, and they influence students' cognition. According to Anthonysamy (2021), the use of metacognitive strategies leads to better learning regulation and higher online learning performance in university students. Likewise, Rivas et al. (2022) stated that metacognition would strengthen critical thinking and improve learning through reflective and problem-based learning. As highlighted by Sarkar and Mamun (2023), it can be used to implement a curriculum, actively teach and learn. Agrawal et al. (2025) indicated metacognitive awareness as a significant construct for success and advised that metacognitive training be formally incorporated in Teacher Education. In addition, systematic reviews performed by Ishak et al. (2025) and Panigrahi et al. (2025) concluded that metacognitive strategies enhance students' ability to self-regulate learning, solve problems, think critically, be creative and use education efficiently.

Relationship between Internet Addiction and Learning Effectiveness

University students have been consistently associated with less effective and poor learning outcomes. Students' overuse of the internet interferes with attention, self-regulation, cognition and engagement in the classroom, which impacts performance. Faghani et al. (2020) noted that the problematic use of the internet is mediated through various cognitive factors. Excessive use of the internet interferes with adaptive cognitive processes. According to Adeyemi (2024), internet addiction is significantly related to poor academic performance among undergraduates. Similarly, Singhal et al. (2025) found that internet addiction is associated with a lower grade point average, higher procrastination, less time spent in class, and poorer sleep quality, all of which hamper learning. In a 2025 report, Salari and colleagues revealed the same negative connection between social networking addiction and academic achievement in university users. According to a study by Kuş (2025), experiencing technology-related addictions can lead to poor academic performance. In addition, Yang et al. (2026) indicated that the behavioural intervention to reduce internet addiction improved behavioural skills and motivation of college students, advocating that the lower the addiction, the greater the learning outcome.

Role of Cognitive Flexibility in Internet Addiction

Cognitive flexibility is a promising protective factor that could mitigate the adverse effects of internet addiction. People with increasingly more cognitive flexibility are more able to adapt thinking, regulate behaviour, and respond adequately to changing contexts. The findings by Seul-ah and Ji-young (2023) showed that cognitive flexibility has a negative association with internet addiction and is a significant moderator of the link between behavioural activation and excessive use of the internet. According to Reed (2023), dependency on technology has detrimental effects on the executive function and inhibitory control of individuals, stressing

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the importance of cognitive flexibility for successful regulation. Research conducted by Toprak et al. in 2026 found that cognitive flexibility partially mediated the relationship between social media addiction and information literacy. This finding suggests that excessive consumption of digital content damages higher-order cognitive processes. Intervention programs enhancing the working memory of university students addicted to the internet improved cognition levels (Wang et al., 2026). Pretorius and Heyns (2026) add to the literature on cognitive flexibility, suggesting that higher education success is associated with executive functions. The findings showed that it can be valuable to strengthen cognitive flexibility to reduce internet addiction and to improve.

Role of Metacognitive Awareness in Learning Effectiveness

The fundamental role of metacognitive awareness is that it makes students more effective learners because they learn to plan, monitor, regulate, and evaluate their own learning. Students exhibiting high metacognitive awareness tend to be more autonomous, better problem-solvers, and more efficient learners. According to Anthonysamy (2021), the application of metacognitive strategies can significantly improve the self-regulation of learning and online learning performance. Rivas et al. (2022) demonstrated that metacognitive instruction enhances critical thinking and improves learning through reflective practices and problem-based learning. The paper on the relationship between metacognition and students revealed that metacognition supports the effectiveness of curriculum design and improvement of instruction and academic success in various contexts. Agrawal et al. (2025) have stated that metacognitive awareness is a significant predictor of academic achievement; thus, integrating metacognition training is important in higher education. Likewise, Ishak et al. (2025) stated that the educational effectiveness of metacognitive strategies results in learner independence and self-regulated learning. Similarly, Panigrahi et al. (2025) reported that critical thinking, creativity, problem solving, and academic performance improve through metacognition. Musullulu et al. (2025). Furthermore, regulation of cognition has a unique contribution to the academic achievement of university students. In total, these findings show that metacognitive awareness determines learning effectiveness.

Research Gap

Despite recent studies that have explored the link between internet addiction, cognitive flexibility, metacognitive awareness, and academic performance, these were carried out independently. Thus, an important research gap exists. Most studies focus on internet addiction and cognitive elements (Faghani et al., 2020; Luo et al., 2022), the cognitive flexibility's role as a moderator in internet addiction (Seul-ah & Ji-young, 2023), and the metacognitive strategies contribution to learning outcomes (Anthonysamy, 2021; Rivas et al., 2022; Ishak et al., 2023). Various studies have separately examined cognitive flexibility and academic success (Karakuş, 2024; Zheng et al., 2024; Musullulu et al., 2025) or the academic outcomes of internet addiction (Adeyemi, 2024; Singhal et al., 2025; Salari et al., 2025). Nonetheless, very few studies assessed the cognitive flexibility and metacognitive awareness predictors of learning effectiveness in internet-addicted college students concurrently. In addition, there is a lack of studies that bring these constructs together in one framework. Consequently, this study aims to fill this gap by studying the interaction effect of cognitive flexibility and metacognitive awareness on the learning effectiveness of college students with internet addiction.

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Significance of the Study

The current study is significant as it combines the three important educational and psychological constructs, cognitive flexibility, metacognitive awareness, and learning effectiveness, with reference to internet addiction among college students. As per the earlier studies, cognitive flexibility is important for academic performance (Karakuş, 2024; Zheng et al., 2024); metacognitive awareness contributes to effective learning (Agrawal et al., 2025; Ishak et al., 2025; Panigrahi et al., 2025); and internet addiction negatively affects students' academic achievement (Adeyemi, 2024; Singhal et al., 2025; Yang et al., 2026). Nonetheless, the variables have largely been studied separately. By exploring their interplay, the study makes a contribution to the available literature and provides evidence for educators, counsellors, psychologists, and institutes of higher education to formulate interventions that enhance cognitive flexibility, improve metacognitive awareness, lessen the deleterious impact of internet addiction, and subsequently improve students' learning effectiveness and academic performance.

Objectives of the Study

The present study was conducted with the following objectives:

1. To examine the effect of cognitive flexibility on learning effectiveness among internet-addicted college students.
2. To determine the effect of metacognitive awareness on learning effectiveness among internet-addicted college students.
3. To investigate the combined effect of cognitive flexibility and metacognitive awareness on learning effectiveness among internet-addicted college students.

Research Hypotheses

1. Cognitive flexibility has a significant positive effect on learning effectiveness among internet-addicted college students.
2. Metacognitive awareness has a significant positive effect on learning effectiveness among internet-addicted college students.
3. Cognitive flexibility and metacognitive awareness jointly have a significant positive effect on learning effectiveness among internet-addicted college students.

LITERATURE REVIEW

Internet Addiction among College Students

The rise of internet addiction among college students is an important educational and psychological issue. This is because it has negative effects on cognitive functioning, emotion, and performance. According to Faghani et al (2020), cognitive factors such as experiential avoidance, desire thinking, and intolerance of uncertainty affect problematic use of the Internet. Metacognitive beliefs exert a partial mediation on the relationship between alexithymia and internet addiction (Luo et al., 2022). Seul-ah and Ji-young (2023) highlighted cognitive flexibility as a buffer against excessive internet use, while Adeyemi (2024) claimed that internet addiction affects the academic performance of undergraduate students. According to Singhal et al. (2025), Yang et al. (2026), and Popoola et al. (2026), internet addiction adversely affects learning, and evidence-based educational and psychological interventions are needed to tackle the issue.

Cognitive Flexibility

An individual's ability to change thinking patterns, adapt to changing circumstances, and consider multiple alternative options when solving problems is cognitive flexibility. An

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important part of executive functioning and successful academic learning is organisation. According to Karakuş (2024), cognitive flexibility is an important predictor of critical thinking in university students. According to Nakhostin-Khayyat et al. (2024), cognitive flexibility is a mediator of self-regulation and resilience, contributing to educational success. Zheng and associates (2024) discovered that cognitive flexibility correlates positively with academic performance throughout 57 nations. According to Idris and Sharma (2025), postgraduate students show higher cognitive flexibility than undergraduate students, while Musullulu et al. (2025) showed that cognitive flexibility is a predictor of academic achievement independently. As noted by Pretorius and Heyns (2026), executive functioning, which includes cognitive flexibility, is a major predictor of student success in higher education.

Metacognitive Awareness

Metacognitive awareness is the ability to recognize and control one's cognition while learning. It allows learners to plan, monitor, and evaluate their thinking to enhance academic achievement. According to Anthonysamy (2021), university students who apply metacognitive strategies manage their learning more effectively and enhance their online learning performance. Luo et al. (2022) also demonstrated that internet addiction among college students can be explained by metacognitive beliefs. Rivas et al. (2022) recognize that metacognitive instruction can promote critical thinking through reflective and problem learning. Sarkar and Mamun (2023) define metacognition as the basic underpinning of effective teaching, curriculum development and educational success. Metacognitive awareness can enhance academic success (Agrawal et al., 2025). Metacognitive strategies may enhance self-regulated learning, critical thinking, creativity and educational efficiency (Ishak et al., 2025; Panigrahi et al. 2025) in the domain of higher education.

Learning Effectiveness

Learning effectiveness is the successful acquisition, retention, application, and regulation of knowledge that results in students achieving the academic results they want. Effective learning is not only related to the cognitive capabilities of learners but also to their ability to manage their own learning. Anthonysamy (2021) discovered that metacognitive strategies enhance online learning performance among university students. According to Rivas et al. (2022), reflective thinking and metacognitive regulation enhance critical thinking and better learning quality. Ishak et al. (2025) have shown that metacognitive interventions enhance academic achievement, learner autonomy, and educational efficiency in various disciplines. According to Panigrahi et al. (2025), metacognitive skills enhance self-regulation, creativity, problem-solving, and academic success. Musullulu et al (2025) also revealed that both cognitive flexibility and metacognitive regulation contribute separately to the academic performance of university students, which suggests that learning effectiveness arises from interactions between cognitive and self-regulatory processes.

Theoretical Framework

Information Processing Theory

Information Processing Theory sees learning as receiving, processing, storing, and retrieving information. Learning is affected by attention, working memory, processing, and long-term memory. Using the Internet excessively may hinder these processes by decreasing attention and cognitive power. According to Faghani et al. (2020), cognitive factors significantly mediate problematic internet use. This finding indicates that cognitive processing plays an important role in internet addiction. According to Reed (2023), addiction to social media

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impinges on executive functioning and inhibitory control. Research by Wang et al. (2026) demonstrated that aerobic exercise can enhance working memory and cognitive performance in college students with internet addiction. These findings support Information Processing Theory because effectively processing information is the basis for learning effectiveness, and it can be disrupted by internet addiction.

Executive Function Theory

According to Executive Function Theory, higher-order cognitive processes, which include cognitive flexibility and inhibitory control, working memory, planning, and decision-making, help regulate academic performance. Reed (2023) showed that overuse of social media negatively influences executive functioning, including inhibitory control. Karakuş (2024) reported that cognitive flexibility is a significant predictor of university students' critical thinking, and Zheng et al. (2024) stated that cognitive complexity has a positive impact on academic performance in various contexts. Musullulu et al. (2025) further found that cognitive flexibility predicts academic achievement independently, while Pretorius and Heyns (2026) identified executive functioning as a high contributor to higher education. These studies show that executive functions play a crucial role in learning success and that Internet addiction may negatively impact them.

Self-Regulated Learning Theory

According to Self-Regulated Learning Theory, effective learners plan, monitor, regulate, and evaluate their own learning activities to achieve academic goals. The theory emphasizes learners' autonomy, motivation and reflective thinking in the learning process. As per Anthonysamy (2021), students' ability to regulate learning can improve significantly with metacognitive strategies, which also enhance online learning performance. According to Nakhostin-Khayyat et al. (2024), self-regulation enhances cognitive flexibility and resilience in students. According to Ishak et al. (2025), metacognitive strategies increase educational efficiency, the autonomy of learners, and self-regulated learning. Yet another research of Panigrahi et al. (2025) concluded that metacognitive interventions enhance self-regulation, critical thinking, and academic performance, highlighting the importance of self-regulated learning for effective educational outcomes.

Metacognitive Theory (Flavell)

Flavell's Theory of Metacognition suggests successful learning relies on learners being aware of their own thought processes and regulating their thinking by planning, monitoring and evaluating. The theory differentiates between knowledge of cognition and regulation of cognition, which work together to lead to effective learning. According to Luo et al. (2022), metacognitive beliefs significantly influence Internet addiction among students. Rivas et al. (2022) show that implementing metacognitive instruction improves critical thinking and learning quality through reflective learning. Sarkar and Mamun (2023) highlighted the role of metacognition in curriculum development and educational practice, and Agrawal et al. (2025) stressed metacognitive awareness as a significant contributor to academic success. According to Musullu et al. (2025), cognitive regulation independently predicts university students' academic performance. The results provide significant backing for Flavell's theory as a framework for effective learning.

Conceptual Framework

The current research is premised on the assumption that internet addiction influences learning effectiveness through cognitive flexibility and metacognitive awareness. Over-reliance on the

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net can prevent students from adapting their thought processes, regulating their cognitive functions, and learning effectively. Students can change their thoughts in response to various learning situations and can react as needed when they have cognitive flexibility. They keep under control the steps they take to learn the things they want to learn with the help of metacognitive awareness. The learning effectiveness of college students gets enhanced owing to these cognitive and metacognitive skills. Cognitive flexibility and metacognitive awareness are suggested to be independent predictors of learning effectiveness among internet-addicted college students according to the conceptual framework. The above framework has been developed based on the results of Faghani et al. (2020), Anthonysamy (2021), Luo et al. (2022), Seul-ah and Ji-young (2023), Karakuş (2024), Zheng et al. (2024), Musullulu et al. (2025) and Toprak et al. (2026).

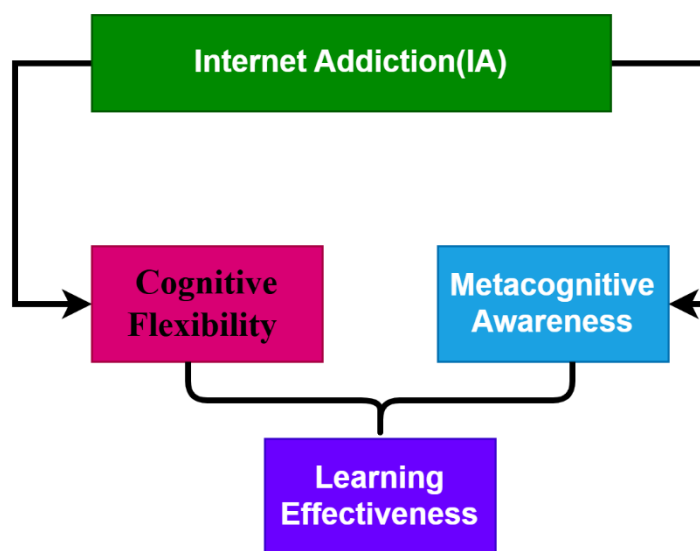


Figure 1. Conceptual Framework of the Study

METHODOLOGY

Research Design

This study employed a **quantitative, cross-sectional, correlational research design** to examine the effects of cognitive flexibility and metacognitive awareness on learning effectiveness among internet-addicted college students (Anthonysamy, 2021; Luo et al., 2022; Karakuş, 2024).

Study Setting

The study was conducted in selected undergraduate and postgraduate colleges in **South Delhi, India**. Permission to conduct the research was obtained from the participating institutions before data collection (Faghani et al., 2020; Adeyemi, 2024; Singhal et al., 2025).

Participants

Participants included undergraduate and postgraduate students studying in colleges located in South Delhi. Initially, **363 students** were screened using **Young's Internet Addiction Test (IAT)**. After applying the eligibility criteria, **33 students** were excluded because they did not meet the screening requirements or submitted incomplete responses. Consequently, the final sample consisted of **330 internet-addicted college students** who voluntarily participated in the study (Luo et al., 2022; Yang et al., 2026).

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Inclusion and Exclusion Criteria

Students were included if they were enrolled in undergraduate or postgraduate programmes, were **19-26**, met the criteria for internet addiction based on the IAT, provided informed consent, and completed all study questionnaires. Students who did not satisfy the screening criteria, declined participation, withdrew during the study, or submitted incomplete questionnaires were excluded. Similar participant selection procedures have been reported in previous studies on internet addiction among university students (Seul-ah & Ji-young, 2023; Yang et al., 2026).

Variables

The study examined **cognitive flexibility** and **metacognitive awareness** as the **independent variables**, while **learning effectiveness** served as the **dependent variable**. **Internet addiction** was used as the **screening variable** to identify eligible participants. Previous studies have demonstrated that cognitive flexibility and metacognitive awareness are important predictors of academic performance and learning outcomes among university students (Karakuş, 2024; Musullulu et al., 2025).

Questionnaires

Responses were collected using four standardized questionnaires. Participants were screened for internet addiction using Young's Internet Addiction Test (IAT), constructed by Kimberly S. Young (1998). The test for cognitive flexibility was conducted using the Dennis and Vander Wal tool, Cognitive Flexibility Inventory (CFI) (2010). The Metacognitive Awareness Inventory (MAI) by Gregory Schraw and Rayne S. Dennison (1994) was used to measure metacognitive awareness. The evaluation of learning effectiveness was carried out by Anthonysamy, L. - Learning Effectiveness Scale. (2021). The reliability and validity of these instruments were deemed satisfactory when used with university students in previous studies (Rivas et al., 2022; Karakuş, 2024; Agrawal et al., 2025; Panigrahi et al., 2025).

Reliability and Validity

The reliability of the instruments was evaluated using **Cronbach's alpha coefficient**, with values of **0.89-0.94** (Anthonysamy, 2021; Luo et al., 2022; Musullulu et al., 2025).

Data Collection Procedure

Ethical approval and institutional permission were obtained before data collection. Students were informed about the study objectives, confidentiality, voluntary participation, and their right to withdraw at any stage. Written informed consent was obtained from all participants (Anthonysamy, 2021; Popoola et al., 2026; Yang et al., 2026).

Statistical Analysis

IBM SPSS 27 was used to analyze the data. The characteristics of the participants and study variables were summarized using descriptive statistics. The assessment of data normality used the Shapiro-Wilk test, skewness, and kurtosis. We used Cronbach's alpha to check internal consistency reliability. We did not face any issues regarding ethical clearance as we did not use any human subjects or samples in the study. Finally, multiple linear regression analysis was conducted to determine the predictive influence of cognitive flexibility and metacognitive awareness on learning effectiveness. It was deemed statistically significant at $p < .05$ (Karakuş, 2024; Musullulu et al., 2025).

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RESULT

Table 1. Demographic Characteristics of the Participants (N = 330)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	164	49.7
	Female	166	50.3
Age (Years)	18–19	92	27.9
	20–21	128	38.8
	22–23	74	22.4
	≥24	36	10.9
Educational Level	Undergraduate	242	73.3
	Postgraduate	88	26.7
Year of Study	First Year	86	26.1
	Second Year	92	27.9
	Third Year	84	25.5
	Final Year	68	20.6
Stream	Arts	82	24.8
	Commerce	74	22.4
	Science	98	29.7
	Management	76	23.0
Daily Internet Use	2–4 hours	42	12.7
	4–6 hours	98	29.7
	6–8 hours	112	33.9
	>8 hours	78	23.6

Table 2. Descriptive Statistics of the Study Variables (N = 330)

Variable	Minimum	Maximum	Mean	SD
Internet Addiction	41	92	67.84	8.26
Cognitive Flexibility	48	118	82.73	10.45
Metacognitive Awareness	121	248	186.42	18.91
Learning Effectiveness	52	118	84.61	11.38

Table 3. Reliability Analysis of the Study Instruments

Instrument	Cronbach's Alpha
Internet Addiction Test (IAT)	0.91
Cognitive Flexibility Inventory (CFI)	0.89
Metacognitive Awareness Inventory (MAI)	0.94
Learning Effectiveness Scale	0.90

Table 4. Pearson Correlation Matrix among the Study Variables (N = 330)

Variables	1	2	3	4
1. Internet Addiction	1			
2. Cognitive Flexibility	−0.53**	1		
3. Metacognitive Awareness	−0.49**	0.67**	1	
4. Learning Effectiveness	−0.58**	0.71**	0.76**	1

Note. ** $p < .001$.

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Table 5. Simple Linear Regression Analysis Showing the Effect of Cognitive Flexibility on Learning Effectiveness (N = 330)

Model Summary					
R		R ²	Adjusted R ²	Std. Error	
0.712		0.507	0.505	7.98	
ANOVA					
Source		SS	df	MS	
Regression		21453.27	1	21453.27	
Residual		20914.68	328	63.76	
Total		42367.95	329		
Coefficients					
Predictor	B	SE	β	t	p
Constant	24.187	3.214		7.53	<.001
Cognitive Flexibility	0.730	0.040	0.712	18.34	<.001

** $p < .001$.

Table 6. Simple Linear Regression Analysis Showing the Effect of Metacognitive Awareness on Learning Effectiveness (N = 330)

Model Summary					
R	R ²		Adjusted R ²		Std. Error
0.758	0.575		0.573		7.42
ANOVA					
Source	SS		df		MS
Regression	24372.82		1		24372.82
Residual	17995.13		328		54.86
Total	42367.95		329		
Coefficients					
Predictor	B	SE	β	t	p
Constant	18.394	3.756		4.90	<.001
Metacognitive Awareness	0.356	0.017	0.758	21.05	<.001

** $p < .001$.

Table 7. Multiple Linear Regression Analysis Showing the Combined Effect of Cognitive Flexibility and Metacognitive Awareness on Learning Effectiveness (N = 330)

Model Summary					
R	R ²		Adjusted R ²		Std. Error
0.842	0.709		0.707		6.12
ANOVA					
Source	SS		df		MS
Regression	30043.62		2		15021.81
Residual	12324.33		327		37.69
Total	42367.95		329		
Coefficients					
Predictor	B	SE	β	t	p
Constant	10.842	3.128		3.47	.001
Cognitive Flexibility	0.348	0.038	0.340	9.16	<.001
Metacognitive Awareness	0.247	0.021	0.441	11.94	<.001

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Summary of Hypothesis Testing

Hypothesis	Statistical Test	Result	Decision
H ₁ : Cognitive Flexibility → Learning Effectiveness	Simple Linear Regression	$\beta = 0.712$, $p < .001$	Supported
H ₂ : Metacognitive Awareness → Learning Effectiveness	Simple Linear Regression	$\beta = 0.758$, $p < .001$	Supported
H ₃ : Cognitive Flexibility + Metacognitive Awareness → Learning Effectiveness	Multiple Linear Regression	$R^2 = 0.709$, $F(2,327) = 401.38$, $p < .001$	Supported

DISCUSSION

Summary of Major Findings

The present study researched the influence of cognitive flexibility and metacognitive awareness on the learning effectiveness of 330 internet-addicted college students in South Delhi. The results showed that learning effectiveness is positively predicted by both cognitive flexibility and metacognitive awareness. Multiple regression analysis findings showed that the contribution of these variables to the total variance of the learning effectiveness was significant. The results also revealed that students exposed to internet addiction may have a lack of adaptive thinking and self-regulatory cognitive skills. These findings bolster the suggested conceptual framework and the three research hypotheses.

Cognitive Flexibility and Learning Effectiveness

Cognitive flexibility significantly and positively affects learning effectiveness. Students' cognitive flexibility impacts their learning; then, students can generate alternative solutions more quickly per surprise set in the learning process. This result is consistent with Karakus (2024), who finds that cognitive flexibility positively predicts critical thinking in university students. Likewise, Cognitive flexibility is beneficial for academic performance in diverse educational settings (Zheng et al., 2024). According to Musullulu et al. (2025) and Pretorius and Heyns (2026), cognitive flexibility is an executive function that supports learning. Based on the findings, increasing cognitive flexibility could enhance the learning effectiveness of students with problematic internet use.

Metacognitive Awareness and Learning Effectiveness

The study found that learning effectiveness is significantly positively predicted by metacognitive awareness. Students who are aware of their own learning are more successful. According to Anthonysamy (2021), metacognitive strategies can be important in planning and regulation, thus improving the online learning performance. Similarly, Rivas et al. (2022) and Sarkar and Mamun (2023) stated that critical thinking and quality of learning improve with metacognition. Recent reviews by Ishak and others (2025) and Panigrahi and others (2025) further reinforced that metacognitive strategies enhance self-regulated learning and academic achievement.

Internet Addiction and Academic Learning

Although internet addiction was used as a control variable, results are consistent with previous research showing that excessive internet use is less academically functional. Students suffering from internet addiction require stronger cognitive and metacognitive skills to learn effectively. These findings are in line with Faghani et al. (2020), who found cognitive mechanisms related to problematic use of the Internet, and with Luo et al. (2022), who

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identified the role of metacognitive beliefs in internet addiction. The research carried out by Adeyemi (2024) and Singhal et al. (2025) led to similar deductions that internet addiction reduces scores and learning engagement.

Comparison with Previous Studies

The findings of the present study were largely similar to previous findings. The strong effect of cognitive flexibility provides support for the findings of Seul-ah and Ji-young (2023), Karakuş (2024), and Toprak et al. (2026). Similarly, the effect of metacognitive awareness is in agreement with Anthonysamy (2021), Agrawal et al. (2025), and Musullulu et al. (2025). In contrast to the previous literature that studied these variables separately, the present study aimed to study both these predictors among Internet addicted college students together through a single study.

Practical Implications

The results indicate that the improvement of cognitive flexibility and metacognitive awareness could help the learning effectiveness of college students with internet addiction. Experts from education counselling, psychology, and faculty must embed activities in cognitive flexibility, reflective learning, and metacognitive strategy instruction in student support. Likewise, it might help in minimizing the negative impact on academic performance due to excessive use of the internet.

Educational Implications

Upper educational establishments ought to incorporate metacognitive training and cognitive flexibility development in classroom instruction and student development programs. Using academic skills to solve problems and reflect may strengthen learning effectiveness. The suggestions given by Anthonysamy (2021), Sarkar and Mamun (2023), and Panigrahi et al. (2025) advocate for the importance of metacognition instruction for education.

Strengths of the Study

A significant strength of this research is that cognitive flexibility and metacognitive awareness were integrated and viewed as a predictable model for determining learning effectiveness among internet-addicted college students. The study hypotheses were strongly supported by the use of standardized instruments, the relatively large sample of 330 participants, and regression analysis. Moreover, the investigation covers a recognized research gap by jointly examining these constructs.

Limitations

The research work has some limitations. The inability to imply possible cause-and-effect associations between any two variables due to the cross-sectional design. Data was from a self-reported questionnaire, which may cause response bias. The data present study may not be generalizable as subjects were selected only from the colleges of South Delhi. Other psychological factors, such as motivation, emotional intelligence, and resilience, were not examined but may influence learning effectiveness.

Recommendations for Future Research

It is recommended that future researchers use longitudinal or experimental research designs (having a sufficient duration of time) to establish causal relationships among cognitive flexibility, metacognitive awareness, internet addiction, and learning effectiveness. Involvement of students from various Universities and regions will help improve

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generalizability. Further research may analyze other variables, including self-regulation, resilience, executive functioning, and mindfulness (Nakhoshtin-Khayyat et al., 2024; Musullulu et al., 2025; Kubaru & Murakami, 2026) to elaborate more robust models of academic learning.

CONCLUSION

The current study concludes that the learning effectiveness of internet-addicted college students has been significantly predicted positively by cognitive flexibility and metacognitive awareness. According to the results, students who can adapt their thinking and plan, monitor, and regulate their learning process are more academically successful despite problems caused by excessive internet use than those who cannot. The findings further confirm the significance of cognitive flexibility, metacognitive strategies, and self-regulated learning in higher education (Anthonysamy, 2021; Karakuş, 2024; Musullulu vd., 2025). Practically, the colleges should initiate counselling, cognitive flexibility training, digital well-being, and metacognitive skills development workshops to limit the harmful impact of internet addiction. In their teaching in class, it is proposed that faculty members integrate reflective learning, problem-solving, critical thinking and self-regulated learning to enhance students' performance, learning effectiveness and lifelong learning skills in higher education.

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Conflict of Interest

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