

Epistemic Curiosity and Academic Self-Regulatory Learning in Undergraduates: Unveiling the Mediating Role of Academic Self-Efficacy

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<https://doi.org/10.62345/jads.2024.13.3.43>

Abstract

This study sought to investigate the correlation between epistemic curiosity, academic self-efficacy, and self-regulated learning in undergraduate students. The study explored how academic self-efficacy mediated the interaction between epistemic curiosity and academic self-regulating learning. Selected from many colleges in Islamabad and Rawalpindi, a suitable sample of 240 students—120 male and 120 female—aged 18 to 25 years ($M=20.47$, $SD=1.39$). The present research applied the epistemic curiosity scale (Litman, 2008), academic self-efficacy scale (Sachitra & Bandra, 2017), and the academic self-regulatory learning Questionnaire (Nambiar et al., 2022). Pearson product-moment correlation indicated a substantial positive correlation among university students' epistemic curiosity, academic self-efficacy, and academic self-regulatory learning. Using Structural Equation Modeling (SEM), mediation studies found that academic self-efficacy greatly mediated the link between epistemic curiosity and academic self-regulatory learning among university students. The results showed that undergraduate students' academic self-efficacy greatly enhanced the positive link between epistemic curiosity and academic self-regulatory learning, to maintain the positive relationship between undergraduate students' sense of epistemic curiosity and self-regulated learning, this study highlights the importance of academic self-efficacy, guiding for improving teaching strategies. It also provides empirical data to direct behavior increasing curiosity and confidence, fostering better academic performance.

Keywords: Epistemic Curiosity, Academic Self-Efficacy, Self-Regulatory Learning.

Introduction

Satisfying our intellectual thirst is not as simple as satisfying our physiological thirst. This involves epistemic curiosity, or the quest for knowledge (Litman & Spielberger, 2003), which is considered a driving factor in innovation and learning (Hardy et al., 2017; Kang et al., 2009; Litman, 2005). Undergraduate university students' curiosity about knowledge can influence how they approach various learning activities, seek new information, monitor their knowledge, and make short and long-term learning goals, which then determine their performance in higher education (Eren, 2011; Litman, 2005, 2008).

In the academic realm of the student, self-efficacy is another crucial aspect that matters. Educational psychology has paid much attention to academic self-efficacy, aiding students to do better in educational institutions (Meng & Zhang, 2023). So, to meet academic objectives,

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students who have a strong drive and curiosity for knowledge and skills to regulate their learning may possess faith and confidence in their ability to plan and execute learning tasks. In educational contexts, epistemic curiosity receives greater attention than other conceptions of curiosity since it is important to students' learning, cognitive development, and success (Eren, 2011; Engel, 2015). Epistemic curiosity is seen as a complicated emotional-motivational state since it can be aroused by both negative sentiments of uncertainty resulting from a lack of information and positive feelings of interest associated with learning new information. Litman and Jimerson (2004) explored the dimensionality of epistemic curiosity and created an EC model with two types: deprived type EC and Interest type EC. Interest epistemic curiosity is the motivation to learn motivated by an innate interest in learning and the pleasure of discovering new things. Deprived EC (DEC) is a term used to describe an unmet desire that involves a greater drive to learn to fill in information gaps or lessen uncertainty.

A learner will be more engaged in a task if they feel capable of fulfilling it. Academic self-efficacy is the learner's appraisal of their ability to achieve the required performance in the subject (Zhao et al., 2023). It is a critical component of self-perception building in the educational context. If students believe they can complete a task, they will be more interested in it. Academic self-efficacy is defined as a learner's willingness to participate in class discussions, take notes from other students, be willing to ask and answer questions, be aware of the effort put into studying, be able to make their study plan, and be willing to ask lecturers for help. Students that are skilled at solving problems and who have confidence in their capacity to organize and complete activities are exhibiting high levels of self-efficacy. On the other hand, those who lack this confidence believe that activities are superfluous and are less likely to devote their time and energy to accomplishing them (Dogan, 2015).

Higher education requires students to have self-control, self-sufficiency, and initiative (Sachitra & Bandara, 2017). Research on academic self-regulated learning initially surfaced in the middle of the 1980s. Self-regulated learning is an all-encompassing process of learning that is created and adjusted to help individuals reach their goals. It is informed by a variety of motivational attitudes, actions, and metacognitive exercises (Schunk & Zimmerman, 2012). The idea of self-regulatory learning is complex and emphasizes the learner's active participation. It involves three main stages of forethought, performance control and self-reflection (Abar & Loken, 2010; Zimmerman, 2008).

The term forethought describes the preparatory, critical thinking, and goal-setting processes that occur before the commencement of a learning activity. The process of continuously assessing and adjusting one's learning habits to ensure that learning objectives are being accomplished is known as performance control. Thinking carefully and critically about one's experiences, learning strategies, and results is self-reflection (Zimmerman, 2002). Studies have indicated that promoting self-efficacy among students may improve their learning practices (Karwowski, 2012; Hayat et al, 2020). Previous research (Bandura, 1978, 1986; Schunk, 1990; Zimmerman, 1990) primarily examined the relationship between academic self-efficacy and academic self-regulated learning, finding a strong positive correlation (Duckworth et al., 2009). Agustiani et al. (2016) investigated the connection among 101 students enrolled in Universitas Padjadjaran's Psychology department regarding learner self-efficacy, controlled learning, and learning attainment or performance. Self-efficacy and learning regulation were found to positively correlate, suggesting that respondents with greater levels of self-efficacy engaged in more self-directed and regulated learning activities. Learners with low self-efficacy, however, may suffer since their academic achievement and self-regulatory learning are usually subpar. In this case, however, strong interest is crucial since it mitigates the negative effects of poor self-efficacy on learners' academic performance (Shin, 2024). Among 400 participants from Southwest University, Li et al. (2019) looked further into the relationship between learner curiosity and self-efficacy. The relationship between curiosity and self-efficacy was shown to

be significantly positive. Researchers Hong et al. (2019) looked at how students' creative performances were influenced by their creative self-efficacy and epistemic curiosity. Freshmen and sophomores in the fashion design department made up the selected participants. Results showed that interest and deprived epistemic curiosity were strongly correlated with students' creative self-efficacy.

In an investigation conducted by Shin (2024) among 363 undergraduate students enrolled in online courses with varying levels of self-efficacy, the relationship between students' curiosity and academic self-regulatory learning was examined. The results demonstrated a direct correlation between students' curiosity and their academic grades. Over the course of two experiments, Chevrier et al. (2019) further evaluated a model that implies the links between self-regulatory strategies, epistemic emotions, and epistemic cognition. One hundred fourteen Canadian undergraduate students make up the sample. The findings suggested that learning techniques and epistemic emotions affected students' ability to learn self-regulated. Curiosity, an epistemic feeling, increased the likelihood of metacognitive self-regulation.

Additionally, Binu et al. (2020) studied 55 first-year mechanical engineering students to determine the association between the learning regulation approach and epistemic curiosity. The study discovered a strong relationship between students' learning strategies and D-type epistemic curiosity. This suggests a direct connection between students' interests, information-seeking behaviors, and learning processes. Lauriola et al. (2015) used two experiments to investigate the relationship between two forms of epistemic curiosity and learners' capacity for self-regulation. 151 Italian volunteers took part in Study 1, while 218 Americans and 56 Germans participated in study 2. The study discovered that D-type epistemic curiosity was positively correlated with careful information-seeking and thoughtfulness, whereas I-type epistemic curiosity had a positive link with optimistic learning methods and taking chances.

The direction and magnitude of the possible association between epistemic curiosity and self-regulated learning among university students still need further consideration. There is a gap in whether the students having epistemic curiosity also possess academic self-regulated learning and whether epistemic curiosity and academic self-efficacy predict self-regulatory learning or not. The current study is based on the premise that undergraduate students who have intrinsic interest in learning and developed feelings of efficiency and competency in academics they will eventually self-regulate their learning by using different self-directed learning strategies, making goals, working on themselves, and monitoring their learning or not. This study will act as a gate away for future research.

Therefore, the objectives of the current study are to explore relationships among epistemic curiosity, academic self-efficacy, and academic self-regulatory learning to investigate predicting role of epistemic curiosity and academic self-efficacy on academic learning regulation and to determine the mediating role of academic self-efficacy in the relationship between epistemic curiosity and academic self-regulatory learning among undergraduate university students.

Hypotheses

1. Epistemic curiosity will be positively related with academic self-efficacy and academic self-regulatory learning among university students.
2. Epistemic curiosity and academic self-efficacy will likely to positively predict academic self-regulatory learning among university students.
3. Academic self-efficacy will mediate the relationship between epistemic curiosity and academic self-regulatory learning among university students.

Methodology

Research Design

The current study employed a cross-sectional research design. The data was collected by using quantitative approach i.e. survey method.

Sampling Technique

The non-probability convenience sampling technique was used to recruit the participants. This method was selected to facilitate easy access to the sample population drawn from various universities in Rawalpindi and Islamabad.

Participants

A sample of 240 undergraduate university students, including both males and females aged 18–25 years ($M=20.47$, $SD=1.39$) were drawn from multiple universities of Rawalpindi and Islamabad. The students had spent at least three months in the respective university and had no physical disability.

Instruments

Demographic Information Measure: Demographic information sheet was used to gather information on age, gender, semesters, CGPA, and residence type.

Epistemic Curiosity Scale (ECS): Litman (2008) developed it, having two parts: interest-type and deprivation-type epistemic curiosity. It comprises ten items, measured on a 4-point frequency Likert scale: 1 for Almost Never, 2 for Sometimes, 3 for Frequently, and 4 for Almost Always. The measure has acceptable internal consistency as Cronbach alpha > 0.80 (I-type: $\alpha=.82$; D-type: $\alpha=.76$). It has good convergent and discriminant validity.

Academic Self-Efficacy Scale (ASES): Sachitra and Bandra (2017) created the Academic Self-Efficacy Scale through the adaptation and modification of the tool created by Byrne (2014) and Matoti (2011). It is 20 items scale with one reverse-scored item which is item 17. The Academic Self-Efficacy Scale uses a five-point Likert scale to score responses, from 1 denoting "strongly disagree" to 5 denoting "strongly agree", where a great degree of academic self-efficacy is demonstrated by high scores. The scale's reliability was signified by Cronbach's alpha of 0.96. Furthermore, it indicated good convergent, construct, and discriminant validity.

Academic Self-Regulatory Learning Questionnaire (A-SRL-Q): Zimmerman (1989) developed the original academic self-regulatory learning questionnaire, later revised by Nambiar et al (2022). *ASLQ* is a 36-item questionnaire that measures responses on a four-point Likert scale: 1 for strongly agree, 2 for agree, 3 for disagree, and 4 for strongly disagree. The reversed scored items are items 4 and item 16 as these are negatively worded items and the rest were positively worded items. The measure has three components: performance control (19 items), self-reflection (7 items), and forethought (10 items). Internal consistency for forethought performance control and self-reflection was found to be 0.72, 0.85, and 0.75, respectively (Nambiar et al., 2022).

Procedure

The study plan was submitted to the research committee at Bahria University Islamabad Campus for approval. Following permission, participant data collection was completed. There are 240 participants in the study: 120 men and 120 women, ages 18 to 25. An informed consent form was presented to participants when they were personally approached. Additionally, a thorough explanation of the research topic and methodologies was provided to them. Confidentiality and anonymity were guaranteed because the data was gathered with participant agreement. It was explained to the participants that they might draw whenever they wished. Participants were asked to answer the questions honestly and carefully because the results of

the study will be influenced by their answers. Given that every participant completed and returned the questionnaires, a 100% response rate was obtained. The SPSS v.27 model was then used to evaluate the gathered data and determine the study's conclusions.

Ethical Considerations

The current research method was guided by stringent standards about ethical considerations. Permission from the authors was acquired before using the scales. The freedom to withdraw from the study at any time was granted to the participants, who also received detailed information about its principles. Their informed consent was acquired. The participants received guarantees that the data would be kept confidential, anonymous, and used exclusively for study. None of the study subjects experienced any physical or psychological injury.

Results

Table 1: Descriptive Statistics of Demographic Characteristics of Participants (N=240)

Variables	<i>f</i>	%	<i>M</i>	<i>SD</i>
Gender				
Male	120	50		
Female	120	50		
Age (in Years)			20.47	1.39
Semesters				
1-2	60	25		
3-4	60	25		
5-6	60	25		
7-8	60	25		
Residence type				
Day Scholars	192	80		
Hostelites	48	20		
CGPA			2.12	1.25

Note. *f*=frequency, %=percentage

Table 1 explains the demographic characteristic of participants. The gender distribution of the sample is balanced, with the average age of 20.47 and SD of 1.39. The sample is representative of a variety of semesters, with an equal representation (1-2 semesters =25%, 3-4 semesters = 25%, 5-6 semesters =25%, 7-8semesters = 25%). A smaller percentage of participants live in hostels, but the majority are day scholars (20%=Hostilities', 80%=Day Scholars). The sample's average CGPA of 2.12 with the SD of 1.25.

Table 2: Descriptive Statistics and Reliability Analysis of Study Variables (N=240)

Variable	<i>Ranges</i>							
	<i>k</i>	α	<i>M</i>	<i>SD</i>	<i>Actual</i>	<i>Potential</i>	<i>Skewness</i>	<i>Kurtosis</i>
Epistemic Curiosity	10	.82	29.04	4.99	28	10-40	-.40	1.33
Interest Epistemic Curiosity	5	.74	15.33	2.75	15	5-20	-.92	2.41
Deprivation Epistemic Curiosity	5	.78	13.71	3.07	14	5-20	-.18	.170
Academic Self-Regulated Learning	36	.88	74.74	12.95	59	36-152	-.15	1.97
Forethought	10	.76	23.15	4.40	32	10-40	-.20	1.20
Performance Control	19	.77	36.82	6.61	19	19-76	-.23	1.19
Self-Reflection	7	.73	14.48	3.36	15	7-32	.21	1.00
Academic Self-Efficacy	20	.89	74.29	13.25	69	20-100	-.92	1.01

Note. *K*=number of items, α = Cronbach's alpha. *SD*= standard deviation.

Table 2 indicates the number of items, reliability, mean, standard deviation, range (actual and potential), skewness and kurtosis. The reliability analysis showed that Cronbach Alpha reliability for epistemic curiosity was .82, and for its subscales i.e. interest and deprivation epistemic curiosity were .74 and .78 respectively. Furthermore, the reliability analysis showed that Cronbach Alpha reliability for academic self-regulatory learning was .88, and for its subscales i.e. forethought, performance control and self-reflection were .76, .77 and .73. Lastly, the reliability analysis showed the Cronbach Alpha reliability for academic self-efficacy that was .89. The alpha coefficient of all the scales ranges from .73-.89 indicating that they are valid for further analysis.

Table 3: Pearson correlation between Epistemic Curiosity, Academic Self Efficacy Academic Self-Regulated Learning, in University Students (N=240)

Variables	2	3	4	5	6	7	8
1 Epistemic Curiosity	.43***	.47***	.52***	.49***	-.01	-.06	-.10
2 Interest Epistemic Curiosity		.46**	.05	.29*	.01	.04	-.010
3 Deprivation Epistemic Curiosity			.15	.27*	-.03	-.15	-.16
4 Academic Self-Efficacy				.37**	.42**	.37**	.44**
5 Academic Self-Regulated Learning					.36***	.37***	.49***
6 Forethought						.34***	.38***
7 Performance Control							.61***
8 Self-Reflection							

* $p < .05$., ** $p < .01$., *** $p < .001$.

Table 3 showed the epistemic curiosity including (both interest and deprivation epistemic curiosity) was found the significantly positively associated with academic self-efficacy while epistemic curiosity was found to be significantly positively correlated with academic self-regulated learning. However, academic self-efficacy was also found to be significantly positively correlated with academic self-regulated learning (forethought, performance control, and self-reflection) in university students.

Structural equation modeling was employed to examine mediating role of academic self-efficacy between epistemic curiosity and academic self-regulated learning among university students. Model fit is showed in table 4.

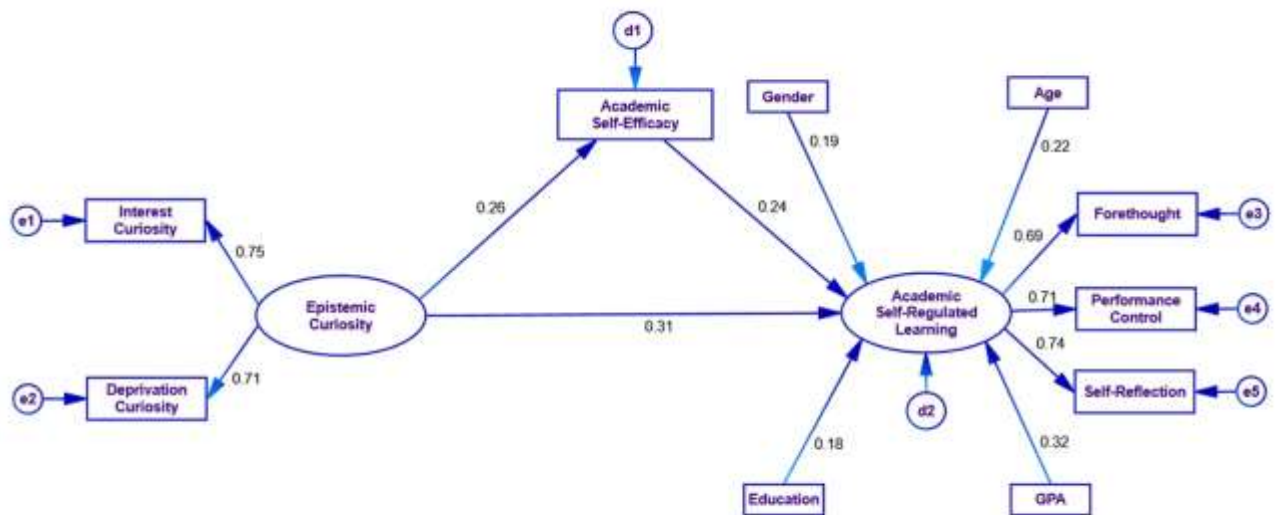
Table 4: Fit Indices for Epistemic Curiosity, Academic Self-Efficacy, and Academic Self-Regulated Learning in University Students (N = 240)

Model	χ^2	df	χ^2/df	GFI	CFI	NNFI	RMSEA	SRMR
Model Fit	91.27	34	2.68	.95	.92	.91	.06	.05

Note. All change in chi square values is computed relative to model, $\chi^2 > .05$., GFI= Goodness of fit index, CFI=comparative fit index, NNFI= non-normed fit index; RMSEA=root mean square error of approximation, SRMR=Standardized root mean square.

The initial model's absolute fit, as shown by the chi-square test $\chi^2 (34) = 91.27$, $p < .05$, demonstrated an excellent fit with the data. However, recognizing the chi-square test's limitations related to sample size and number of parameters to be estimated for a model, we examined additional fit indices (GFI, CFI, NNFI, RMSEA, SRMR) for a more comprehensive evaluation. These indices (RMSEA = .06, SRMR = .05, GFI = .95, CFI = .92, NNFI = .91, and $\chi^2/df = 2.68$) collectively indicated that the model exhibited excellent fit according to conventional standards of descriptive fit measures.

Figure 1: Empirical Results of Mediation Analysis of Academic Self-Regulated Learning, Epistemic Curiosity and Academic Self-Efficacy in University Students (N = 240)



The estimates were analyzed for direct and indirect effects after done with the model fit, for epistemic curiosity academic self-efficacy, and academic self-regulated learning in university students (table 5 and 6).

Table 5: Standardized Estimates of Direct Effects for Epistemic Curiosity, Academic Self-Regulated Learning, and Academic Self-Efficacy in University Students (N = 240)

Variables	Academic Self-efficacy		Self-regulated Learning	
	β	SE	β	SE
Epistemic Curiosity	.26**	0.16	.31***	0.23
Self-regulated Learning			.24**	0.12
Covariates			-	-
Age			.22*	0.11
Gender			.19*	0.17
Education			.18*	0.12
Grade Point Average			.36***	0.19
Total R^2	.309		.411	

Note. Gender, Men = 1, Women = 0 * $p < .05$, ** $p < .01$, *** $p < .001$

The direct effect revealed that epistemic curiosity was found to be significant positive predictor of academic self-efficacy and self-regulated learning. Similarly, academic self-efficacy was significant positive predictor of self-regulatory learning. Additionally, covariates indicated that age, gender, education, GPA were significantly positively predicting academic self-efficacy.

Table 6: Standardized Estimates of Indirect Effects through Academic Self-Efficacy between Epistemic Curiosity and Academic Self-Regulated Learning

Variables	Academic Self-Efficacy	
	β	SE
Epistemic Curiosity	.08*	0.06

* $p < .01$.

The results of indirect effect indicated that academic self-efficacy was found to be significant positive mediator between epistemic curiosity and academic self-regulated learning in university students, which showed that increase in epistemic curiosity tend to enhance academic self-efficacy. And increase in academic self-efficacy in-turn increases academic self-regulated learning in university students.

Discussion

The current study investigated the intricate relationships among three crucial variables: academic self-efficacy, academic self-regulatory learning, and epistemic curiosity. The distribution of genders, ages, semesters, forms of residency, and *CGPA*, among other key characteristics of the sample, is briefly summarized in table 1. The internal consistency of the variables was examined in the current study using reliability analysis. The scales' respective sub-scale alpha reliability was all determined to be good (table 1). In addition, table 2 displays the total number of variables as well as their mean and standard deviation. As can be seen in table 2, every scale and subscale has skewness and kurtosis values that fall between +2 and -2, meeting the criteria for a normal distribution.

To determine the relationship between the variables, bivariate correlation was utilized (table 3). The first hypothesis was confirmed by the empirical results of this study, which showed a statistically significant positive association between university students' epistemic curiosity and their self-regulatory learning abilities as well as their academic self-efficacy. This implies that scores on academic self-efficacy tend to increase as scores on epistemic curiosity increase. Present study also found that epistemic curiosity and academic self-regulatory learning are significantly positively correlated, this indicates that academic self-regulatory learning scores tend to increase when epistemic curiosity scores tend to increase and vice versa (table 3). This aligned with earlier research findings which validated that curiosity greatly improve learning outcomes, particularly in problem-based learning settings that encourage autonomous inquiry and problem-solving, and there was a statistically significant positive relationship between trait curiosity and creative self-efficacy among college students (Diaz & Arroyo, 2016; Glogger-Frey et al., 2015; Witherby & Carpenter, 2022). Furthermore, epistemic emotion of curiosity also enhance the likelihood of metacognitive self-regulation in learning, and previous findings indicated that epistemic curiosity and self-regulation in learning are positively correlated among undergraduate university students, as (Chevrier et al., 2019; Lauriola, 2015).

The second study hypothesis was validated by the current study's findings, which showed that academic self-efficacy and epistemic curiosity are significant predictors of self-regulated learning practices among university students (table 3). Research has consistently shown that undergraduate students' self-regulated learning practices and course outcomes were predicted by their levels of self-efficacy and epistemic curiosity, as curiosity, when viewed as a central motivational mechanism of the reward-sensitivity system, fosters intrinsic motivation, that in turn increases the intensity of control over self-regulated beliefs (Mishra, 2024; Shin, 2024).

The study further hypothesized that academic self-efficacy would serve as a mediating factor, linking epistemic curiosity to academic self-regulatory learning among university students, which was proved by the results of the present study (Table 6). This implies that increase in

epistemic curiosity tend to enhance academic self-efficacy, and increase in academic self-efficacy in-turn increases academic self-regulated learning in university students. The results of this study were in line with earlier studies that found that curiosity and self-efficacy beliefs complement one another, and a student's capacity for problem-solving, self-regulated learning, and self-directed learning will all increase with their level of academic self-efficacy as academic self-efficacy was strongly positively correlated with self-regulated learning, self-directed learning, and problem-solving skills (Chen et al., 2019; Cho & Kim, 2019; Kokcu & Cevik, 2020; Mishra, 2024; Zhang et al, 2018). This suggests that academic self-efficacy can mediate the relationship between learner's curiosity and self-regulatory learning.

Conclusion

Undergraduates in this study demonstrated that there is a connection between academic self-efficacy, academic self-regulatory learning, and epistemic curiosity. These three variables were discovered to be significantly correlated with one another. Students who exhibited high levels of academic self-efficacy and epistemic curiosity were also more likely to demonstrate academic self-regulation in their learning. Additionally, it brought attention to how academic self-efficacy acts as a mediator between epistemic curiosity and academic self-regulation in learning. The significance of these findings lies in the fact that they provide light on the positive correlations between students' levels of academic self-regulatory learning, their levels of epistemic curiosity, and their motivation, self-assurance, and independence in the classroom.

Implications

The primary implication of the current research findings is to facilitate students' curiosity about self-regulated learning. Research indicates that self-regulated learning significantly enhances the academic performance of college and university students (Koivuniemi et al., 2017), while the declining quality of education in Pakistan requires the adoption of remedial measures (Ghazi et al., 2010). To elevate the standards of higher education in Pakistan, it is essential to advocate for the incorporation of self-regulated learning. Educators can create distinctive programs by understanding the relationships among curiosity, self-confidence, and self-regulation. These programs possess the capacity to enhance students' curiosity and self-confidence while facilitating their development as autonomous learners and improving their academic performance. Academic self-efficacy, self-regulatory learning, and epistemic curiosity can foster the development of lifelong learners. Students who exhibit curiosity, confidence, and proficient self-regulation in their learning are more inclined to seek information beyond conventional classroom environments.

Suggestions

Educational institutions should strive to improve students' self-efficacy and self-regulation to avert academic failure. Each learner must feel supported to cultivate the belief that they can acquire knowledge and enhance their skills. Educators should recognize the following learning contexts: "clear and well-paced instruction, fostering student independence, teachers exhibiting enthusiasm, integrating humor, demonstrating fairness, and maintaining high expectations for students' abilities" (Boekaerts & Cascallar, 2006), as well as "choice and consistency" (Sheldon & Elliot, 1998). Educators must devise distinctive teaching frameworks that include these notions to foster self-regulation in their students. Longitudinal studies are essential for comprehensively understanding the development and evolution of phenomena over an extended period. Future researchers may longitudinally assess students to examine the development and interplay of their curiosity, self-confidence, and learning capabilities.

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