ChatGPT as a Mediating Tool in Education: Enhancing Learning Efficiency, Academic Performance, and Academic Self-Concept in Effort-Talent Focused Environments

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Abstract

This study investigated ChatGPT's impact on learning efficiency, academic performance, and academic self-concept among 563 undergraduates from Chinese Traditional (10.8%), Wenzhou Kean (63.9%), and Kean Universities (25.2%). Using a descriptive-correlational design and convenience/snowball sampling, survey data were collected and analyzed. Results revealed a strong positive correlation between learning efficiency and academic performance, with ChatGPT's real-time feedback enhancing engagement and critical thinking. Personalized tutoring with adaptive pacing was linked to reduced anxiety and increased self-efficacy. A moderate correlation was also observed between academic performance and academic self-concept, with ChatGPT indirectly reinforcing students' motivation, participation, and perceived competence, particularly in effort-focused environments. However, the study acknowledges key limitations. The correlational design cannot establish causality, and improvements may stem from confounding variables such as prior motivation, parental support or influence. Overreliance on AI tools may hinder the development of foundational skills, while ethical concerns and misinformation risks remain significant. The sample's technological advantage and cultural context also limit generalizability. To maximize benefits while mitigating risks, the study recommends integrating AI tools like ChatGPT into course design with structured critical thinking tasks and ethical guidelines. Institutions should support effort-based grading, encourage culturally enriching parental involvement, and expand research to under-resourced educational contexts. These measures can help align AI tool use with holistic academic and psychological development.

Keywords: *Learning Efficiency, Academic Performance, Academic Self-Concept, School-Focused Environment*

1. Background Introduction

Artificial intelligence (AI) holds considerable promise for enhancing educational experiences, offering personalized learning opportunities, and reshaping the role of educators in contemporary classrooms [1]. A notable advancement in this area is the Chat Generative Pre-trained Transformer (ChatGPT), a conversational AI tool that has gained widespread attention for its applications in education. Increasingly, students are turning to ChatGPT as a supplementary resource to support their studies. By analyzing learners' behaviors, preferences, and prior learning history, AI technologies can tailor instructional content and provide targeted feedback for individual needs [2].This capacity to personalize learning has demonstrated strong potential in improving learners' efficiency and facilitating measurable academic progress [3]. When integrated thoughtfully, ChatGPT can serve as a creative partner—helping students generate ideas, clarify concepts, and access timely assistance—ultimately fostering a more autonomous and supportive home learning environment [4]. Hence, as educational systems globally embrace digital transformation, understanding the impact of AI tools like ChatGPT on enhancing students' learning efficiency, academic performance, and academic self-concept becomes fundamentally imperative.

1.1 *Learning Efficiency*

Learning efficiency refers to the optimal allocation of resources to achieve desired learning outcomes, including the ability to acquire and retain knowledge effectively while minimizing the time and effort required [5]. Research highlights that tailored strategies and timely feedback are key to improving efficiency, as they help learners better understand content and self-regulate their progress [6]. ChatGPT, as an advanced AI tool, offers various functionalities—such as personalized tutoring, real-

time feedback, homework assistance, and language practice—that can support learners in optimizing their study efforts [7; 4].

Homework Assistance. According to [8], ChatGPT sereves as a valuable tool that can help students solve difficulties encountered in homework by providing prompts, step-by-step guidance, and explaining concepts. However, [9] pointed out that if students rely too much on ChatGPT's assistance, it may hinder the development of their basic skills, including critical thinking. *Personalized Tutoring.* By helping to understand concepts and providing structured learning plans, ChatGPT has contributed to students' learning [4]. Using the personalized tutoring provided by ChatGPT, students can focus on their weakest areas and learn at their own pace, thereby improving learning efficiency and optimizing learning outcomes [10]. *Language Practice.* [11] indicated that ChatGPT provided EFL students with opportunities for active participation and continuous practice by generating high-quality conversational materials. In addition, the interactive exercises and real-time feedback provided by ChatGPT helped learners understand and apply language concepts, thereby promoting their more effective language learning [12]. *Real-time Feedback.* . One of ChatGPT's most impactful features is its capacity to deliver instant, formative feedback. This immediacy helps learners identify and correct errors during the learning process, fostering engagement and improving outcomes [13; 14]. Compared with traditional methods, the feedback from Chatgpt not only provides students with the opportunity to make learning progress independently but also helps students identify and clarify misunderstandings in real-time, thereby improving their learning engagement and efficiency [15].

1.2 Academic Performance

Academic performance, often measured by grades and GPA, reflects students' academic capabilities [16; 17]. It may improve via chatbot use, especially for first-generation students [18]. While ChatGPT offers personalized learning [1], it also risks spreading misinformation and increasing plagiarism [19;20].

Critical Thinking. AI supports critical thinking by enhancing literature screening, theoretical analysis, and hypothesis testing, thus improving research quality [21]. It also fosters deep reflection through personalized systems and intelligent mentors [22]. *Engagement/Motivation.* AI boosts engagement and motivation by personalizing content delivery, increasing interest and participation [23]. In language learning, it enhances enjoyment and goal-setting through interactive, tailored feedback [24]. *Self-efficacy.* Chatbots enhance self-efficacy by offering real-time, personalized support, building confidence and autonomy [25]. In programming education, ChatGPT helps learners tackle challenges more effectively, improving outcomes [26]. *Plagiarism Awareness.* While AI improves writing efficiency, it raises concerns about originality and academic integrity [27]. Research shows it may lead to fabrication and ethical violations, posing risks to education and science [28; 29].

1.3 Academic Concept

Academic self-concept reflects how students perceive their abilities and potential within educational settings (Kavanagh, 2020 [30]; Marsh & Martin, 2011 [31]; Bong & Skaalvik, 2003 [32]). Evaluation and comparison are the two core aspects of academic self-concept (Meyer et al., 2023 [33]).

Parents' level of education. Higher parental education correlates with a more positive academic self-concept [34]. College-educated parents often instill greater confidence in their children's learning abilities through academic support and involvement [35; 36]). *Self-evaluation.* Self-evaluation reflects perceived academic competence, shaped by past achievements [37]. Success or failure experiences influence this self-belief [38]. *Peer comparison.* Adolescents form academic self-concept by comparing themselves to peers [39]. Social comparison theory suggests students assess their abilities relative to noticeable or similar peers [33;40]. *School-focused environment.* Effort-focused environments foster student success by valuing learning processes over innate ability [41]. Talent-focused settings may harm minority or first-generation students' self-concept, making them feel less capable [41; 42].

1.4 Learning Efficiency and Academic Performance

Learning efficiency positively correlates with academic performance, as demonstrated by AI-driven personalized tutoring systems that enhance student engagement and achievement across diverse

student populations [43]. ChatGPT's personalized tutoring helps students focus on weaknesses, optimize study time, and improve grades [10]. Adaptive feedback in writing reduces revision time while enhancing quality [15]. Feedback grounded in social and temporal self-comparisons has significantly enhanced students' academic outcomes [44]. However, excessive reliance on AI tools like ChatGPT may reduce effortful engagement (e.g., plagiarized homework), paradoxically weakening performance [45].

1.5 Academic Performance and Academic Self-concept

Recent research suggests that ChatGPT can enhance students' academic performance by fostering motivation and self-efficacy [46]. Improved grades through ChatGPT's support (e.g., homework help) enhance self-perceived capability [47]. Academic performance, in turn, has been positively associated with academic self-concept, reflecting the value of psychological factors in shaping learning outcomes [48]. Moreover, ChatGPT's personalized guidance can significantly contribute to students' self-concept and personal growth [49]. Students who hold a more positive academic self-concept are also more likely to engage with ChatGPT in productive ways, maximizing its potential benefits [50]. Furthermore, ChatGPT has been shown to promote self-confidence by reinforcing students' academic abilities and motivation, thereby strengthening their overall academic self-concept [51]. Conversely, poor performance driven by AI dependency (e.g., plagiarism penalties) diminishes self-concept, highlighting the need for balanced AI integration [29].

2. Methodology

A descriptive-correlational, cross-sectional design was employed to investigate ChatGPT's mediating role in the relationships between learning efficiency, academic performance, and academic self-concept among a sample of 563 undergraduate students. To ensure wide participation, convenience and snowball sampling techniques were utilized, with survey questionnaires distributed across three institutions: Chinese traditional universities (10.8%), Wenzhou-Kean University (63.9%), and Kean University in the United States (25.2%). Quantitative data were collected through an online self-constructed questionnaire administered via Wenjuanwang.com, Qualtrics, and WeChat platforms. The instrument demonstrated strong internal consistency, as evidenced by Cronbach's alpha coefficients: Learning Efficiency ($\alpha = 0.925$), Academic Performance ($\alpha = 0.710$), and Academic Self-Concept ($\alpha = 0.828$). Responses were measured using a five-point Likert scale. Descriptive statistics were used to summarize trends, including means, standard deviations, frequency distributions, and percentiles. Pearson's correlation coefficient was employed to examine relationships among the key variables, with a significance level set at $\alpha = 0.05$ and a 95% confidence interval. Ethical protocols were strictly followed, including informed consent and the assurance of participant confidentiality. Quantitative analysis was conducted using SPSS, supporting rigorous interpretation of the relationships between students' perceptions and academic outcomes.

3.Results and Discussions.

3.1 Learning Efficiency

Table 1 shows ranking of ChatGPT utilization as a mediating tool to learning efficiency. Analysis of 561 valid responses showed that 457 participants (81.5%) employed ChatGPT for homework assistance. Primary applications included obtaining question-specific hints (75.1%),clarifying academic concepts (71.6%), and receiving stepwise guidance for complex tasks (68.9%). Among 367 users (65.4% of respondents), ChatGPT was predominantly used for analyzing complex academic concepts (87.7%). A total of 313 participants (55.8%) reported using ChatGPT to obtain real-time evaluation for their academic writing. Text structure (67.7%),feedback was most utilized followed by grammar (57.5%) and academic language (51.1%). Few participants 152 (27.1%) adopted ChatGPT for language practice with translation support (70.4%) and conversational simulations (67.1%) being primary applications.

Table 1. Purpose of ChatGPT Usage

Variables	Utilization of ChatGPT	F	P(%)	Variables	Utilization of ChatGPT	F	P(%)

Homework Review	Get hints on key points of a question.	343	75.1	Language Practice	Interactive conversation exercises simulating everyday communication situations	102	67.1
	Get step-by-step instructions for complex tasks	315	68.9		Correction of grammar, vocabulary and pronunciation	95	62.5
	Find explanations of academic concepts	327	71.6		Translation and vocabulary assistance	107	70.4
	Brainstorm for ideas for answers to assignments	245	53.6		I think ChatGPT has improved my language learning efficiency.	4	2.6
Personalized Tutoring	Seeking clarification of complex academic concepts	322	87.7	Real-time Feedback (Academic Writing)	Grammar	180	57.5
	Tailor a structured study plan	155	42.2		Spelling	139	44.4
	Programming or solving technical problems	167	45.5		Text structure	212	67.7
	Completing assignments including writing papers	128	34.9		Academic language	160	51.1
	Others	22	6.0				

Table 2 presents the results of ChatGPT's influence on learning efficiency as follows: ***Homework Review:*** A very high agreement with 84.4% of responses falling within the "Agree" to "Strongly Agree" range showed that ChatGPT enhanced assignment completion ease (*M* = 4.26, *SD* = 0.77) and improved learning efficiency (*M* = 4.18, *SD* = 0.83). ***Personalized Tutoring:*** Participants reported very high agreement (82%) regarding adaptation to individual learning paces (*M* = 4.17, *SD* = 0.79) and high agreement (67.6%) on identification of knowledge gaps (*M* = 3.87, *SD* = 1.02). ***Real-Time Feedback***: A high agreement (72.5% and 61.6%) was observed among participants, recognizing ChatGPT's role in improving learning efficiency in academic writing (M = 3.90, SD = 1.06) and enhancing engagement compared to traditional feedback methods (*M* = 3.67, SD = 1.08). ***Language Practice:*** Despite low utilization (152), a high agreement (81.6%)of the users perceived significant enhancement in language skill development (*M* = 4.05).

Table 2. ChatGPT's Influence on Learning Efficiency

Variables	Behavioral Indicators		1 (SD)	2	3	4	5 (SA)	M	M of Ms	SD	Scaled response
Homework Review	Using ChatGPT makes it easier for me to complete assignments.	F	2	6	63	188	198	4.26		0.77	Agree
		P(%)	0.4	1.3	13.8	41.1	43.3				
	I feel that my actual learning efficiency has improved by using ChatGPT to assist with homework.	F	3	13	64	194	183	4.18	4.22	0.83	Agree
		P(%)	0.7	2.8	14.0	42.5	40.0				
Personalized Tutoring	Personalized tutoring with ChatGPT is well adapted to my learning pace, helping me grasp difficult concepts more easily.	F	2	7	57	163	138	4.17		0.79	Agree
		P(%)	0.5	1.9	15.5	44.4	37.6				
	ChatGPT helps me identify my weaknesses, allowing me to focus on the areas where I need to improve.	F	6	34	79	131	117	3.87	4.07	1.02	Agree
		P(%)	1.6	9.3	21.5	35.7	31.9				
	The personalized learning experience provided by ChatGPT has improved my overall learning efficiency.	F	2	11	50	159	145	4.18		0.82	Agree
		P(%)	0.5	3.0	13.6	43.3	39.5				
Language Practice	I think using ChatGPT-generated conversational materials is appropriate for my language level.	F	1	4	32	71	44	4.01		0.82	Agree
		P(%)	0.7	2.6	21.1	46.7	28.9		4.05		
	I think ChatGPT has improved my language learning efficiency.	F	2	4	22	74	50	4.09		0.83	Agree
		P(%)	1.3	2.6	14.5	48.7	32.9				
Real-time Feedback	I think ChatGPT's real-time feedback accurately guides me to improve my academic writing.	F	11	18	74	131	79	3.80		1.00	Agree
		P(%)	3.5	5.8	23.6	41.9	25.2				
	Compared with traditional methods such as peer review or instructor feedback, real-time feedback from ChatGPT has increased my learning engagement.	F	16	26	78	119	74	3.67		1.08	Agree
		P(%)	5.1	8.3	24.9	38.0	23.6		3.79		
	I feel that using ChatGPT for real-time feedback improves my overall learning efficiency.	F	13	20	53	125	102	3.90		1.06	Agree
		P(%)	4.2	6.4	16.9	39.9	32.6				
Overall Learning Efficiency									3.95	0.86	

Legend: Strongly Agree/Profoundly Enhance (4.51-5.00); Agree/Significantly Enhance (3.51-4.50); Neutral/Offers Moderate Support (2.51-3.50); Disagree/Provides Limited Support (1.51-2.50); Strongly Disagree/Ineffective in improving learning efficiency (1.00-1.50).

As shown on Table 2, participants generally agree that ChatGPT significantly enhanced their learning efficiency, making tasks easier and contributing positively to their overall learning experience (*M* = 3.95). Generally, participants found ChatGPT helpful in enhancing their ability to understand and apply academic content efficiently. Home Review (*M* = 4.22) *accelerated assignment completion* due to ChatGPT's immediacy in generating explanations and frameworks thereby underscoring its role in reducing time investment and effort. *Conceptual Mastery* via personalized tutoring (*M* = 4.02) reported

clearer understanding of complex topics while adaptive pacing and tailored explanations enabled efficient knowledge gap identification. Language Practice (*M* = 4.05), though minimally adopted contributed to *targeted language skill development* from translation support, conversation simulations and grammar correction. Real-time feedback (*M* = 3.79*) improved academic writing quality*, particularly in text structure and grammar, in addition to its role in reducing drafting time and repetitive revisions. Furthermore, the lowest mean and relatively higher standard deviation indicate that students have different views regarding the impact of ChatGPT's real-time feedback on learning. Specifically, some students do not consider ChatGPT's feedback as more engaging or beneficial than traditional peer review or instructor feedback. Nevertheless, they still recognize its effectiveness in improving learning
efficiency and believe that real-time feedback can guide them to improve their academic writing skills.
Implications: Learning efficiency was rated positively with Home Review and personalized tutoring receiving the highest scores, indicating that students credit ChatGPT with making study tasks easier and clarifying difficult concepts. Real-time Feedback (M = 3.79, highest SD) was more variably received, signalling that some learners still prefer traditional instructor or peer input.

3.2 Academic Performance

Table 3 outlines participants' perceptions across four key variables of academic performance. Among these, critical thinking (*M* = 3.78) and self-efficacy (*M* = 3.75) received the highest mean scores, indicating that students perceive ChatGPT *significantly enhances their analytical skills and academic confidence*. These high mean scores suggest that students view ChatGPT not merely as a source of multiple perspective but as a facilitator for better understanding, deeper analysis, problem-solving, and independent learning. They believe it supports the development of critical thinking by encouraging them to question, reflect, and synthesize academic content more effectively. Participants also expressed moderately positive attitudes in relation to learning motivation and engagement (*M* = 3.49), with many indicating that ChatGPT *increases their interest in academic tasks and helps maintain focus during learning activities.* This suggests that the tool can act as a motivating factor, where self-directed learning is crucial.

Table 3. Academic Performance Descriptive Analysis

Variables	Behavioral Indicators		1 (SD)	2	3	4	5 (SA)	M	M of Ms	SD	Scaled response
Critical thinking	How often do you use ChatGPT in a week?	F	46	119	162	110	98	3.18	3.78	1.22	Average
		P(%)	8.6	22.2	30.3	20.6	18.3				
	My understanding of the course content has improved after using ChatGPT.	F	20	24	107	219	165	3.91		1.0	Good
		P(%)	3.7	4.5	20	40.9	30.8				
	ChatGPT provides multiple perspectives, helping me think more comprehensively in academic discussions.	F	13	21	103	225	173	3.98		0.95	Good
		P(%	2.4	3.9	19.3	42.1	32.3				
	ChatGPT helps me think critically when analyzing academic problems.	F	18	37	119	226	135	3.79		1.01	Good
		P(%	3.4	6.9	22.2	42.2	25.2				
	ChatGPT helps me understand and evaluate complex academic concepts better.	F	13	15	97	230	180	4.03		0.92	Good
		P(%	2.4	2.8	18.1	43	33.6				
Motivation/ Engagement	ChatGPT makes me feel more motivated to complete my learning tasks.	F	23	54	146	180	132	3.64	3.49	1.09	Good
		P(%)	4.3	10.1	27.3	33.6	24.7				
	ChatGPT increased my interest in the course content.	F	30	73	188	157	87	3.37		1.08	Average
		P(%)	5.6	13.6	35.1	29.3	16.3				
	ChatGPT has made me more willing to volunteer questions or participate in class discussions.	F	35	83	158	163	96	3.38		1.14	Average
		P(%)	6.5	15.5	29.5	30.5	17.9				
	ChatGPT enabled me to participate more actively in the course material.	F	25	57	141	206	106	3.58		1.06	Good
		P(%)	4.7	10.7	26.4	38.5	19.8				
Self-efficacy	ChatGPT makes me feel more confident and less anxious when completing academic tasks.	F	19	30	108	234	144	3.85	3.75	1.00	Good
		P(%)	3.6	5.6	20.2	43.7	26.9				
	ChatGPT helps me feel more able to self-monitor when I am learning.	F	27	64	184	174	86	3.43		1.05	Average
		P(%)	5	12	34.4	32.5	16.1				
	ChatGPT's feedback has increased my confidence in overcoming learning challenges when completing assignments or projects.	F	25	31	107	237	135	3.8		1.03	Good
		P(%)	4.7	5.8	20	44.3	25.2				
	ChatGPT boosts my confidence in tackling learning challenges and understanding complex course concepts.	F	18	35	101	235	146	3.85		1.00	Good
		P(%)	3.4	6.5	18.9	43.9	27.3				
	ChatGPT's usefulness in academic learning gives me confidence in improving my academic performance.	F	17	30	128	213	147	3.83		1.00	Good
		P(%)	3.2	5.6	23.9	39.8	27.5				
Plagiarism Awareness	ChatGPT makes it easier to complete assignments without personal effort, raising concerns about plagiarism and its potential negative impact on my academic performance.	F	38	84	156	170	87	3.34	3.59	1.14	Average
		P(%)	7.1	15.7	29.2	31.8	16.3				
	I recognize that "patchwriting", which involves making minor modification to an original passage of text—even when cited— is a violation of academic integrity and could negatively affect my academic performance.	F	17	33	126	208	151	3.83		1.01	Good
		P(%)	3.2	6.2	23.6	38.9	28.2				
Overall academic performance								3.81		.56	Good

Legend: Strong (4.51-5.00); Good (3.51-4.50); Average (2.51-3.50); Somewhat low (1.51-2.50); Low (1.00-1.50).

However, responses to the variable related to *academic integrity*, particularly on the topic of plagiarism awareness (*M* = 3.59), reveal a more ambivalent stance. While some participants acknowledged ChatGPT's usefulness in clarifying concepts and supporting independent work, others *raised concerns about its potential to facilitate academic dishonesty.* This mixed response highlights a critical tension in the use of AI in education: while it can empower students to learn more effectively, it may also blur the boundaries of originality and authorship if not used ethically.

Implications: Academic performance indicators likewise showed favorable means: critical thinking and self-efficacy were rated highest, while motivation/engagement was moderate and plagiarism awareness revealed mixed views about academic integrity. These patterns imply that students see ChatGPT as a catalyst for analysis and confidence, but also recognise its potential misuse.

3.3 Academic Self-Concept

As shown on Table 4, participants generally hold a moderately positive academic self-concept (*M* = 3.51), with variation observed across specific dimensions. Notably, the highest mean scores were recorded in the variable of *School-focused Environment* (*M* = 3.80) and *Self-evaluation* (*M* = 3.73), indicating that students tend to view their academic abilities more positively when shaped by personal effort and supportive school environments. These findings reflect that students perceive their schools as valuing intelligence and recognize praise from teachers for consistent effort, which contributes to stronger academic self-beliefs in diverse educational contexts.

In contrast, the constructs of *Peer Comparison* and *Parent's Level of Education* both recorded lower mean scores (*M* = 3.39), suggesting that students' academic self-concept is more neutral when influenced by social comparison and familial background. Particularly, the lower score related to parental education implies that students whose parents have lower educational attainment may internalize lower expectations, potentially impacting their confidence in their academic potential

Table 4. Academic Self-Concept Descriptive Analysis

Variables	Behavioral Indicators		1 (SD)	2	3	4	5 (SA)	$\bar{X}$	$\bar{X}$ of Means	SD	Scaled response
Parent's level of education	My perception of my own academic potential is shaped by the level of education my parents have achieved.	F	101	128	135	116	45	2.76	3.90	1.24	Average
		P(%)	19.2	24.4	25.7	22.1	8.6				
	My parents' reading habits strengthened my reading skills, contributing to a positive academic self-concept.	F	47	92	171	141	74	3.20		1.15	Average
		P(%)	9.0	17.5	32.6	26.9	14.1				
	My parents take me to cultural activities, such as viewing exhibitions, visiting museums, and attending cultural shows, which sparks my interest in self-study	F	47	76	145	174	83	3.32		1.17	Average
		P(%	9.0	14.5	27.6	33.1	15,8				
	The extent my parents communicate coursework with me increases my confidence in mastering the learning materials.	F	60	100	160	146	59	3.08		1.17	Average
		P(%	11.4	19.0	30.5	27.8	11.2				
Self-evaluation	My ability to take well-organized notes strengthens my confidence in my academic abilities.	F	6	26	118	237	138	3.90	3.73	0.88	Good
		P(%)	1.1	5.0	22.5	45.1	26.3				
	Feeling that most exams are easy for me enhances my academic self-concept	F	24	72	205	161	63	3.32		1.00	Average
		P(%)	4.6	13.7	39.0	20.7	12.0				
	Having a clear sense of my academic goals boosts my confidence in achieving academic success.	F	7	25	138	235	121	3.83		0.88	Good
		P(%)	1.3	4.8	26.3	44.6	23				
	Being good at scheduling my study time contributes to my positive academic self-concept.	F	8	28	116	238	135	3.88		0.90	Good
		P(%)	1.5	5.3	22.1	45.3	25.7				
Peer-comparison	I believe I perform academically better than the average level of my peers.	F	21	54	208	177	65	3.40	3.39	0.97	Average
		P(%)	4.0	10.3	29.6	33.7	12.4				
	I find it easier to learn new things in my studies than my classmates do.	F	18	56	218	173	60	3.38		0.94	Average
		P(%)	3.4	10.7	41.5	33.0	11.4				
School-focused environment	The effort-focused feedback (such as"Well done, you're working hard") received from the teacher made me feel confident in my learning ability.	F	4	16	109	227	169	4.03	3.80	0.85	Good
		P(%)	.8	3.0	20.8	43.2	32.2				
	The more the school values hardworking students, the more confident I am in my academic performance.	F	10	37	167	196	115	3.70		0.95	Average
		P(%)	1.9	7.0	31.8	37.3	21.9				
	The talent-focused feedback (such as"Well done, you're smart") received from the teacher makes me feel confident in my learning ability..	F	6	22	123	232	142	3.92		0.87	Good
		P(%)	1.1	4.2	23.4	44.2	27.0				
	The more the school emphasizes inherent intelligence and talent, the more confident I feel in my academic performance.	F	16	49	187	174	99	3.95		1.00	Good
		P(%)	3.0	9.3	35.6	33.1	18.9				
Overall academic self-concept (ASC)									3.51	0.62	Average

Legend: Strong ASC (4.51-5.00); Good ASC (3.51-4.50); Average ASC (2.51-3.50); Somewhat low ASC (1.51-2.50); Low ASC (1.00-1.50).

Implications: Overall academic self-concept was moderately positive.The school-focused environment and self-evaluation dimensions were strongest, suggesting that supportive school climates and personal effort boost self-beliefs. Lower means for peer comparison and parental education indicate that social comparison and family background temper students' academic confidence.

3.4 Learning-Efficiency—Academice Performance—Academic-Self-Concept Relationships

3.4.1 Correlation Among Constructs

The correlation analysis explored the interrelationships between the three constructs: *learning efficiency, academic performance, and academic self-concept.* Results revealed there was a *strong positive correlations between learning efficiency and academic* performance, r (506) = .78, p < .01. While results showed a *moderate positive correlation between academic performance and academic self-concept*, r (523) = .43, p < .01.

3.4.2 Learning Efficiency – Academic Performance

Specifically, findings indicated that real-time feedback, particularly from AI-based tools like ChatGPT, plays a central role in enhancing learning efficiency and academic performance. The most significant correlation was observed between *real-time feedback* and *critical thinking,* a key indicator of academic performance, with a strong positive correlation, r(308) = .81, p < .01. These results align with the reports of Delaval et al. [44;15]. Similarly, *motivation and engagement,* which are closely aligned with academic self-concept, also reported *a strong positive correlation with real-time feedback r* (308) = 0.74, p < 0.01.

Simultaneously, learning efficiency—defined here by students' perceived improvement in learning through tool-assisted study—was closely linked with *academic self-concept.* Specifically, *real-time feedback was strongly correlated with self-efficacy*, r(308) = .79, p < .01; *language-practice activities were likewise strongly correlated with self-efficacy, r*(148) = .77, p < .01; and *personalized tutoring was strongly correlated with self-efficacy, r*(358) = .72, p < .01. In other words, when students feel that their learning processes are efficient and purposeful, their *motivation and self- efficacy rises*, and they engage more fully—both characterizes a strong academic self-concept. Collectively, these results indicate that students who report greater learning efficiency from digital tools also tend to express higher motivation and confidence in their academic abilities.

Implications: The consistently strong correlations between real-time feedback, and language adaptive tutoring through ChatGPT, is not merely a supplementary aid but a pivotal instructional lever. When students perceive their study process as efficient, their motivation, self-efficacy appear to rise, which in turn, is associated with higher course grades. Consequently, AI-enabled feedback and personalization have the potential to initiate and sustain a virtuous cycle of engagement and academic success. *3.4.3 Academic Performance—Academic Self-Concept:* The present study identified a significant, positive relationship between students' academic self-concept—cultivated within a *school-centered environment—and their self-efficacy for academic performance* when using ChatGPT r (523) = .33,

p < .01. The heightened self-efficacy increases the likelihood that teachers are more likely to notice and reinforce students' effort and emerging talent/competence (e.g., praise for persistence or well done, you're smart!) Such feedback is central to the development of a positive academic self-concept. This reciprocal loop—AI-enhanced self-efficacy followed by teacher affirmation—offers a plausible mechanism through which self-concept strengthens over time and translates into higher grades.

Similarly, a positive association was observed between motivation/engagement and *parental educational attainment and cultural-enrichment activities r* (523) = .33, p < .01. ChatGPT usage appears to enhance academic performance by fostering intrinsic motivation, which manifests as heightened learning interest, proactive participation in class discussions, and sustained engagement with course materials. This relationship is further contextualized by parental influence, where exposure to cultural enrichment activities (e.g., museum visits, exhibition attendance, and participation in educational events) correlates with stronger academic self-concept. Students who engage in such activities report enhanced mental concentration and self-perception as capable learners, likely due to accumulated knowledge and intellectual reinforcement from these experiences. Consequently, this fortified academic self-concept amplifies motivation, creating a cyclical relationship wherein motivated students utilize ChatGPT more effectively to deepen their learning and achieve academic excellence.

Implications: Students from families that regularly engage in cultural activities, such as visiting museums or attending educational events, tend to report stronger academic self-concepts. These students appear to utilize tools like ChatGPT more effectively, demonstrating behaviors such as asking insightful questions and showing increased interest in course materials and engagement. As such, schools might consider involving families by designing AI-supported extension activities that

complement cultural experiences or by providing prompt templates that parents and students can use collaboratively at home.

4.Conclusion, Limitations, and Recommendations

The study found that learning efficiency was strongly associated with academic performance, while academic performance showed a moderate relationship with academic self-concept. These findings suggest that AI-generated feedback, such as that provided by ChatGPT, may enhance learning efficiency, which in turn supports higher achievement and, to a lesser degree, contributes to a stronger academic self-concept. However, as a correlational study, causal relationships cannot be established. Improvements in outcomes may reflect pre-existing factors such as student motivation, parental influence or support rather than direct effects of ChatGPT. In addition, excessive reliance on AI tools may risk skill erosion in critical thinking, while the accuracy of AI-generated feedback and ethical concerns around plagiarism remain critical issues. The sample's technological advantage and cultural specificity also limit broader applicability, and reliance on self-reported data introduces potential bias.
Accordingly, we recommend the following: (a) Integrate AI tools that offer immediate, personalized, and constructive feedback into course design, alongside scaffolded tasks that promote critical thinking and academic integrity. (b) Combine AI-supported learning with effort- and strategy-focused praise to enhance students' self-concept. (c) Encourage culturally enriching parental involvement to reinforce positive academic self-beliefs. (d) Expand research to under-resourced or rural educational settings to address equity concerns. By addressing these limitations and building on the strengths of AI integration, educators can more effectively align technological tools with holistic educational development.

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