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Relationship between Artificial Intelligence and Students' Learning Strategies at Secondary Level

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ABSTRACT

The objective of the study was to identify the level of AI and students' learning strategies, and to find the relationship between AI and students' learning strategies at secondary level. Artificial Intelligence is reshaping students' learning strategies by providing personalized content, immediate feedback, and data-driven insights that enhance engagement and comprehension. However, while AI promotes self-regulated learning and collaboration, it also requires careful balance to preserve essential human interaction in education. A quantitative and descriptive method is used in the study. The majority of participants were in the secondary school district of Sheikhupura. A questionnaire served as this study's primary research tool. The validity of the questionnaire was found through experts' opinions and reliability through pilot testing. Descriptive and inferential statistics was used. The findings of the study revealed that there was highly significant relationship between AI and students' learning strategies at secondary level.

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1. Introduction

The impact of artificial intelligence (AI) on students' studying strategies is huge, reworking how they collect knowledge, interact with instructional materials, and broaden crucial abilities. AI-pushed tools, consisting of personalized learning systems, adaptive checks, and sensible tutoring systems, are reshaping the academic landscape. Those gear leverage algorithms that assess students' strengths and weaknesses, allowing for customized content material transport. studies suggests that this tailored technique can growth engagement and comprehension, as students get hold of help acceptable to their person learning paces and styles (Baker & Siemens, 2014; Bressane et al., 2024; Holmes, Bialik, & Fadel, 2019; Luckin & Holmes, 2016; Roll & Wylie, 2016). The adaptability of AI gear contrasts sharply with traditional teaching techniques, which regularly adopt a one-size-fits-all version. By way of developing a customized enjoy, AI enhances students' motivation and promotes a experience of autonomy, that is vital for self-regulated studying—a vital ability for lifelong getting to know (Kahn & Winters, 2021; Williamson & Eynon, 2020; Winne & Nesbit, 2010). One of the maximum distinguished blessings of AI is its ability to provide immediate remarks, an important issue for powerful learning. With AI-powered structures, students can acquire comments right away after finishing sports or exams, helping them understand and rectify errors in real-time. This instant remarks loop is instrumental in reinforcing accurate expertise, because it prevents the reinforcement of misconceptions that may arise whilst mistakes aren't addressed promptly (Roschelle, Lester, & Fusco, 2020; Zawacki-Richter et al., 2019). Via addressing college students' unique misunderstandings, AI encourages metacognition, prompting newbies to reflect on their concept strategies and become more mindful in their cognitive strategies. Studies suggest that students who engage in such

metacognitive practices tend to perform better academically (Black & Wiliam, 2009; Williamson & Eynon, 2020), as they are much more likely to set desires, reveal their know-how, and modify their gaining knowledge of techniques as wished.

Furthermore, AI technology, consisting of herbal language processing, have led to the advent of chat-bots and digital teaching assistants which could assist college students in numerous methods, from answering simple queries to assisting with complex assignments. The presence of those virtual assistants presents college students with round-the-clock educational assist, which is in particular beneficial for rookies who may additionally need assist outside of traditional lecture room hours (Roschelle, Lester, & Fusco, 2020). Virtual assistants can reduce dependency on instructors for recurring questions, empowering students to searching for answers independently and construct self-assurance in hassle-solving (Liu, Gao, & Guan, 2021). However, this elevated reliance on AI-based assistants has raised concerns approximately diminishing interpersonal interactions with instructors and friends, which are vital for social and emotional development (Hsu, Chang, & Jen, 2024). At the same time as AI offers positive academic blessings, it is essential to balance its use to make certain that scholars maintain to develop critical interpersonal talents. AI's capability to music and examine statistics on students' learning habits provides insights that may manual each college students and educators. by means of monitoring patterns together with time spent on particular subjects or the styles of mistakes usually made, AI structures can provide tailor-made suggestions to optimize have a look at habits. For example, if a pupil continuously struggles with algebraic standards, an AI-powered studying platform would possibly advise extra physical games or sources centered at that subject matter (Iglesias et al., 2009). This records-pushed method lets in for strategic interventions which can cope with mastering demanding situations earlier than they emerge as entrenched. consistent with Holmes, Bialik and Fadel (2019), AI-powered analytics have the ability to enhance getting to know effects with the aid of fostering self-focus in college students and allowing instructors to adopt proactive strategies based on actual information in place of assumptions (Black & Wiliam, 2009; Zhu & Zhang, 2022).

Nevertheless, AI's position in shaping studying strategies isn't without demanding situations. One concern is the potential for over-reliance on algorithmic guidelines, which might stifle creativity and vital questioning. when AI structures manual gaining knowledge of paths too rigidly, there is a chance that students will awareness narrowly on reaching most beneficial set of rules-pushed consequences rather than exploring thoughts freely (Cantú-Ortiz et al., 2020). This dilemma can restrict the improvement of highbrow curiosity, an essential trait that drives exploration and fosters innovation (Marquez et al., 2023). Moreover, AI's reliance on vast amounts of records increases privatizes issues, as students' non-public records is frequently required to create customized studying experiences. The moral implications of collecting and storing such records need to be cautiously considered, especially within the context of minors (Marquez et al., 2023). Furthermore, the blessings of AI aren't similarly accessible to all college students, leading to concerns approximately educational fairness. AI-greater mastering tools are often extra with no trouble available in nicely-resourced faculties, creating a virtual divide which can exacerbate present inequalities. College students in underfunded educational systems might also have restricted get entry to these technology, leaving them at a downside in comparison to their friends who gain from personalized gaining knowledge of opportunities (Chen, Chen, & Lin, 2020). This discrepancy highlights the need for regulations and investments that make certain equitable get right of entry to AI-powered educational resources, so that each one college students have the possibility to benefit from those improvements (Black & Wiliam, 2009; Cunska, 2020; Roschelle, Lester, & Fusco, 2020). AI's have an effect on extends to collaborative gaining knowledge of strategies, as well. With AI-facilitated group initiatives and dialogue platforms, college students can collaborate on duties, acquire steering, and song organization development via shared digital gear (Hutson et al., 2022). Those systems can encourage energetic participation and foster a experience of network among college students, even when they may be no longer physically co-located (Feng, 2025; Roschelle, Lester, & Fusco, 2020; Zawacki-Richter et al., 2019). However, researchers caution that even as AI can help collaboration, it cannot replace the nuanced, empathetic steerage a teacher provides in managing group dynamics and selling inclusive participation (Luckin & Holmes, 2016; Williamson & Eynon, 2020). A balanced technique is wanted to ensure that AI enhances, in preference to replaces, the human components of collaborative mastering.

Additionally, AI is reworking evaluation techniques, enabling a shift from standardized trying out to extra formative, ongoing assessments. Via AI, checks may be included seamlessly into the learning process, taking into account continuous remarks as opposed to periodic assessments (Baker & Siemens, 2014; Holmes, Bialik, & Fadel, 2019; Luckin & Holmes, 2016; Williamson & Eynon, 2020). This shift aligns with the instructional shift toward competency-based totally getting to know, in which college students progress primarily based on mastery of talents in place of time spent in elegance. Studies show that formative evaluation is more effective in promoting deep studying, because it encourages college students to attention on knowledge and mastery in preference to virtually accomplishing a passing grade (Holmes, Bialik, & Fadel, 2019). However, critics argue that counting on AI for evaluation can reduce the complexity of learning to quantifiable metrics, which won't completely capture college students' understanding and competencies (Kahn & Winters, 2021). The objectives of the study are to identify the level of AI and students' learning strategies at secondary level and to find the relationship between AI and students' learning strategies at secondary level.

2. Methodology

The study employs a descriptive and quantitative methodology. Most of the competitors were from Sheikhupura's secondary school district. There are 509 secondary schools in all, with 168 being public and 341 being private. Public schools had 46308 pupils, while private schools had 31215 (SIS, 2022). A multi-stage sampling procedure was used to obtain the sample. Using the stratified sample technique, the researcher first distinguished between two strata (public and private). The cluster sampling technique was then used to divide the whole population into five sections (or clusters) based on location. From each cluster, ten private and six public schools were selected. Thirty public and sixty private secondary schools provided data for the study. A sample of 600 students was selected using the basic random sampling technique. The main research instrument used in this study was a questionnaire. Expert judgments and pilot testing revealed the questionnaire's validity and reliability. Inferential and descriptive statistics were applied.

3. Data analysis

3.1. Artificial intelligence

The table illustrates the AI description on the basis of mean and standard deviation. According to the respondents responses, I am aware of what artificial intelligence (AI) is and how it is used in various applications (M=1.66; SD=0.80), I have used AI-powered educational tools or platforms for learning purposes (M=1.86; SD=0.96), AI technologies help me understand difficult concepts more easily (M=1.80; SD=0.97), AI-powered personalized learning platforms enhance my learning experience (M=2.00; SD=0.97), AI tools provide valuable feedback that helps me improve my academic performance (M=2.17; SD=1.03), I am concerned about the privacy and security of my data when using AI-powered educational platforms (M=1.95; SD=1.02), I worry about the potential bias or inaccuracies in AI algorithms affecting my learning outcomes (M=2.29; SD=1.13), I am concerned that excessive reliance on AI may hinder the development of critical thinking skills (M=1.91; SD=0.91), I believe AI will play an increasingly important role in education in the future (M=2.30; SD=1.10), I am interested in learning more about how AI can be used to enhance education (M=1.98; SD=0.05), I am satisfied with the use of AI technologies in my educational experience (M=2.08; SD=1.04), I believe that AI technologies have positively impacted my learning outcomes (M=1.96; SD=0.96), I prefer learning through AI-powered platforms over traditional teaching methods (e.g., lectures, textbooks) (M=2.19; SD=1.06), AI technologies have made learning resources and materials more accessible to me (M=2.05; SD=0.95), and I view AI as a helpful tool that complements and enhances my learning experience (M=2.00; SD=1.03). The degree of agreement was reflected in the responses from all respondents combined.

Table 1: Item-wise analysis of Artificial intelligence

Items	N	Mean	S.D.
I am aware of what artificial intelligence (AI) is and how it is used in various applications.	600	1.66	.800
I have used AI-powered educational tools or platforms for learning purposes.	600	1.86	.960
AI technologies help me understand difficult concepts more easily.	600	1.80	.972

AI-powered personalized learning platforms enhance my learning experience.	600	2.00	.970
AI tools provide valuable feedback that helps me improve my academic performance.	600	2.17	1.036
I am concerned about the privacy and security of my data when using AI-powered educational platforms.	600	1.95	1.028
I worry about the potential bias or inaccuracies in AI algorithms affecting my learning outcomes.	600	2.29	1.137
I am concerned that excessive reliance on AI may hinder the development of critical thinking skills.	600	1.91	.911
I believe AI will play an increasingly important role in education in the future.	600	2.30	1.108
I am interested in learning more about how AI can be used to enhance education.	600	1.98	1.057
I am satisfied with the use of AI technologies in my educational experience.	600	2.08	1.045
I believe that AI technologies have positively impacted my learning outcomes.	600	1.96	.967
I prefer learning through AI-powered platforms over traditional teaching methods (e.g., lectures, textbooks).	600	2.19	1.067
AI technologies have made learning resources and materials more accessible to me.	600	2.05	.953
I view AI as a helpful tool that complements and enhances my learning experience.	600	2.00	1.038

3.2. Metacognitive Strategies

The table illustrates the sample description. According to the respondents responses, I check my understanding while studying (M=1.48; SD=0.524), I plan my approach before starting a task (M=1.71; SD=0.55), I reflect on my learning after completing an assignment (M=1.69; SD=0.502). Overall, respondents' responses reflected toward the level of agreement.

Table 2: Item-wise analysis

Items	N	M	S.D.
I check my understanding while studying.	600	1.48	.524
I plan my approach before starting a task.	600	1.71	.558
I reflect on my learning after completing an assignment.	600	1.69	.502

3.3. Self-Regulated Learning

The table illustrates the sample description. According to the respondents responses, I set specific goals for my learning before starting a study session (M=1.70; SD=0.55), I monitor my progress and adjust my study strategies as needed (M=1.72; SD=0.66), I motivate myself to stay on task even when I face challenges (M=1.77; SD=0.68). Overall, respondents' responses reflected toward the level of agreement.

Table 3: Item-wise analysis

Items	N	M	S.D.
I set specific goals for my learning before starting a study session.	600	1.70	.554
I monitor my progress and adjust my study strategies as needed.	600	1.72	.662
I motivate myself to stay on task even when I face challenges.	600	1.77	.683

3.4. Elaborative Interrogation

The table illustrates the sample description. According to the respondents responses, I ask myself why the information I learn is important (M=1.67; SD=0.55), I connect new information to what I already know when studying (M=1.79; SD=0.65), I frequently pose questions about the material to deepen my understanding (M=1.78; SD=0.57). Overall, respondents' responses reflected toward the level of agreement.

Table 4: Item-wise analysis

Items	N	M	S.D.
I ask myself why the information I learn is important.	600	1.67	.551
I connect new information to what I already know when studying.	600	1.79	.652
I frequently pose questions about the material to deepen my understanding.	600	1.78	.575

3.5. Interleaved Practice

The table 5 illustrates the sample description. According to the respondents responses, I mix different subjects or topics during my study sessions (M=1.74; SD=0.64), I find it helpful to switch between various types of problems while practicing (M=1.84; SD=0.72), I believe that studying multiple topics at once improves my understanding (M=1.78; SD=0.68). Overall, respondents' responses reflected toward the level of agreement.

Table 5: Item-wise analysis

Items	N	M	S.D.
I mix different subjects or topics during my study sessions.	600	1.74	.642
I find it helpful to switch between various types of problems while practicing.	600	1.84	.722
I believe that studying multiple topics at once improves my understanding.	600	1.78	.682

3.6. Collaborative Learning

The table 6 illustrates the sample description. According to the respondents responses, I enjoy working with classmates to solve problems together (M=1.60; SD=0.60), I often discuss course material with peers to enhance my understanding (M=1.76; SD=0.63), I believe that group study sessions help me learn better (M=1.70; SD=0.57). Overall, respondents' responses reflected toward the level of agreement.

Table 6: Item-wise analysis

Items	N	M	S.D.
I enjoy working with classmates to solve problems together.	600	1.60	.608
I often discuss course material with peers to enhance my understanding.	600	1.76	.635
I believe that group study sessions help me learn better.	600	1.70	.574

Table 7: Relationship between AI and Metacognitive Strategies

		AI	Metacognitive Strategies
AI	Pearson Correlation	1	.584**
	Sig. (2-tailed)		.000
	N	600	600
Metacognitive Strategies	Pearson Correlation	.584**	1
	Sig. (2-tailed)	.000	
	N	600	600

The above table illustrates the relationship between AI and Metacognitive Strategies. The value of Pearson correlation is 0.584 which shows that there was a moderate positive relationship between AI and Metacognitive Strategies.

Table 8: Relationship between AI and Self-Regulated Learning

		AI	Self-Regulated Learning
AI	Pearson Correlation	1	.416**
	Sig. (2-tailed)		.002
	N	600	600
Self-Regulated Learning	Pearson Correlation	.416**	1
	Sig. (2-tailed)	.002	
	N	600	600

The above table illustrates the relationship between AI and Self-Regulated Learning. The value of Pearson correlation is 0.416 which shows that there was a moderate positive relationship between AI and Self-Regulated Learning.

The table illustrates the relationship between AI and Elaborative Interrogation. The value of Pearson correlation is 0.516 which shows that there was a moderate positive relationship between AI and Elaborative Interrogation.

Table 9: Relationship between AI and Elaborative Interrogation

		AI	Elaborative Interrogation
AI	Pearson Correlation	1	.516**
	Sig. (2-tailed)		.002
	N	600	600
Elaborative Interrogation	Pearson Correlation	.516**	1
	Sig. (2-tailed)	.002	
	N	600	600

Table 10: Relationship between AI and Interleaved Practice

		AI	Interleaved Practice
AI	Pearson Correlation	1	.506**
	Sig. (2-tailed)		.002
	N	600	600
Interleaved Practice	Pearson Correlation	.506**	1
	Sig. (2-tailed)	.002	
	N	600	600

The above table illustrates the relationship between AI and Interleaved Practice. The value of Pearson correlation is 0.506 which shows that there was a moderate positive relationship between AI and Interleaved Practice.

Table 11: Relationship between AI and Collaborative Learning

		AI	Collaborative Learning
AI	Pearson Correlation	1	.406**
	Sig. (2-tailed)		.002
	N	600	600
Collaborative Learning	Pearson Correlation	.406**	1
	Sig. (2-tailed)	.002	
	N	600	600

The above table illustrates the relationship between AI and Collaborative Learning. The value of Pearson correlation is 0.406 which shows that there was a moderate positive relationship between AI and Collaborative Learning.

4. Discussion

The relationship among AI and metacognitive techniques is evidenced through a moderate advantageous correlation, as indicated via a Pearson correlation value of 0.584. This correlation shows that as college students more and more interact with AI-driven gear, their use of metacognitive techniques, together with self-tracking and mirrored image, additionally has a tendency to enhance. AI structures offer actual-time comments and personalised learning paths that inspire students to mirror on their know-how and actively regulate their learning processes, fostering metacognitive cognizance (Holmes, Bialik, & Fadel, 2019; Winne & Nesbit, 2010). As a end result, AI now not most effective helps content acquisition but additionally promotes the improvement of important self-regulatory abilities, making inexperienced persons extra adept at handling their cognitive processes effectively. The slight high quality Pearson correlation of 0.416 between AI and Self-Regulated getting to know suggests that AI integration fairly helps students' capacity to adjust their mastering behaviors, consisting of intention-putting, self-tracking, and reflection. This fine relationship suggests that as AI equipment grow to be more integrated, college students are more and more empowered to take possession of their gaining knowledge of, using remarks and tips to enhance their instructional techniques and consequences. Studies has proven that AI's adaptive features, which include personalized steerage and instantaneous feedback, play a function in fostering these self-regulatory talents (Baker & Siemens, 2014; Roll & Wylie, 2016). Therefore, AI no longer most effective enhances mastering efficiency but also encourages behavior that make contributions to lengthy-time period, self-sustained instructional boom.

The connection among AI and elaborative interrogation—an instructional technique that involves asking "why" questions to deepen understanding—is fairly wonderful, with a Pearson correlation fee of 0.516. This shows that AI gear can guide and beautify elaborative interrogation with the aid of prompting newcomers to interact with content material actively and seriously. AI-pushed academic systems can generate questions tailored to each student's needs, encouraging them to hyperlink new records with prior expertise, for that reason fostering deeper learning

(Kuleto et al., 2021). Studies display that such interactions facilitate sturdier encoding of information, as AI structures can customize questioning to goal regions wherein freshmen want further elaboration (Zawacki-Richter et al., 2019).

The moderate superb correlation (r = 0.506) between AI and interleaved practice indicates that as AI-driven gear come to be more established in gaining knowledge of environments, college students can be increasingly more likely to adopt interleaved exercise strategies. Interleaved exercise, which involves mixing unique forms of problems or subjects instead of specializing in separately, has been shown to improve lengthy-term retention and adaptability in hassle-solving (Rohrer & Taylor, 2007). AI systems often assist interleaved learning through dynamically adjusting hassle kinds primarily based on pupil performance, assisting rookies to increase bendy understanding systems and avoid rote memorization (Ritter et al., 2016). For this reason, AI-pushed structures can function treasured gear for integrating interleaved exercise into observe routines, improving students' conceptual information and retention. The connection between AI and collaborative gaining knowledge of is indicated by way of a Pearson correlation of 0.406, which indicates a slight fantastic association. this implies that as AI gear end up included into educational environments, they could undoubtedly affect collaborative studying with the aid of facilitating communication, monitoring group progress, and supplying guidance thru digital systems (Roschelle, Lester, & Fusco, 2020; Williamson & Eynon, 2020). AI complements collaborative learning via developing shared virtual spaces where students can trade ideas, guide each other, and work on organization obligations even remotely. But, whilst AI gear promote collaboration, they cannot absolutely reflect the interpersonal dynamics and empathy that conventional, in-person interactions foster.

5. Conclusion

AI plays a transformative role in education, particularly in enhancing personalized and collaborative learning experiences. The objective of the study was to identify the level of AI and students' learning strategies, and to find the relationship between AI and students' learning strategies at secondary level. The study employs a descriptive and quantitative methodology. Most of the competitors were from Sheikhupura's secondary school district. There are 509 secondary schools in all, with 168 being public and 341 being private. Public schools had 46308 pupils, while private schools had 31215. The results state that AI tools enable tailored learning, immediate feedback, and facilitate group interactions, their benefits are moderated by challenges, such as reduced human interaction and potential inequalities in access. The moderate positive correlation between AI and collaborative learning underscores the potential of AI to enrich group work, though it cannot wholly replace human dynamics. For AI to fulfill its promise, a balanced approach that integrates AI's strengths while preserving essential human elements in education is crucial.

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