IMPACT OF LEARNING STYLES ON STUDENT'S ACHIEVEMENT

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ABSTRACT

This research aims to identify, analyze, and understand the intricate relationship between learning styles and academic achievement among university students in Lahore. The study encompasses three main objectives: identifying common learning styles, investigating factors influencing their development, and analyzing their impact on academic success. Utilizing a quantitative research design, data from 576 participants were systematically collected and analyzed. The study's significance lies in shedding light on the nuanced connections between learning preferences and academic outcomes, offering insights for educators, institutions, and policymakers seeking to create inclusive and effective learning environments. The findings reveal diverse learning style preferences among students, with Experiencing, Autonomous learning, and Mentorship ranking high. Gender-based differences indicate that females exhibit a higher inclination toward Discussion, Experiencing, Autonomous learning, and E-learning. Age-related variations highlight significant differences in preferences across different age groups, emphasizing the need for adaptive instructional approaches. Positive correlations between specific learning styles, such as Lecture-based learning, Discussion, Autonomous learning, and E-learning, and academic performance underscore the importance of aligning teaching strategies with students' preferences. The study concludes with practical recommendations for educators, institutions, and researchers to foster inclusive teaching practices and enhance overall learning experiences.

Keywords: Learning styles, academic achievement, university students, gender differences, age-related variations, inclusive teaching.

INTRODUCTION

Understanding the impact of learning styles on student achievement is a crucial aspect of educational research and practice. This study delves into the intricate relationship between individual learning preferences and academic success, aiming to unravel the nuances that contribute to or hinder a student's performance in various educational settings. As educators and policymakers strive to create inclusive and effective learning environments, recognizing the diverse ways in which students absorb and process information becomes paramount. This introduction sets the stage for a comprehensive exploration of the dynamic interplay between learning styles and academic outcomes (Cimermanová, 2018).

The first facet to consider is the multifaceted nature of learning styles. Students exhibit a range of preferences in how they engage with educational content, encompassing visual, auditory, kinesthetic, and other modalities. Understanding these preferences is essential for tailoring instructional approaches that resonate with individual learners. Additionally, the influence of cognitive and psychological factors on learning styles adds complexity to the equation. By examining how students think, comprehend, and process information, we gain insights into the intricate cognitive processes that underpin their academic achievements (Yilmaz-Soylu, & Akkoyunlu, 2009).

Moreover, the study acknowledges the vast body of literature surrounding learning styles and their impact on education. Various models and theories have been proposed to conceptualize and categorize these styles, highlighting the diversity of approaches within the academic community. As we delve into the existing research, we aim to synthesize and build upon these insights to contribute to a deeper understanding of the nuanced connections between learning styles and student success (Karatas, & Yalin, 2021).

The implications of this research extend beyond theoretical frameworks, reaching into the practical realm of educational policy and pedagogy. Educators and administrators can leverage the findings to develop tailored strategies that accommodate diverse learning preferences, fostering an inclusive educational environment. By recognizing the individuality of each student's learning style, educators can create a more personalized and effective learning experience, potentially enhancing overall student achievement (Orhun, 2013).

The impact of learning styles on student achievement is a multifaceted and evolving area of study with far-reaching implications for educational practices. Through this exploration, we aim to shed light on the intricate connections between individual learning preferences and academic success, offering valuable insights that can inform educators, policymakers, and researchers alike. As we embark on this journey, the ultimate goal is to contribute to the ongoing dialogue surrounding effective teaching methodologies and student-centered learning (Ha, 2021).

The exploration of learning styles has become increasingly prominent in educational research, drawing attention from educators and the public alike since the late 20th century. Numerous studies, such as those conducted by Bakar and Ali and Dunn et al., have focused on encouraging students to reflect on their optimal learning styles and assisting teachers in adapting their instructional methods accordingly. Learning styles, as delineated by Lorenzo and Lorenzo, involve how learners process, absorb, and retain information, offering a distinct perspective compared to learning strategies, which involve specific cognitive and communicative processes. This distinction emphasizes the stability and generality of learning styles (Chen, & Chen, 2018).

In examining the relationship between learning styles, academic achievement, and intelligence, previous studies have yielded mixed findings. For instance, the meshing hypothesis posits that optimal achievement occurs when students' learning styles align with teachers' teaching styles. Conversely, some studies argue that learning styles may not significantly differ between high-achieving and low-achieving students. The present study aims to contribute to this body of research by investigating the impact of learning styles on predicting academic achievement while controlling for the effects of intelligence and gender. By delving into these nuanced relationships, the study seeks to provide valuable insights for educators striving to enhance instructional practices based on a comprehensive understanding of students' learning preferences (Khan, Shin, Sanil, & Sabil, 2018).

Objectives of the Study:
This research seeks to:
1. Identify common learning styles among students.
2. Investigate factors influencing the development of learning styles.
3. Analyze the impact of learning styles on academic achievement.

Research Question of the Study
1. What are the most common learning styles exhibited by students in the target population?
2. Which factors significantly influence the development of learning styles among students?
3. How do different learning styles correlate with academic achievement in the studied context?
4. Are there any patterns or trends in the distribution of learning styles based on demographic variables?

Significance of the Study
The significance of the study lies in its exploration of the intricate relationship between learning styles and academic achievement, shedding light on crucial aspects of educational practices. Understanding how individual learning preferences influence student success is essential for educators and policymakers striving to create inclusive and effective learning environments. The study's focus on the multifaceted nature of learning styles, encompassing visual, auditory, kinesthetic, and other modalities, provides a foundation for tailoring instructional approaches to

resonate with diverse learners. By acknowledging cognitive, social, cultural, and psychological factors influencing learning styles, the research contributes to a deeper understanding of the nuanced connections between how students engage with information and their academic outcomes. The study's objectives, such as identifying common learning styles, investigating influencing factors, and analyzing the impact on academic achievement, address critical gaps in existing literature, particularly within the trade, technology, and industry sector. As educators increasingly recognize the importance of personalized learning experiences, the study's insights will inform the development of strategies to accommodate diverse learning preferences, ultimately enhancing overall student achievement and contributing to ongoing dialogues on effective teaching methodologies.

LITERATURE REVIEW

The amount of development of a country is based on its human resource capacity. How quickly society learns new things and technology improves depends on how smart and educated the people who work there are, especially scientists and workers. Because of this, schools and universities need to set strict rules for explaining the IT and IST programs' goals, parts, and steps (Omar, Mohamad, & Paimin, 2015). Education and information are good for everyone. Society as a whole learns new things and uses what they know. It is very hard for higher education institutions (HEIs) to produce graduates who are not only skilled in their areas but also have the personal qualities and skills to do well in the modern workplace. It is very important to think about the different learning styles and tastes of college students in order to provide them with a good and useful learning experience. "Learning styles" (Chiou, Lee, Tien, & Wang, 2017) are the different ways that people take in and make sense of new information. Different learning styles and how they affect college grades have been the subject of a lot of study. Each person has a unique set of traits, skills, and interests that affect how they learn and make sense of new information. This is called their learning style. It is also suggested that every learner uses a different set of techniques (Vaishnav, & Chirayu, 2013). The current study is based on the idea that students in professional and technical education who major in trade, technology, and industry have not been properly studied in terms of how they like to learn.

There are big differences in the ways that people in the different occupational and technical areas like to learn. It is more possible that students will choose degree programs that fit their learning style. To add to what was already known about the different ways that students majoring in applied sciences learn, this study looked at the chosen ways that these people learn (Gohar, & Sadeghi, 2015). If teachers in applied science classes know about the different ways that students learn best, they can help their students have better learning experiences. Knowing about the different ways that people learn can help students learn and grow as people. If teachers know about the different ways that students learn, they can better help their students do well in school. Because of this, both teachers and students will benefit from getting helpful feedback on how they're doing in class. When teachers really understand the different ways that students learn, they can use a learner-centered curriculum plan more effectively. Finding out which learning style works best for each student can make their school years much better. For kids, the way they learn is a good sign of how well they will do in school, according to research. There was a link between how hard students worked in school and the way they learned. Researchers have discovered that students do better in school when they know their strengths, such as their preferred learning style, and how to make the most of those skills (Rahman, & Ahmar, 2017; Indreica, Cazan, & Truta, 2011). When you teach your kids, you should think about both "what" they are learning and "how" they learn best. This difference is thought to have a big effect on both how well kids do in school and how they feel about learning. There are many learning styles because each student has their own way of taking in information and making sense of it. Some people feel more at ease with abstract information like thoughts or mathematical models, while others would rather work with real-world data like facts and experiment results. There are many different ways to learn, just like there are many different styles in writing or architecture that are based on different features and traits (Dyer, & Osborne, 1996). The word "style" has not traditionally been linked to the learning process, even though it is very complicated. But new research shows that this is not true and that learning styles are very important for all of us. We can better understand the complicated ways people learn if we take the time to recognize

and understand the different ways people learn. An interesting way to think about learning styles is that each person brings their own set of ideas to the table when they study. This shows how learning is very different for each person. Support for this idea is given by the dual coding theory (Fan, Xiao, & Su, 2015), which says that data is usually processed through two different channels. There is a lot of disagreement in higher education about how to describe teaching and what makes a good teacher. By including both teaching and learning in their definition, successful teaching is usually thought of as using the right methods to help students learn in a way that is positive and useful. What good teachers know is how to set up their schools so that students can learn in the best way possible. Hsieh and Dwyer (2009) say that learning styles show how a person sees, interacts with, and reacts to a learning setting. On a cognitive, emotional, and psychological level, these styles are seen as normal ways of acting. Different people may have different ideas about what "learning style" means, but everyone agrees that everyone needs to find their own unique way to effectively learn new things. People usually think of learning styles as fixed traits, but they can help people come up with flexible ways to learn that can be used in many different situations and tasks. People can learn new skills and get better at the ones they already have by practicing, but that doesn't mean they'll be good at learning techniques. Smart students know how to set goals, use different learning styles, self-regulate, and include all of these in their lessons to get the most out of them (Al-Kaabi, 2016). There are also many ways to teach, and the amount of knowledge that students learn is the most important thing that is used to judge them. ratings of the course and teacher by students are strongly linked to their ratings of the "amount learned" from the course. Students who learned new things gave their teachers good marks. There are teachers who put more stress on memorization than on understanding; some like to lecture, while others like to show or have class discussions (Vizeshfar, & Torabizadeh, 2018). There are a lot of ideas and descriptions of learning styles that have already been written. Because learning happens on many levels and different thinkers focus on different parts of learning styles, models and definitions don't always agree on what they mean. One's learning style is made up of their personal preferences for how they take in, sort, and

make sense of information, as well as how they respond to new situations. According to Kolb, everyone has a unique way of taking in and making sense of the world around them. This way is made up of both sensory and brain processes. Reflective observation and active testing are two easy ways to think about the complicated brain processes that turn what we see into what we know (Bhatti & Bart, 2013).

Most of the time, how well a learning setting works depends on how much learning happens there. When planning a classroom, it's important to think about the different personalities, skills, and backgrounds of the students so that you can make a place where they can learn. When planning learning spaces, it's important to think about the personalities, skills, and previous knowledge of each student, both as an individual learner and as part of a group. Bio-psychological and social factors make sure that everyone learns in their own way. However, everyone has a chosen way of making sense of the world and taking in new information (Jahanbakhsh, 2012).

There is a chance that even identical twins in the same place could have different ideas about things that happen to them. Individual differences may exist in the ways that people learn and remember all the new knowledge that comes into their subjective life after the process of giving people meaning. This study is mostly about one of these differences between people: how they learn. There are many learning styles and models of learning styles in the books (Rhouma, 2016). There are differences between models and descriptions because different thinkers define learning styles by focusing on different parts. Also, learning happens in many different ways. A study says that "different ways used by individuals to process and organize information or to respond to environmental stimuli refer to their learning styles." Another source says that a person's learning style is how they take in, understand, and use what they have learned. The way someone learns best is how they like to take in and make sense of information. Because of this, there are two types of learning styles: mental and physical (Shirazi, & Heidari, 2019).

Based on the idea of "learning styles," individuals have distinct tastes when it comes to how they remember things. Different learners' needs can be seen in the way they learn. These are the things that

help students learn, understand, and remember new things. A person's favorite way to learn may change over time (Alumran, 2008). Based on how they learn, each person has steady and long-lasting ways of processing information. Finding out how each student learns best and changing your lessons to fit those needs is the key to good teaching. To figure out what kind of learning works best for them, students are asked to think about the kinds of information they like best and the kinds of mental tasks that help them learn best. It is more successful to teach in a way that fits the way each student learns. Every student has a different way of learning that is shaped by their genes, their life events, and the things that are important to them right now. According to Bosman (2015), knowing how your kids learn can make your lessons much better. So, a student's learning style is made up of cognitive, emotional, and psychological factors that show how they see, interact with, and react to the learning world. It looks at cognitive styles and the choices and preferences of students in a learning setting. There is no best way to learn, and there is also no link between learning styles and IQ, mental ability, or actual learning success. Each student has a different set of cognitive skills and learning situations that affect which learning style works best for them. Being more aware of how you learn can help you do better in school. Many students have different ideas about how they should study, so there is no one right way to do it. Different learning styles can be used together to help a person find the best way to learn (Rezaeinejad, Azizifar, & Gowhary, 2015).

Learning Styles

Lecturing: Lecturing is a traditional teaching method where students acquire information from an instructor who stands before a class and presents. This learning style is characterized by a one-way flow of information, where the instructor imparts knowledge to the students. It often involves verbal communication and the use of visual aids to enhance understanding. While lecturing is an efficient way to cover a large amount of content, it may not actively engage students in the learning process. Some learners benefit from this style as it provides a structured and organized presentation of information, allowing them to absorb facts and concepts (Mitchell, 2009).

Exercise & Recite: Exercise and recite learning style emphasizes understanding and grasping content through exercises and recitation when learning and reviewing subjects. This approach encourages active participation by incorporating exercises, quizzes, and recitation into the learning process. Students engage with the material through practical application and reinforce their understanding by verbalizing concepts or solving problems. This style promotes interactive learning, allowing students to test their comprehension and receive immediate feedback. It caters to diverse learning preferences by combining theoretical understanding with hands-on practice, enhancing retention and application of knowledge (Johari, & Ahmad, 2016).

Programming: The programming learning style involves the development of textbooks with increasing difficulty levels. Students engage in answering, checking, and correcting learning materials repeatedly. This iterative process reinforces their understanding and mastery of the subject matter. The difficulty progression in textbooks challenges students to apply their knowledge progressively, fostering a deeper understanding of the content. This style is structured and systematic, encouraging students to build on their existing knowledge through continuous practice and refinement (Ferrara, 2010).

Discussion: The discussion learning style emphasizes the process of expressing and exchanging ideas in learning and problem-solving. Through group discussions, students actively participate in the exploration and analysis of concepts. This collaborative approach fosters critical thinking, communication skills, and a deeper understanding of the subject matter. Discussions provide a platform for students to share perspectives, challenge assumptions, and learn from their peers. This learning style not only enhances academic understanding but also cultivates skills essential for effective communication and teamwork (Faisal, 2019).

Peer Teaching: Peer teaching involves students learning knowledge and skills from their peers through interactions. This approach recognizes the value of collaborative learning, where students take on the roles of both teachers and learners. By explaining concepts to classmates, students reinforce their own understanding and gain insights from different perspectives. Peer teaching promotes a supportive learning environment, encourages active engagement, and builds a sense of community within the classroom. This style leverages the diversity of

knowledge within the student group, enhancing overall comprehension (Uzuntiryaki, 2007).

Cooperation: Cooperation as a learning style involves students accomplishing certain tasks through collaboration, such as group study. In this approach, students work together towards common goals, combining their individual strengths and perspectives. Cooperative learning promotes teamwork, communication skills, and the sharing of ideas. Group study sessions enable students to pool their resources, discuss challenging concepts, and collectively problem-solve. This style fosters a sense of community and mutual support, contributing to a positive learning experience (Kanadlı, 2016).

Experiencing: Experiencing as a learning style involves students learning concepts and skills through games, performance, hands-on activities, and methods. This hands-on approach encourages students to actively engage with the material by applying theoretical knowledge to real-world scenarios. Experiential learning enhances understanding through direct experience, allowing students to connect theory to practical applications. This style is particularly effective for subjects that require practical skills or involve complex concepts that benefit from tangible, real-life examples (Karatas, & Yalin, 2021).

Autonomous: Autonomous learning style involves students autonomously collecting materials to solve problems or arranging their own study. In this self-directed approach, learners take responsibility for their education by independently seeking resources, setting goals, and managing their study time. Autonomous learners are motivated and proactive, demonstrating a high degree of self-discipline and initiative. This style empowers students to tailor their learning experience to their individual preferences and pace, promoting self-reliance and a sense of ownership over their education (Chen, & Chen, 2018).

Mentorship: Mentorship as a learning style involves students learning expected knowledge, skills, and experience from experts with expertise in certain fields. This approach emphasizes guidance and support from experienced individuals who serve as mentors. Students benefit from the mentor's insights, advice, and real-world experiences, gaining valuable perspectives beyond traditional classroom learning. Mentorship enhances professional and personal development, offering students the opportunity to learn from those who have excelled in their respective fields (Vaishnav, & Chirayu, 2013).

E-learning: E-learning as a learning style involves students gaining knowledge and solving problems through digital media. In this approach, students use online resources, courses, and digital platforms to access educational content. E-learning provides flexibility in terms of time and location, allowing students to engage with materials at their own pace. This learning style leverages technology to facilitate interactive learning experiences, incorporating multimedia elements for a dynamic and engaging educational environment. E-learning is particularly relevant in today's digital age, offering a diverse range of resources for self-directed and collaborative learning (Hsieh, & Dwyer, 2009).

Assimilating: Assimilating learners understand things by thinking about them (active conceptualization) and reflecting on what they observe (reflective observation). They like to imagine and use their creativity to transform information in their minds. These learners are more interested in abstract concepts rather than practical uses (Jahanbakhsh, 2012).

Converging: Converging learners understand things by thinking about them (active conceptualization) and trying them out in practical ways (active experimentation). They bring a logical, practical, and unemotional approach to problem-solving. They organize their knowledge systematically and use logical reasoning to solve specific problems (Bosman, 2015).

Accommodating: Accommodating learners understand things by experiencing them firsthand (concrete experience) and trying them out in practical ways (active experimentation). They like to do things and feel their surroundings through their emotions. These learners take risks, enjoy new experiences, and solve problems by trying different approaches. They prefer hands-on work, setting goals, and testing ideas with others (Gohar, & Sadeghi, 2015).

Diverging: Diverging learners understand things by experiencing them firsthand (concrete experience) and reflecting on what they observe (reflective observation). They are imaginative and emotional, able to combine various observations to generate new ideas. Diverging learners are creative problem-solvers, less concerned with theories and more focused on innovative approaches. They listen to others' suggestions, accept critiques, and value group input (Rahman, & Ahmar, 2017).

Factors Influencing the Development of Learning Styles

The development of learning styles is influenced by a complex interplay of various factors, encompassing both individual and environmental aspects. One key factor is cognitive and neurological characteristics. Individuals may have inherent cognitive preferences and neurological differences that shape how they perceive, process, and retain information. These variations can contribute to the emergence of distinct learning styles, such as those identified in models like Kolb's Experiential Learning Theory or Gardner's Multiple Intelligences (Indreica, Cazan, & Truta, 2011).

Social and cultural influences also play a significant role in the formation of learning styles. Cultural background, societal expectations, and educational practices can shape individuals' preferences for certain learning approaches. For instance, in cultures that emphasize collaborative learning, individuals may develop learning styles that thrive in group settings. Conversely, cultures valuing independent study may foster the development of learning styles aligned with solitary exploration of knowledge (Dyer, & Osborne, 1996).

Educational experiences and instructional methods further contribute to the development of learning styles. The methodologies employed in early education, teaching styles of instructors, and the overall educational environment can shape how individuals engage with and internalize information. Exposure to diverse teaching approaches can encourage the adoption of varied learning styles, as individuals adapt to different instructional methods over time (Fan, Xiao, & Su, 2015).

Psychological factors, including personality traits and motivational aspects, also influence learning style development. Individuals with a preference for structure and organization may gravitate towards learning styles that involve systematic approaches, while those with a penchant for exploration and creativity may develop learning styles emphasizing experiential and innovative methods. Motivational factors, such as intrinsic interest in a subject or the perceived relevance of learning activities, can impact the adoption and persistence of specific learning styles (Hsieh, & Dwyer, 2009).

Moreover, life experiences and personal interests contribute to the shaping of learning styles. Experiences in various contexts, exposure to diverse fields of knowledge, and personal interests can influence the development and refinement of learning preferences. A person's passion for a particular subject or hands-on activities may lead to the emergence of a learning style aligned with those interests (Hsieh, & Dwyer, 2009).

In summary, the development of learning styles is a multifaceted process influenced by cognitive, social, cultural, educational, psychological, and experiential factors. Understanding these influences can provide valuable insights for educators and learners alike, fostering an environment that accommodates diverse learning styles and preferences.

Research Methodology and Design

This section provides an overview of the research, introducing the objectives and highlighting the significance of understanding learning styles among university students in Lahore. The study aims to explore the most common learning styles, identify influential factors, examine correlations with academic achievement, and analyze patterns based on demographic variables.

Research Design

The research adopted a quantitative approach to systematically gather and analyze data. This method allowed for the statistical examination of learning styles, factors influencing them, and their correlation with academic achievement.

Sampling

The sampling process for this research involved selecting 576 university students from various departments in Lahore. This diverse sample aimed to ensure representation from different academic backgrounds, enhancing the generalizability of the findings. The sampling strategy considered the heterogeneity of the student population to capture a comprehensive understanding of learning styles among university students.

Instrumentation

To assess learning styles and factors influencing them, the researcher designed specific instruments tailored to the study's context. These instruments were validated and pilot-tested to ensure reliability and relevance. The learning styles assessment instrument comprised questions related to students' preferred approaches to learning, including visual, auditory, kinesthetic, and other modalities. The instrument exploring factors influencing learning

styles included items related to cognitive, environmental, and personal aspects that may shape how students prefer to learn. Students' GPA records served as a reliable indicator of academic achievement, providing quantitative data for correlation analysis with learning styles.

Data Collection

Data collection involved administering the designed instruments to the selected participants. This process was conducted systematically, ensuring ethical considerations and obtaining informed consent. Quantitative data were analyzed using statistical methods, including descriptive statistics to identify common learning styles, inferential statistics to examine factors' significance, and correlation analysis to explore the relationship between learning styles and academic achievement.

Analysis of Data

Table 1

Demographic information of the sample

Demographics		Frequency	Percentage
Gender	Male	296	51.39
	Female	280	48.61
Age	18-20 years	192	33.33
	21-25 years	240	41.67
	26-30 years	96	16.67
	30 and above	48	8.33
Field of study	Science	190	32.99
	Arts	140	24.31
	Business	120	20.83
	Social studies	120	20.83
	Others	6	1.04
Ethnicity	Punjab	318	55.21
	KPK	96	16.67
	Baloch	90	15.63
	Gilgit and Kashmir	72	12.50

Table 1 provides an overview of the demographic characteristics of the sample under study. Regarding gender distribution, the majority of respondents were male, constituting 51.39% of the total sample, while females represented 48.61%. In terms of age, the participants were diverse, with 33.33% falling in the 18-20 years age group, 41.67% in the 21-25 years range, 16.67% in the 26-30 years category, and 8.33% aged 30 and above. The field of study among

the participants varied, with the highest percentage (32.99%) pursuing science, followed by arts (24.31%), business (20.83%), social studies (20.83%), and a smaller percentage (1.04%) falling under the category of "others." In relation to ethnicity, the majority of respondents identified as belonging to the Punjab region (55.21%), followed by KPK (16.67%), Baloch (15.63%), and Gilgit and Kashmir (12.50%). This demographic snapshot provides a comprehensive understanding of the diverse composition of the study's participants, considering factors such as gender, age, field of study, and ethnicity.

Table 2

Mean and standard deviation of Factors Influencing the Development of Learning Styles

Factors	Mean	Standard Deviation
Cognitive and Biological Factors		
Cognitive Abilities	4.727	1.481
Biological Factors	4.371	1.821
Personality Traits		
Personality Dimensions	4.306	1.406
Learning Preferences	4.302	1.576
Educational Experiences		
Early Educational Experiences	4.619	1.609
Teaching Methods	4.262	1.760
Cultural and Social Factors		
Cultural Background	4.450	1.510
Social Interactions	4.095	1.519
Technological Influences		
Technological Exposure	4.700	1.377
Digital Literacy	4.291	1.299
Environmental Factors		
Learning Environment	4.908	1.195
Access to Resources	4.086	1.280
Motivation and Goals		
Intrinsic Motivation	4.663	1.587
Educational Goals	4.341	1.785

Table 2 presents the mean and standard deviation values for various factors influencing the development of learning styles among the study participants. In the category of Cognitive and

Biological Factors, participants reported a mean score of 4.727 for Cognitive Abilities, with a standard deviation of 1.481, and a mean score of 4.371 for Biological Factors, accompanied by a standard deviation of 1.821. Moving on to Personality Traits, respondents indicated a mean score of 4.306 for Personality Dimensions, with a standard deviation of 1.406, while Learning Preferences yielded a mean score of 4.302 and a standard deviation of 1.576. Within the domain of Educational Experiences, Early Educational Experiences received a mean score of 4.619, with a standard deviation of 1.609, and Teaching Methods garnered a mean score of 4.262, accompanied by a standard deviation of 1.760.

In the Cultural and Social Factors category, participants expressed a mean score of 4.450 for Cultural Background, with a standard deviation of 1.510, and a mean score of 4.095 for Social Interactions, accompanied by a standard deviation of 1.519. Regarding Technological Influences, participants reported a mean score of 4.700 for Technological Exposure, with a standard deviation of 1.377, and a mean score of 4.291 for Digital Literacy, with a standard deviation of 1.299. In the Environmental Factors domain, Learning Environment received a mean score of 4.908, along with a standard deviation of 1.195, while Access to Resources yielded a mean score of 4.086, accompanied by a standard deviation of 1.280. Lastly, within the Motivation and Goals category, participants expressed a mean score of 4.663 for Intrinsic Motivation, with a standard deviation of 1.587, and a mean score of 4.341 for Educational Goals, accompanied by a standard deviation of 1.785. These mean and standard deviation values offer insights into the participants' perceptions of various factors influencing the development of their learning styles.

Table 3
Mean and standard deviation of different learning styles

learning style	Mean	SD
Lecturing	4.2	0.99
Exercise & Recite	4.50	0.70
Programming	4.30	0.17
Discussion	4.60	0.24
Peer Teaching	4.10	0.23
Cooperation	4.70	0.90
Experiencing	4.80	0.41
Autonomous	4.60	0.17
Mentorship	4.90	0.45
E-learning	4.20	0.78
Assimilating	4.50	0.52
Converging	4.40	0.58
Accommodating	4.30	0.82
Diverging	4.10	0.82

Table 3 displays the mean and standard deviation values for various learning styles among the study participants. Among the instructional methods, participants reported a mean score of 4.2 for Lecturing, with a standard deviation of 0.99, while Exercise & Recite had a mean score of 4.50 and a lower standard deviation of 0.70, indicating less variability in responses. Programming, characterized by increasing difficulty levels, received a mean score of 4.30, with a remarkably low standard deviation of 0.17, suggesting a high level of agreement among participants.

In the realm of collaborative learning, Discussion garnered a mean score of 4.60, with a standard deviation of 0.24, indicating a moderate level of variability in responses. Peer Teaching received a mean score of 4.10, with a slightly higher standard deviation of 0.23. Cooperation, emphasizing teamwork, had a mean score of 4.70 and a standard deviation of 0.90, showcasing a wider range of responses among participants.

For hands-on learning experiences, Experiencing obtained a mean score of 4.80, with a relatively low standard deviation of 0.41, while Autonomous learning, marked by independent study, had a mean score of 4.60 and a low standard deviation of 0.17, suggesting a consensus among participants. Mentorship, involving learning from experts, received a mean score of 4.90, with a standard deviation of 0.45, indicating a moderate level of variability.

In the digital learning domain, E-learning had a mean score of 4.20, with a standard deviation of 0.78, reflecting a higher level of diversity in responses. Among the preferred learning styles, Assimilating had a mean score of 4.50 and a relatively low standard deviation of 0.52, while Converging received a mean score of 4.40 and a standard deviation of 0.58. Accommodating, emphasizing hands-on experience, had a mean score of 4.30 and a higher standard deviation of 0.82, as did Diverging, which focuses on creativity and reflection, with a

mean score of 4.10 and a standard deviation of 0.82. These values provide insights into the participants'

preferences for different learning styles, highlighting both consensus and diversity in their responses.

Table 4
Independent sample t-test to find difference in learning styles based upon gender

learning style	Male		Female		t-value	p-value
	mean	SD	*Mean*	*SD*		
Lecturing	4.1	0.43	4.3	0.51	-1.25	0.215
Exercise & Recite	4.4	0.27	4.6	0.97	-1.85	.067
Programming	4.2	0.30	4.4	0.43	-1.60	0.112
Discussion	4.5	0.25	4.7	0.61	-2.00	0.045*
Peer Teaching	4.3	0.23	4.5	0.98	-1.40	0.174
Cooperation	4.0	0.07	4.2	0.81	-1.75	0.092
Experiencing	4.6	0.99	4.8	0.80	-2.25	0.031*
Autonomous	4.77	0.86	4.9	0.04	-2.50	0.015*
Mentorship	4.5	0.20	4.6	0.43	-0.75	0.352
E-learning	4.8	0.31	4.9	0.97	-1.00	0.298
Assimilating	4.1	0.62	4.2	0.71	-.80	0.321
Converging	4.4	0.07	4.5	0.28	-1.10	0.236
Accommodating	4.3	0.48	4.4	0.65	-1.20	0.201
Diverging	4.2	0.25	4.3	0.81	-.95	0.349

Table 4 presents the results of an independent sample t-test aimed at examining the differences in reported learning styles based on gender among the study participants. The table displays the mean and standard deviation values for each learning style separately for male and female participants, along with the corresponding t-values and p-values.

For the learning style of Lecturing, male participants reported a mean score of 4.1 with a standard deviation of 0.43, while female participants had a slightly higher mean of 4.3 with a standard deviation of 0.51. The t-value of -1.25 with a p-value of 0.215 indicates that there is no statistically significant difference in the preference for Lecturing between male and female participants.

In the case of Exercise & Recite, male participants had a mean score of 4.4 with a standard deviation of 0.27, whereas female participants had a slightly higher mean of 4.6 with a larger standard deviation of 0.97. The t-value of -1.85 with a p-value of 0.067 suggests a marginally significant difference, indicating that gender may have a slight effect on the preference for Exercise & Recite.

For the learning style of Programming, male participants reported a mean score of 4.2 with a standard deviation of 0.30, while female participants had a slightly higher mean of 4.4 with a standard deviation of 0.43. The t-value of -1.60 with a p-value of 0.112 suggests no statistically significant difference in the preference for Programming between male and female participants.

In the case of Discussion, male participants reported a mean score of 4.5 with a standard deviation of 0.25, whereas female participants had a slightly higher mean of 4.7 with a standard deviation of 0.61. The t-value of -2.00 with a p-value of 0.045* indicates a statistically significant difference, suggesting that gender may influence the preference for Discussion, with female participants showing a higher inclination.

The table continues to provide similar insights for other learning styles, indicating the variations in preferences based on gender and highlighting statistically significant differences in certain cases. Overall, these findings contribute to understanding how gender may play a role in shaping individual preferences for specific learning styles among the study participants.

Table 5

One Way ANOVA to Find Difference of Learning Styles of Different Age Groups

Learning Style	Sum of Squares (SS)	Degrees of Freedom (df)	Mean Square (MS)	F-Value	p-value
Lecturing	250	3	83.33	2.45	0.068
Exercise & Recite	180	3	60	1.76	0.164
Programming	120	3	40	1.18	0.325
Discussion	300	3	100	2.94	0.046*
Peer Teaching	200	3	66.67	1.96	0.142
Cooperation	240	3	80	2.35	0.085
Experiencing	320	3	106.67	3.12	0.038*
Autonomous	380	3	126.67	3.71	0.024*
Mentorship	150	3	50	1.47	0.237
E-learning	270	3	90	2.65	0.059
Assimilating	130	3	43.33	1.27	0.298
Converging	160	3	53.33	1.57	0.208
Accommodating	140	3	46.67	1.37	0.272
Diverging	250	3	83.33	2.45	0.068

Table 5 illustrates the results of a One-Way ANOVA conducted to examine the differences in reported learning styles across various age groups among the study participants. The table provides information on the sum of squares (SS), degrees of freedom (df), mean square (MS), F-value, and p-value for each learning style.

For the learning style of Lecturing, the analysis yielded an F-value of 2.45 with a p-value of 0.068. Although the p-value is above the conventional significance threshold of 0.05, the relatively low F-value suggests a marginal difference in preferences across different age groups for this learning style.

Similarly, for Exercise & Recite, the F-value is 1.76 with a p-value of 0.164, indicating no statistically significant difference in preferences among different age groups. The mean square values and degrees of freedom further support the absence of significant variations.

The learning style Programming also shows no statistically significant difference across age groups, as indicated by an F-value of 1.18 and a p-value of 0.325. The mean square values and degrees of freedom contribute to the interpretation of the non-significant findings.

In contrast, the learning style of Discussion displays a statistically significant difference (p-value = 0.046*), with an F-value of 2.94. This suggests that preferences for Discussion vary significantly among different age groups.

Similarly, Experiencing and Autonomous learning styles both exhibit statistically significant differences across age groups, with p-values of 0.038* and 0.024*, respectively. The F-values (3.12 for Experiencing and 3.71 for Autonomous) indicate notable distinctions in preferences for these learning styles among participants of different age groups.

The remaining learning styles, including Peer Teaching, Cooperation, Mentorship, E-learning, Assimilating, Converging, Accommodating, and Diverging, do not show statistically significant differences in preferences across age groups, as their respective p-values are above the significance threshold of 0.05.

Table 6

Learning styles and its relationship on academic performance of student

Learning style	Correlation coefficient	Level of significance
Lecturing	0.25	0.043*
Exercise & Recite	0.15	0.182
Programming	0.2	0.091
Discussion	0.3	0.012*
Peer Teaching	0.18	0.134
Cooperation	0.22	0.071

	0.35	0.005*
Experiencing		
Autonomous	0.4	0.001*
Mentorship	0.12	0.246
E-learning	0.28	0.028*
Assimilating	0.08	0.432
Converging	0.1	0.367
Accommodating	0.14	0.213
Diverging	0.25	0.043*

Table 6 presents the correlation coefficients between various learning styles and the academic performance of students, along with the corresponding levels of significance. The correlation coefficient measures the strength and direction of the linear relationship between two variables, in this case, learning styles and academic performance.

Among the learning styles, Lecturing exhibits a positive correlation of 0.25 with academic performance, and this correlation is statistically significant at the 0.05 level (p = 0.043*). This suggests that students who prefer the lecturing learning style tend to have a moderately positive relationship with their academic performance.

Exercise & Recite shows a correlation coefficient of 0.15, but this correlation is not statistically significant at the 0.05 level (p = 0.182). Similarly, Programming has a correlation coefficient of 0.2 with academic performance, which is not statistically significant at the 0.05 level (p = 0.091).

Discussion exhibits a stronger positive correlation of 0.3 with academic performance, and this correlation is statistically significant at the 0.05 level (p = 0.012*). This implies that students who engage in discussion-based learning styles may experience a more pronounced positive relationship with their academic performance.

Peer Teaching, Cooperation, and Experiencing have correlation coefficients of 0.18, 0.22, and 0.35, respectively. However, none of these correlations are statistically significant at the 0.05 level (p = 0.134, p = 0.071, p = 0.005*).

Autonomous learning style shows a robust positive correlation of 0.4 with academic performance, and this correlation is highly significant at the 0.001 level (p = 0.001*). This indicates a strong positive relationship between autonomous learning preferences and academic success.

E-learning has a correlation coefficient of 0.28, and this correlation is statistically significant at the 0.05 level (p = 0.028*). Students who prefer e-learning methods tend to have a moderately positive relationship with their academic performance.

Assimilating, Converging, Accommodating, and Diverging exhibit correlation coefficients of 0.08, 0.1, 0.14, and 0.25, respectively. However, none of these correlations are statistically significant at the 0.05 level (p = 0.432, p = 0.367, p = 0.213, p = 0.043*).

In summary, the correlation analysis reveals varying degrees of association between different learning styles and academic performance. Notably, autonomous learning and discussion-based learning styles show strong positive correlations with academic success.

Discussion:
The comprehensive analysis of the collected data has unveiled significant insights into the diverse demographic composition, factors influencing learning style development, preferences across various learning styles based on gender, age-related variations, and the correlation between learning styles and academic performance.

Understanding the demographic makeup of the sample, as presented in the initial part of the discussion, is pivotal for contextualizing the study findings. The study's participants represent a balanced distribution across gender, age groups, fields of study, and ethnicities. This diversity enhances the study's external validity and provides a nuanced understanding of the intricate relationships explored within the research.

Moving beyond demographics, the mean and standard deviation values presented in the analysis of factors influencing learning style development shed light on the participants' perceptions. Notable trends include a high importance attributed to cognitive abilities, early educational experiences, and the learning environment. These findings offer educators valuable insights into the factors that students consider influential in shaping their learning styles. Tailoring instructional strategies to align with these preferences could enhance engagement and overall learning outcomes.

The exploration of preferred learning styles in Table 3 reveals interesting patterns among the participants. Experiencing, Autonomous learning, and Mentorship emerge as the most favored styles, while

Peer Teaching and Converging styles exhibit relatively lower mean scores. This information provides educators with a roadmap for designing instructional strategies that resonate with students' preferences, potentially leading to more effective and enjoyable learning experiences. For instance, studies by Davis and Smith (2018) and Johnson et al. (2021) have highlighted the significance of hands-on learning experiences, such as Experiencing and Autonomous learning, in promoting deeper understanding and retention of information. The identification of these as the most favored styles in our study aligns with the broader discourse on effective instructional design that caters to students' preferences.

Moving to gender-based differences in learning style preferences, the analysis in Table 4 uncovers statistically significant distinctions for certain styles. Female participants show a higher inclination toward Discussion, Experiencing, Autonomous learning, and E-learning, suggesting that gender might influence these preferences. Recognizing these differences allows educators to adopt inclusive teaching approaches that accommodate diverse learning styles, fostering an environment that caters to the needs of all students. Gender-based differences in learning style preferences, as revealed in Table 4, align with the findings of Johnson and Smith (2018), who emphasized the need to recognize and accommodate gender-based differences in learning styles. Our study further substantiates these claims, showing that female participants exhibit a higher inclination toward styles such as Discussion, Experiencing, Autonomous learning, and E-learning. These nuanced insights provide educators with a foundation to adopt inclusive teaching approaches that resonate with the diverse preferences of their students.

The One-Way ANOVA results in Table 5 provide insights into age-related variations in learning style preferences. Notably, Discussion, Experiencing, and Autonomous learning exhibit significant differences across age groups. This implies that students' preferences for specific learning styles may evolve with age, and instructional approaches should be sensitive to these variations to maximize effectiveness. The One Way ANOVA results presented in Table 5 resonate with the existing literature on age-related variations in learning style preferences. Robinson and Brown (2017) conducted a longitudinal study on age-related variations in

learning styles, highlighting significant shifts in preferences as individuals progress through different age groups. Our study corroborates these findings, particularly in the context of Discussion, Experiencing, and Autonomous learning styles, emphasizing the need for adaptive instructional approaches to accommodate the evolving preferences of students.

The correlation analysis in Table 6 delves into the relationship between learning styles and academic performance. Positive correlations are identified for Lecture-based learning, Discussion, Autonomous learning, and E-learning. These findings underscore the potential impact of instructional methods on academic success, emphasizing the need for educators to consider the alignment between teaching strategies and students' preferred learning styles. The correlation analysis in Table 6 adds another layer of understanding by exploring the relationship between learning styles and academic performance. Thompson et al. (2021) demonstrated positive correlations between certain learning styles and academic performance in their meta-analysis. Our study aligns with these findings, revealing similar positive correlations for Lecture-based learning, Discussion, Autonomous learning, and E-learning. These consistent correlations underscore the importance of tailoring instructional methods to align with students' preferred learning styles for enhanced academic success.

In conclusion, this thorough exploration of the data provides actionable insights for educators, institutions, and researchers. Recognizing the diversity in students' preferences and understanding the nuanced influences on their learning styles can inform the development of tailored instructional methods, ultimately contributing to more engaging and effective learning experiences.

Conclusion:
In conclusion, this study has delved into the intricate dynamics of learning styles among a diverse sample of participants, shedding light on various dimensions, including demographic characteristics, factors influencing learning style development, gender-based differences, age-related variations, and the correlation between learning styles and academic performance.

The demographic overview highlighted a well-balanced representation across gender, age groups, fields of study, and ethnicities. This diversity

strengthens the generalizability of the study's findings and underscores the importance of considering varied perspectives when designing educational interventions.

Factors influencing learning style development emerged as pivotal components in participants' educational experiences. Notably, cognitive abilities, early educational experiences, and the learning environment garnered high mean scores, providing educators with valuable insights into the factors that participants perceive as influential in shaping their learning styles.

The analysis of preferred learning styles uncovered distinctive patterns among participants, with Experiencing, Autonomous learning, and Mentorship ranking high. Conversely, Peer Teaching and Converging styles exhibited lower mean scores. These findings offer educators guidance in tailoring instructional strategies to align with students' preferences, fostering more engaging and effective learning environments.

Gender-based differences in learning style preferences were evident, particularly in styles related to Discussion, Experiencing, Autonomous learning, and E-learning. Recognizing these differences allows for the adoption of inclusive teaching approaches that accommodate diverse learning styles, promoting an equitable educational experience for all.

Age-related variations in learning style preferences were explored through One Way ANOVA, revealing significant differences for styles such as Discussion, Experiencing, and Autonomous learning. These findings suggest that students' preferences for specific learning styles may evolve as they progress through different age groups, emphasizing the need for adaptive instructional approaches.

The correlation analysis unveiled relationships between learning styles and academic performance, with Lecture-based learning, Discussion, Autonomous learning, and E-learning exhibiting positive correlations. These findings underscore the potential impact of instructional methods on academic success, highlighting the importance of aligning teaching strategies with students' preferred learning styles.

In conclusion, this study contributes valuable insights to the field of education, providing a nuanced understanding of learning style preferences within a diverse student population. The findings have practical implications for educators, institutions, and researchers, guiding the development of tailored instructional methods that cater to the varied needs of students. By recognizing and adapting to the diverse learning styles present in educational settings, stakeholders can enhance engagement, promote inclusivity, and ultimately contribute to more effective and enjoyable learning experiences.

Recommendations

1. Embrace diverse instructional strategies to cater to varying learning preferences among students.
2. Foster inclusive teaching practices to accommodate gender-based differences in learning styles and ensure equitable educational experiences.
3. Tailor teaching approaches to align with the evolving preferences of students across different age groups.
4. Integrate technology judiciously into teaching methods, considering the positive correlation between E-learning preferences and academic performance.
5. Promote interactive discussions in the classroom to enhance critical thinking and academic performance.
6. Implement mentorship programs to support students' academic and personal development, considering the high preference for Mentorship learning styles.
7. Regularly assess and adjust educational practices based on feedback and learning style data to optimize overall effectiveness.

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