



Original Research Article

The Significance of Learning Styles Among College Students: A Cross-Departmental Analysis

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Abstract: **Background:** Recent developments in educational technology have affected how students engage with learning, leading to significant changes in preferences for learning. Learning styles refer to the behaviour and cognitive activities of people that enable them to acquire, process, and retain new information. Regardless of their level of learning ability, each student has a unique and natural way of learning that can be used for both academic and non-educational concerns. These learning styles are typically broken down into visual, auditory, verbal, and kinesthetic learning styles. **Objective:** This study aims to examine variations in learning style preferences among 214 undergraduate and postgraduate students across different college departments. **Methodology:** A survey-based research design was employed to investigate the significance of learning styles among college students and to compare preferences across academic disciplines. Data were collected using the VAK Learning Styles Questionnaire developed by Neil Fleming. Statistical analyses were conducted to evaluate differences based on demographic and academic variables. **Results:** Analysis of responses from 214 participants revealed no statistically significant differences in learning style preferences with respect to age ($p = 0.422$), gender ($p = 0.436$), or course type ($p = 0.683$). Across all groups, auditory learning emerged as the most prevalent learning style. **Conclusion:** The findings indicate consistent learning style preferences across academic disciplines and subsets of the population. Although universal teaching practices are generally effective, learning strategies that favor dominant learning styles, particularly auditory learning, may contribute to student learning and engagement.

Keywords: Learning Styles, Higher Education, College Students, Cross-Departmental Analysis, VAK Learning Style

INTRODUCTION

Education is not a uniform process, as students differ considerably in how they perceive, process, and retain information. Recognizing these differences is essential for improving instructional effectiveness and overall academic outcomes [1]. Previous research suggests that aligning teaching strategies with students' preferred learning styles can enhance comprehension, engagement, and academic performance [2]. Despite this growing body of evidence, limited attention has been given to comparing learning style preferences across different academic departments at the college level. It is widely acknowledged that individuals

exhibit diverse learning preferences. Some students learn more effectively through visual representations, others through auditory explanations, while some benefit most from kinesthetic or hands-on experiences. An important question, however, is whether these preferences vary according to academic discipline, particularly when comparing science-oriented fields with the arts and commerce [3]. The nature of subject matter, teaching methods, and assessment patterns may influence how students engage with learning content.

In practice, instructional approaches in higher education often remain uniform, with limited

consideration for disciplinary or individual learning differences. This raises concerns regarding instructional effectiveness, especially if science students benefit more from laboratory-based, experiential learning, while arts students may respond better to visual or discussion-based methods. When teaching strategies do not align with students' learning preferences, learners may experience disengagement, reduced motivation, or even academic underperformance [4]. Much of the existing literature addressing these issues has been conducted in large metropolitan institutions that are supported by advanced infrastructure and abundant educational resources [5].

However, learning experiences in colleges located in developing or semi-urban regions may differ substantially due to infrastructural constraints, such as limited access to modern laboratories, multimedia tools, and technology-enhanced classrooms [6]. These contextual factors can influence both teaching practices and students' learning preferences. To address this gap, the present study surveyed 214 college students from a university in Rajasthan situated on the outskirts of the state capital. The study seeks to examine whether learning styles differ among students from science, arts, and commerce departments.

Unlike earlier studies conducted in major metropolitan cities such as Mumbai and Delhi [7], this research is situated in a non-metropolitan yet prominent Indian university, where cultural, institutional, and infrastructural characteristics may uniquely shape learning behaviors. Interestingly, the findings challenge commonly held assumptions. Despite the university's elite academic environment, auditory learning emerged as the dominant preference (41%), and only minimal variation was observed across academic departments. These results suggest that even well-established universities in India may continue to rely heavily on lecture-centered instructional models, regardless of disciplinary differences.

Literature Review

Learning Styles

Learning styles are one of the widely studied topics in education. Researchers over the years have concluded that students learn differently, although there are still arguments about how

much learning styles impact academic success. Understanding one's unique learning style is crucial for maximizing individual potential in education [8]. Each person absorbs and processes information differently, making it essential for them to recognize how they learn best. Therefore, the education system needs to adopt a diverse array of teaching methods. This approach allows students to encounter various learning modalities such as visual, auditory, kinesthetic, and tactile, enabling them to discover which methods resonate most effectively with them [9, 10].

Incorporating a range of instructional strategies not only enriches the learning experience but also equips students with the tools necessary to approach problem-solving from different angles. By exploring multiple ways of gaining knowledge, students enhance their critical thinking skills and adaptability, preparing them for real-world challenges. Keefe [11] defined learning style as the cognitive, emotional, psychological, and personal traits that affect a learner's perception, interaction with, and response to their educational environment. Furthermore, an awareness of learning styles is invaluable for educators as well. It empowers them to tailor their teaching methods to meet the varied needs of their students, fostering an inclusive learning environment. By understanding the dynamics of learning styles, educators can engage their students more effectively, encouraging a love for learning that lasts a lifetime. Therefore, promoting awareness and training around learning styles is essential for both students and educators alike.

Fleming's VARK Model: Developed by Neil Fleming in 1987, the VARK model categorizes learners into four types according to their preferred methods of receiving information.

1. Visual learners: They have a preference for visual aids such as charts, graphs, and diagrams. They grasp information more easily when it is shown visually.
2. Auditory Learners: These people acquire knowledge most effectively through listening. They gain from lectures, conversations, and auditory resources. They retain information more effectively when it is communicated verbally.
3. Reading/Writing Learners: Individuals in this category acquire knowledge most effectively through reading and writing. They favor written guidelines and

comprehend information better when reading and jotting notes.

4. Kinesthetic Learners: These individuals excel when engaging in practical activities. They acquire knowledge more effectively through direct involvement rather than merely watching.

The VARK model holds significance in education as it emphasizes the importance of acknowledging various learning preferences to enhance student involvement and retention.

Kolb's Experiential Learning Theory: Created by David Kolb [12], describes learning as a cyclical process consisting of four stages that recur.

1. Concrete Experience: This phase entails engaging in a hands-on experience or activity that acts as the foundation for learning.
2. Reflective Observation: Following the experience, learners reflect on the occurrences. They examine the experience and take into account various perspectives.
3. Abstract Conceptualisation: During this stage, learners derive conclusions from their reflections and create or adjust ideas based on their acquired knowledge.
4. Active Experimentation: The concluding phase entails utilizing the knowledge gained in different scenarios or challenges. This process strengthens comprehension and supports continued learning.

Kolb's model stresses that effective learning includes all four stages and that learners can use different styles depending on the context. However, both models have received criticism. Critics of the VARK model argue that labelling learners into fixed types oversimplifies the complexities of learning. Many learners show a mix of preferences instead of fitting neatly into one category. The model also does not consider how the context and subject matter affect learning. Kolb's model has also been criticized for being too linear. Critics say that learning is not always a straight path, and learners may not follow the stages in order. Additionally, some question whether the model has enough research backing it regarding learning styles and their role in improving learning results.

In summary, both the VARK and Kolb models provide helpful perspectives on learning preferences and processes. However, they should be viewed as guides, considering the various ways people learn and adapt in different

situations. In the last five years, research on learning styles, especially the VARK and Kolb models, has changed and added to the discussion about how effective these models are in education. The VARK model divides learners into four types—Visual, Auditory, Reading/Writing, and Kinesthetic. Some studies support the idea that adapting teaching to these types can improve engagement and memory. However, other research suggests that the benefits of matching teaching methods to specific learning styles may not be as significant as some believe, indicating that a broader approach to teaching can often lead to better outcomes.

The Kolb experiential learning model, which stresses the value of experience in learning and includes four stages - Concrete Experience, Reflective Observation, Abstract Conceptualization, and Active Experimentation, has also been researched further. Recent studies show that this model is useful in adult education and professional development, especially for promoting critical thinking and reflection among learners. Yet, there is still debate about the linear structure of Kolb's model, with some researchers advocating for a more flexible learning approach that reflects the complexities of real-life experiences. Overall, both the VARK and Kolb models offer helpful ways to understand different learning preferences. However, recent findings suggest that a more adaptable use of these models is necessary, as effective learning often relies on a mix of strategies rather than sticking to specific styles. As discussions continue, educators are encouraged to consider the broader context of learning and the importance of flexible teaching methods that can meet the diverse needs of learners.

Previous Findings

Numerous controversies surround the research on learning styles in college students, raising questions about the validity and practicality of these theories. One of the primary contentions is the lack of empirical evidence supporting the idea that tailoring instruction to match a student's preferred learning style enhances learning outcomes. For instance, [4] conducted a review and concluded that the existing research does not provide sufficient evidence to justify the widespread application of learning

styles in educational settings.

Moreover, certain scholars contend that the idea of learning styles simplifies the intricate nature of individual learning. Constructivist theories propose that learning is a fluid process affected by various factors, such as motivation, existing knowledge, and the learning context [13]. By concentrating too much on learning styles, educators might neglect these essential components, which could impede effective teaching strategies. A notable controversy involves the potential for the improper application of learning styles theories in educational settings. Some teachers might mistakenly think that once they identify a student's learning style, instruction must be rigidly aligned with that style. Such inflexibility can hinder an educator's ability to use a variety of teaching methods and may inhibit students from cultivating a more well-rounded skill set [14]. This matter highlights the necessity of embracing a more adaptable teaching approach that utilizes a range of strategies to meet the diverse needs of students.

Hawk & Shaw [16] found that US business students preferred visuals, although Chander et al. [21] study says business students lean toward social/interactive styles. Engineers favored hands-on learning. In India, urban studies echo this: medical students rely on diagrams [17], and engineers thrive in labs [18]. Liew et al. [15] did a study on about 300 Malaysian undergraduates and discovered that 40% were more visual learners, particularly in design courses like architecture, fine arts, etc. On the contrary, a study by James et al. [28] stated that postgraduate science students leaned close to logical learning due to complex theories. Furthermore, the focus on learning styles has led to an increase in commercial products and services aimed at both teachers and learners. This commercialization brings up ethical issues about the possible exploitation of educators and institutions that are in search of effective teaching resources but might be deceived by unsubstantiated claims [15]. However, non-metro elite institutions like NIMS University remain unstudied, despite their unique socio-academic ecosystem [19]. Most studies focus on separate departments, while our work fills this gap by testing if department differences persist in resource-constrained elite settings and

examining 214 students across disciplines.

Research Questions

1. What are the dominant learning styles (visual, auditory, kinesthetic) among college students in science, management, and arts & social sciences departments?
2. How do learning styles significantly differ between science, management, and arts students?
3. What are the effects of learning styles that are specific to different subjects on teaching methods in higher education?

Significance of the Study

Objectives

1. To identify the prevalence of VAK learning styles among undergraduate and postgraduate students in science, management, and arts & social sciences disciplines.
2. To compare significant differences in learning style preferences between science and management students.
3. To propose discipline-specific recommendations for educators to adapt teaching methods based on learning style trends.

Hypothesis

1. Science students exhibit a significantly higher preference for a kinesthetic learning style compared to management students.
2. Management students show a significantly higher preference for auditory learning styles compared to science students.
3. There is no significant difference in preferred learning styles between male and female college students.
4. There is no significant difference in preferred learning styles based on the age of the students.

Methodology

Research Design

This study is a cross-sectional survey, meaning that the data were collected at a single point in time. Similar to the approach used by Riener & Willingham [14] in their discipline-based learning style study, we employed a quantitative research approach to facilitate an objective comparison of various learning styles across different departments within the tertiary institution. By analyzing the data statistically, we aimed to uncover patterns and trends that might inform educators and administrators about the efficacy of instructional methods tailored to students' diverse learning preferences.

This comprehensive analysis highlights the differences in learning styles and provides insight into how these preferences may influence academic performance and engagement across disciplines.

Participants (Sampling)

A carefully selected sample population of 214 undergraduate and graduate students from NIMS University participated in this research study, comprising students from the Science (132), Management (78), and Arts & Social Sciences (4) departments. For data collection, a validated survey instrument was employed, which has demonstrated reliability and accuracy in previous studies. This approach ensures that the findings will be robust and applicable to the broader student population. We employ a survey method to gather quantitative data, utilizing a structured questionnaire designed to capture participants' opinions, behaviours, and demographics. Although the sample was uneven across departments, this reflects enrollment trends in tertiary institutions, as in Liew et al. [15]. Demographic details are summarized in Table 1. By incorporating both closed and open-ended questions, the survey aims to gain a comprehensive understanding of the subject matter while ensuring the results can be statistically analysed for relevance and reliability.

Data Collection

To effectively assess the preferred learning styles of college and university students, the VAK Learning Style model developed by Neil Fleming [3] was employed. This is a 30-item questionnaire categorizing learners into Visual (learn by seeing), Auditory (learn by hearing),

and Kinesthetic (learn by doing). This model categorizes learning preferences into three distinct modalities: Visual, Auditory, and Kinesthetic. The VAK model has been used by Ramadian et al. [16] to study English Language students' learning styles and by Ventura et al. [17] in a cross-disciplinary student sample. By utilizing this framework, the study aimed to gain deeper insights into how students absorb and process information, ultimately helping educators tailor their teaching strategies to better align with the diverse ways in which students learn. The investigator goes from class to class, urging the students to fill out the questionnaire online through a link to a Google form for them to complete and submit their answers. They came from different departments within the colleges of Science, Art/Social Science, and Management. There were no modifications to the tool. Participants were given an anonymity challenge to ensure confidentiality alongside the Google Forms, with an average completion time of 10 minutes. The research explores how their learning styles influence engagement and what teaching methods they favour.

Statistical Techniques

To conduct a comprehensive analysis of the data, the researcher employed several statistical techniques, including the calculation of the Mean to determine the average values, the Standard Deviation (SD) to assess the variability or dispersion within the dataset, and the *t*-test to compare the means of different groups and evaluate the significance of any observed differences. This multifaceted approach allowed for a thorough understanding of the data's characteristics and relationships.

RESULTS

A total of 214 undergraduate and postgraduate students participated in the study. As shown in Table 1, the majority of participants were aged 18–25 years (97.2%), with a nearly equal gender distribution (49% male and 50.9% female). Most respondents were enrolled in science courses (61.7%), followed by management (36.4%) and arts/social sciences (1.9%).

Table 1: Demographic details of the participants

Category	Group	Number (n)	Percentage (%)
Age	18-25 years	208	97.2%
	25-35 years	6	2.8%
Gender	Male	105	49%
	Female	109	50.9%
Course Type	Science	132	61.7%
	Management	78	36.4%
	Arts/ Social Science	4	1.9%

Analysis of learning style preferences revealed that auditory learning was the most prevalent among the participants (41.1%), followed by visual (36.0%) and kinesthetic (22.9%) learning styles (Table 2, Figure 1).

Table 2: Distribution of learning style preferences (Visual, Auditory, and Kinesthetic) among college students based on the VAK model.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Visual	77	36.0	36.0	36.0
	Auditory	88	41.1	41.1	77.1
	Kinesthetic	49	22.9	22.9	100.0
	Total	214	100.0	100.0	

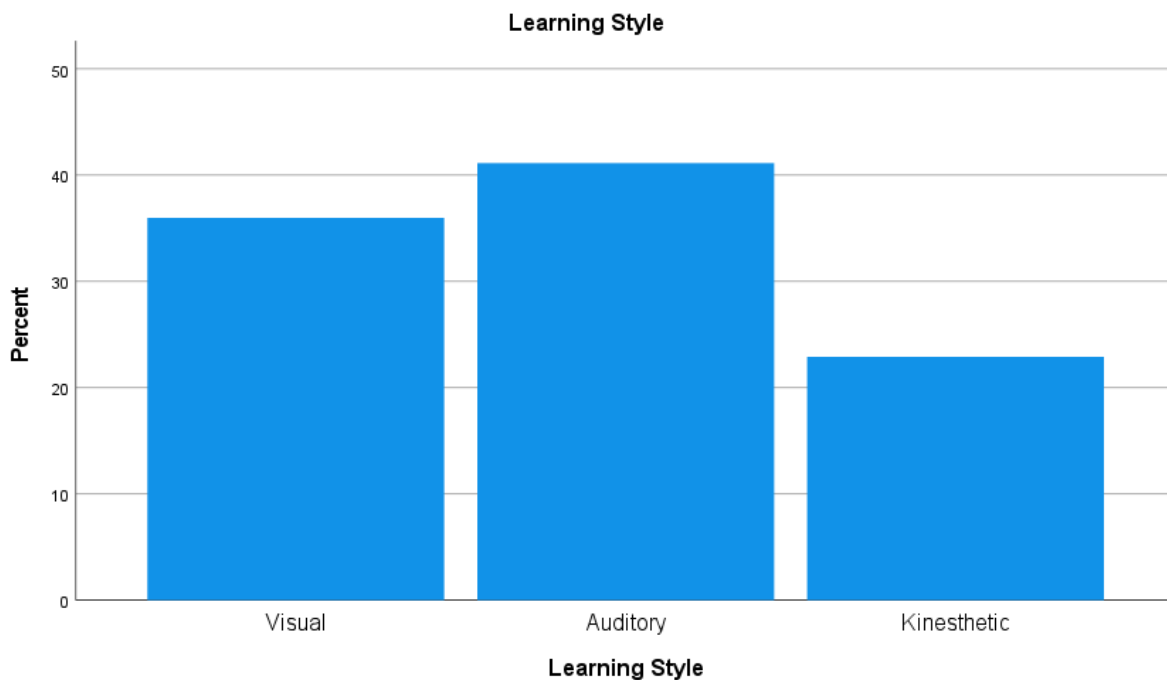


Figure 1: Distribution of learning style preferences (Visual, Auditory, and Kinesthetic)

Hypothesis Testing

Hypothesis 1: There is no significant difference in preferred learning styles based on the age of the students.

		Visual	Auditory	Kinesthetic	
Age Group	18 - 25	76	84	48	208
	25 - 35	1	4	1	6
Total		77	88	49	214

Chi-square analysis indicated no statistically significant association between age and preferred learning style ($\chi^2 = 1.724$, $p = 0.422$). Students across both age groups demonstrated similar distributions of

visual, auditory, and kinesthetic learning preferences.

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1.724 ^a	2	.422
Likelihood Ratio	1.739	2	.419
Linear-by-Linear Association	.184	1	.668
N of Valid Cases	214		

^a. 3 cells (50.0%) have expected count less than 5. The minimum expected count is 1.37.

Hypothesis 2: There is no significant difference in preferred learning styles between male and female university students.

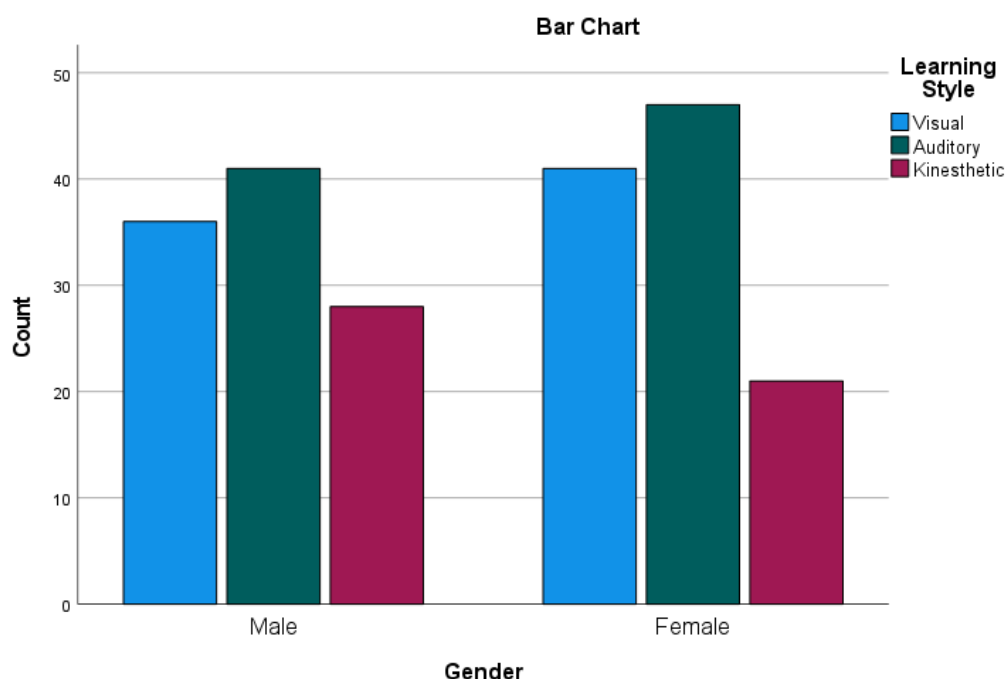


Figure 2: Comparison of learning style preferences between male and female students.

Table 3: Cross-tabulation of age group and preferred learning style among the participants.

		Visual	Auditory	Kinesthetic	
Age Group	Male	36	41	28	105
	Female	41	47	21	109
Total		77	88	49	214

Similarly, no significant difference was observed between gender and learning style preference ($\chi^2 = 1.660$, $p = 0.436$). Both male and female students showed comparable preferences across the three learning styles (Figure 2).

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1.660 ^a	2	.436
Likelihood Ratio	1.663	2	.435
Linear-by-Linear Association	1.072	1	.300
N of Valid Cases	214		

^a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 24.04.

Further analysis examining learning styles across academic departments also revealed no significant differences ($\chi^2 = 2.288$, $p = 0.683$). Students from science, management, and arts/social science disciplines exhibited similar patterns of learning style preferences, with auditory learning remaining dominant across all course types.

Table 4: Distribution of learning styles across academic departments (Science, Management, and Arts/Social Sciences).

Department	Visual	Auditory	Kinesthetic	Total Students
Science	49 (37.1%)	57 (43.2%)	26 (19.7%)	132
Management	27 (34.6%)	29 (37.2%)	22 (28.2%)	78
Arts/Social Sciences	1 (25%)	2 (50%)	1 (25%)	4

DISCUSSION

The findings of this study indicate that auditory learning is the most prevalent learning style among the participants, with 41% of students identifying as auditory learners, followed by visual (36%) and kinesthetic (22.9%) learners. This distribution suggests that listening-based instructional methods, such as lectures, may be particularly effective for a substantial proportion of college students. These results align with Fleming [3], who reported that many students in higher education environments tend to favor auditory modes of learning over hands-on approaches. Similar findings were reported by Prithishkumar and Michael [20], who observed a high prevalence of auditory learners, particularly among science students. In contrast, Alharbi et al. [23] found kinesthetic learning to be the dominant preference among students in Saudi Arabia. The lower proportion of kinesthetic learners observed in the present study may be attributed to differences in instructional practices and learning environments, as students in the current context are more frequently exposed to lecture-based teaching than to laboratory- or activity-based instruction. These findings suggest the need for instructors to incorporate auditory-enhancing strategies such as structured discussions, podcasts, interactive lectures, and question-and-answer sessions. Nevertheless, the presence of a substantial proportion of visual and kinesthetic learners highlights the importance of employing a balanced instructional approach. Visual learners benefit from diagrams, images, videos, and graphical representations, while kinesthetic learners require hands-on experiences, such as laboratory work and experiential activities, to reinforce conceptual understanding. Accordingly, professional development programs that familiarize educators with diverse learning styles may contribute to improved learning outcomes for all students.

With respect to Hypothesis 1, the study found no significant difference in learning style preferences between younger and older students ($p = 0.422$). This finding suggests that students aged 18 and 25 are likely to exhibit similar learning preferences, supporting the work of Ridgway [24], who reported no age-related differences in learning styles among

nursing students. However, this result contrasts with Slater et al. (2016), who identified age-related differences in learning preferences among online learners. The absence of age-based variation in the present study may be explained by the face-to-face instructional environment, which could promote uniform learning behaviors across age groups. Additionally, the college setting often functions as a relatively homogeneous environment, where students are exposed to similar teaching methods regardless of age, potentially leading to convergence in learning preferences. It should be noted, however, that the sample primarily consisted of students aged 18 – 25, and future research should include older learners (30 years and above) to determine whether age-related differences emerge in more diverse age groups. In the interim, educators are encouraged to adopt a combination of teaching strategies, integrating lectures with visual aids and practical activities.

Analysis of Hypothesis 2 revealed no significant difference in learning style preferences between male and female students ($p = 0.436$). This finding is consistent with the results reported by Wehrwein et al. [27], who found minimal gender-based variation in learning styles among college students. Similarly, Felder and Spurlin [26] concluded that gender does not significantly influence learning preferences, even in academically demanding fields such as engineering. In contrast, Denna [25] reported slight gender differences in arts and humanities disciplines, with female students showing a greater preference for visual learning. The absence of such differences in the present study may be attributed to the limited representation of arts and social science students and the focus on a single institutional context. Future studies conducted across multiple universities and cultural settings may provide further insight into the role of gender in shaping learning preferences. At present, the findings support the use of inclusive, multi-modal teaching strategies to ensure equitable engagement among all students.

Regarding Hypothesis 3, the results indicated no significant differences in learning style preferences across science, management, and arts/social science disciplines ($p = 0.683$). This finding aligns with previous studies by Hawk and Shah [19] and Dunn

et al. (2012), which reported that academic major does not significantly determine learning style preference. One possible explanation for this similarity is the use of comparable instructional methods across departments, particularly lecture-based teaching for theoretical content and limited practical exposure in certain courses. As a result, students across disciplines may develop similar learning preferences over time. A limitation of the present study is its focus on only three broad course categories. Disciplines that rely heavily on creativity, physical engagement, or performance, such as music, fine arts, dance, sports science, or architecture, may exhibit different learning style patterns. Future research should explore such disciplines to determine whether more pronounced differences emerge. Based on the current findings, the adoption of multi-style teaching approaches remains a practical and effective recommendation for engaging students across all academic fields.

Conclusion & Recommendations

Based on the sample population from NIMS University, the study found no statistically significant differences in learning style preferences with respect to age ($p = 0.422$), gender ($p = 0.436$), or course type ($p = 0.683$). Students from science, arts/social sciences, and management disciplines exhibited similar learning style patterns. However, auditory learning emerged as the most preferred style, with 41% of students indicating a preference for learning through listening. These findings are consistent with earlier studies by Fleming [3] and Wehrwein et al. [27], which suggest that learning preferences among college students tend to converge within higher education environments. Given the predominance of auditory learning, it is recommended that instructors incorporate more auditory-based teaching strategies across disciplines, such as interactive lectures, group discussions, podcasts, and oral explanations, as supported by Prithishkumar and Michael [20]. At the same time, it is important to recognize that a substantial proportion of students (36%) identified as visual learners. The inclusion of visual elements such as diagrams, charts, videos, and infographics can significantly enhance comprehension and information retention for this group. Additionally, nearly one-quarter of the participants (23%) demonstrated a preference for kinesthetic learning, indicating the need for hands-on and experiential learning opportunities. Practical activities such as laboratory experiments, workshops, fieldwork, and creative projects can support deeper conceptual understanding for these learners. Equipping educators with an awareness of diverse learning styles can contribute to more inclusive and effective teaching practices across educational levels. Incorporating a balanced mix of instructional methods within course curricula is essential; even traditionally lecture-based classes can be enriched

through the integration of visual aids and interactive components that promote student engagement and reduce monotony (Felder & Spurlin [26]). For future research, greater attention should be directed toward older learners, particularly those aged 30 years and above, as their learning preferences, experiences, and motivations may differ from those of younger students. Further studies should also focus on disciplines that emphasize creativity and personal expression, such as music, performing arts, and vocational programs like fashion design, where learning styles may play a more critical role in student engagement and retention. Moreover, adopting observational and classroom-based research methods would provide valuable insights beyond self-reported data, enabling a deeper understanding of how learning styles are expressed in real instructional settings and how teaching strategies can be optimized accordingly.

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