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Preferred Learning Styles of Sport Students in Higher Education in Algeria: An Analysis Using the Felder-Silverman Model

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Estilos de Aprendizaje Preferidos de los Estudiantes de Deporte en Educación Superior en Argelia: Un Análisis Utilizando el Modelo de Felder-Silverman

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Estilos de Aprendizagem Preferidos dos Estudantes de Esporte no Ensino Superior na Argélia: Uma Análise Utilizando o Modelo de Felder-Silverman

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Abstract

This study aimed to investigate the preferred learning styles of sports students in higher education in Algeria. Using the Felder-Silverman model, which categorizes learning styles into four dimensions: active-reflective, visual-verbal, sensing-intuitive, and sequential-global, the research also examined differences in learning styles based on specialization, academic level, and diploma. The research involved 268 students from the Sports Institute in Setif, and the data were analyzed using SPSS version 28. The findings revealed a predominant preference for the visual learning style, followed by the sensing and sequential styles. No significant differences were found in learning styles according to specialization. However, significant differences were observed between groups based on academic level and diploma, and the study recommended creating training courses for teachers that adopt modern methods and encourage them to consider the learning styles of each student.

Key words: learning styles. sport. student. Felder-Silverman model**.** learning.

Resumen
El estudio tiene como objetivo investigar los estilos de aprendizaje preferidos de los estudiantes de deporte en la educación superior en Argelia. Utilizando el modelo de Felder-Silverman, que categoriza los estilos de aprendizaje en cuatro dimensiones: activo-reflexivo, visual-verbal, sensorial-intuitivo y secuencial-global, la investigación también examinó las diferencias en los estilos de aprendizaje según la especialización, el nivel académico y el diploma. La investigación involucró a 268 estudiantes del Instituto de Deportes en Setif, analizados utilizando SPSS versión 28. Los hallazgos revelaron una preferencia predominante por el estilo de aprendizaje visual, seguido por los estilos sensorial y secuencial. No se encontraron diferencias significativas en los estilos de aprendizaje según la especialización. Sin embargo, se observaron diferencias significativas entre grupos basadas en el nivel académico y el diploma. El estudio recomendó trabajar en la creación de cursos de formación para profesores que adopten métodos modernos y alentar a los profesores a considerar los estilos de aprendizaje de cada estudiante.

Palabras clave: *estilos de aprendizaje. deporte. estudiante. modelo de Felder-Silverman. aprendizaje.*

Resumo
O estudo visa investigar os estilos de aprendizagem preferidos dos estudantes de esporte no ensino superior na Argélia. Utilizando o modelo de Felder-Silverman, que categoriza os estilos de aprendizagem em quatro dimensões: ativo-reflexivo, visual-verbal, sensorial-intuitivo e sequencial-global, a pesquisa também examinou diferenças nos estilos de aprendizagem com base na especialização, nível acadêmico e diploma. A pesquisa envolveu 268 estudantes do Instituto de Esportes em Setif, analisados usando o SPSS versão 28. Os resultados revelaram uma preferência predominante pelo estilo de aprendizagem visual, seguido pelos estilos sensorial e sequencial. Não foram encontradas diferenças significativas nos estilos de aprendizagem de acordo com a especialização. No entanto, diferenças significativas foram observadas entre grupos com base no nível acadêmico e diploma. O estudo recomendou trabalhar na criação de cursos de treinamento para professores que adotem métodos modernos e incentivar os professores a considerar os estilos de aprendizagem de cada aluno.

Palavras-chave: *estilos de aprendizagem. esporte. estudante. modelo de Felder-Silverman. aprendizagem.*

Introduction

Learning style theory aims to indicate that each learner has their own learning style. According to Tilly Mortimore, learning style is an aspect of cognition.[1] Rita and Dunn defined learning style as the method by which an individual begins to concentrate on processing and retaining difficult and new information.[2] According to Dunn and Dunn, understanding students' learning is an important part of selecting learning strategies,

[1] Tilly Mortimore, Dyslexia and Learning Style: A Practitioner's Handbook, 2nd ed. (West Sussex, England: John Wiley & Sons, 2008), 12.

[2] Rita Stafford Dunn, ed., Learning Styles and the Nursing Profession (New York: NLN Press, 1998), 3.

but unfortunately, education often continues in traditional ways that completely ignore the individual differences between students and their preferred learning styles.[3]

A study by Gadt and Price indicated that learning styles represent an individual learner's preference for certain educational materials.[4] The study also concluded that there is a strong relationship between a student's learning style and their academic success, meaning that understanding and recognizing individual learning styles can lead to more efficient learning.[5] Researchers like Griggs, James, Gardner, and Kolb concurred that accommodating students' learning styles enhances their learning, underscoring the critical role of teachers in adapting educational strategies to meet their needs in the classroom.[6] Paul also noted that understanding students' needs in terms of learning styles is essential for effective learning.[7]

Furthermore, learning styles are characterized by an individual's approach to their own learning from the perspective of the learner.[8] Learning styles refer to the method or style by which a learner perceives things better; each learner has their own individual learning style, similar to a signature.[9] Utilizing their own learning style allows learners to learn quickly and enjoy themselves.[10] Dunn and Dunn defined learning styles as a set of biological and developmental characteristics that make learning effective for some students and ineffective for others.[11] This means that learning styles explain how a learner can focus, understand, process, and retrieve difficult and new information.[12] The term or concept of learning styles refers to several ways in which most people learn. Jessica Blackmore, quoting Litziger, and Osif believe that learning styles are the different ways through which a learner thinks and learns.[13]

Learning styles have garnered significant attention from educators for two main reasons: Firstly, studies conducted by various researchers, including Hooker and Vittetoe in 1983 and Svinki and Dixan in 1987, have proven their success and effectiveness in aligning and suiting learners' educational purposes.[14] Secondly, it is believed that students who can effectively utilize multiple learning styles are able to successfully adapt to any educational situation, as confirmed by Honey, Mumford, and Dixon.[15] Researchers in educational psychology believe that identifying students' fundamental learning styles can improve teaching.[16] In addition, Cooper Ryan

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[3] Rita Dunn, Learning Styles..., 5.
[4] Cited in Marlene LeFever, Learning Styles (David C. Cook, 2011), 25.
[5] Marlene LeFever, Learning Styles..., 25.
[6] Marlene LeFever, Learning Styles..., 28.
[7] Paul E. Robinson, Foundations of Sports Coaching, 2nd ed. (Milton Park, Abingdon, Oxon; New York, NY: Routledge, 2015), 45.
[8] Peter Honey and Alan Mumford, The Manual of Learning Styles, 3rd ed. (Maidenhead: P. Honey, 1992), 10.
[9] Marlene D. LeFever, Learning Styles: Reaching Everyone God Gave You (Colorado Springs, CO: David C. Cook, 2009), 15.
[10] Marlene LeFever, Learning Styles..., 18.
[11] Rita Dunn, Learning Styles..., 7.
[12] Rita Dunn, Learning Styles..., 8.
[13] Cited in Marlene LeFever, Learning Styles..., 20.
[14] Marlene LeFever, Learning Styles..., 30.
[15] Lindy McAllister et al., Facilitating Learning in Clinical Settings (Cheltenham: Stanley Thornes Publishers, 1997), 50.
[16] Kevin Ryan, James Michael Cooper, and Cheryl Mason Bolick, Those Who Can, Teach, 14th ed. (Australia: Cengage Learning, 2016), 62.

advocates for the application of learning styles theory, as many educators believe that curricula and teaching methods should offer a variety of lessons tailored to different grades.[17] This means that teachers must accommodate students' various learning styles by altering teaching methodologies and assessment methods to reach all students. Flexibility and diversity are key, and it should not be assumed that all students learn the way the teacher teaches. We should not underestimate students because their learning styles differ from the teacher's teaching method. It is also a strong approach to academic teaching, in addition to encouraging teachers to use media and technological tools to reach all students.[18] Over the past forty years, a number of learning style models have been developed, each claiming to evaluate learning in a unique way.[19] A variety of models exist, such as Honey and Mumford (1983), Kolb's Learning Style Inventory (1984), the Myers-Briggs Type Indicator (1980), and the Felder-Silverman (1988) Index of Learning Styles (ILS).[20]

The reviewed studies provide a comprehensive analysis of learning styles within the context of sports and physical education, highlighting a significant trend towards kinesthetic learning preferences among athletes and sports-related students. Starting with Ashadi et al., the research focused on the learning styles of college student athletes, particularly in preparation for distance learning.[21] The study revealed a strong preference for kinesthetic learning styles, emphasizing the need for diverse learning strategies in distance learning environments to cater to these preferences.[22] Similarly, Bostanci explored the learning styles of prospective teachers in sport sciences education, finding a predominant preference for kinesthetic learning among the students.[23] This aligns with the physical nature of their studies and suggests that tailoring educational strategies to these learning styles can enhance academic quality and achievement.[24] Braakhuis investigated the learning styles of elite and sub-elite athletes, noting a preference for kinesthetic and multimodal learning methods.[25] The study highlighted the importance of considering these preferences in training and educational interventions designed by coaches and sports educators.[26] In a related study, Cid et al. provided an overview of learning styles in physical education, discussing various theories and models.[27] The chapter emphasized the importance of adapting teaching methods to suit different learning preferences to improve

[17] Kevin Ryan and James Michael Cooper, Those Who Can, Teach, 12th ed. (Boston, MA: Wadsworth Cengage Learning, 2010), 58.

[18] Kevin Ryan et al., Those Who Can..., 14th ed., 65-66.

[19] Cynthia S. Deale, “Learning Preferences Instead of Learning Styles: A Case Study of Hospitality Management Students’ Perceptions,” International Journal for the Scholarship of Teaching and Learning 13, no. 2 (29 May 2019): 2, https://doi.org/10.20429/ijsotl.2019.130211.

[20] Cynthia Deale, “Learning Preferences...,” 2.

[21] Kunjung Ashadi et al., “Analysis of the Learning Style of College Student Athletes,” in Proceedings of the International Conference on Research and Academic Community Services (ICRACOS 2019) (Surabaya, Indonesia: Atlantis Press, 2020), 25, https://doi.org/10.2991/icracos-19.2020.6.

[22] Kunjung Ashadi et al., “Analysis of the Learning...,” 25.

[23] Özgür Bostanci, “Learning Style Preferences of Prospective Teachers,” Asian Journal of Education and Training 6, no. 2 (2020): 232, https://doi.org/10.20448/journal.522.2020.62.231.236.

[24] Özgür Bostanci, “Learning Style...,” 232.

[25] Andrea Jane Braakhuis, “Learning Styles of Elite and Sub-Elite Athletes,” Journal of Human Sport and Exercise 10, no. 4 (2015): 850, https://doi.org/10.14198/jhse.2015.104.08.

[26] Andrea Braakhuis, “Learning Styles...,” 850.

[27] Fernando Maureira Cid et al., “Learning Styles in Physical Education,” in Advanced Learning and Teaching Environments - Innovation, Contents and Methods, eds. Núria Llevot-Calvet and Olga Bernad Cavero (InTech, 2018), 3, https://doi.org/10.5772/intechopen.72503.

educational outcomes.[28] Fuelscher et al. reviewed literature on learning styles in the context of motor and sport skills, advocating for a nuanced understanding of learning styles to optimize training and performance in sports.[29] Peters et al. examined the learning styles of students enrolled in sports-related programs in higher education, finding a variety of learning preferences with a notable inclination towards kinesthetic learning.[30] This underscores the need for educational practices to align with these diverse learning styles to enhance learning outcomes.[31] Lastly, Stradley et al. assessed the learning styles of undergraduate athletic training students, finding a diverse range of learning methods.[32] The study suggests that athletic training educators should consider these preferences when designing curricula and instructional strategies.[33] In conclusion, these studies collectively emphasize the prevalence of kinesthetic learning preferences among individuals involved in physical education and sports.[34] This trend highlights the need for educators, coaches, and program designers to consider these preferences when developing educational and training programs to enhance learning efficacy and performance in sports-related fields.[35] The study of Braakhuis et al. compared learning style preferences of elite athletes based on gender, sport, and achievement level.[36] Most athletes preferred kinesthetic and multimodal learning, with significant relationships between gender, athlete level, and VARK preferences.[37] The results suggest notable differences in learning style preferences between males and females, and athletes at different levels, highlighting the need for health professionals to use a mix of learning styles when working with athletes.[38]

The study will rely on the Felder and Silverman model, which defines learning styles as a set of cognitive, affective, and psychological behaviors that function together as reasonably reliable indices of students' perceptions, interactions, and responses to the learning environment.[39] It categorizes students into four dimensions: active-reflective (processing information), visual-verbal (presenting information), sensing-intuitive (organizing information), and sequential-global (understanding information).[40] Extensive testing has demonstrated that the Felder-Silverman model is a well-established theoretical model that is highly valid and reliable; learner

[28] Fernando Cid et al., "Learning Styles...," 3.
[29] Ian Tobias Fuelscher, Kevin Ball, and Clare MacMahon, "Perspectives on Learning Styles in Motor and Sport Skills," Frontiers in Psychology 3 (2012): 3, https://doi.org/10.3389/fpsyg.2012.00069.
[30] Derek Peters, Gareth Jones, and John Peters, "Preferred 'Learning Styles' in Students Studying Sports-related Programmes," Studies in Higher Education 33, no. 2 (April 2008): 160, https://doi.org/10.1080/03075070801916005.
[31] Derek Peters et al., "Preferred 'Learning Styles'...," 160.
[32] Stephanie L. Stradley et al., "A Nationwide Learning-Style Assessment of Undergraduate Athletic Training Students," Journal of Athletic Training 37, no. 4 Suppl (December 2002): S141.
[33] Stephanie Stradley et al., "A Nationwide Learning-Style...," S141.
[34] Özgür Bostanci, "Learning Style...," 233; Andrea Braakhuis, "Learning Styles...," 851.
[35] Ian Fuelscher et al., "Perspectives on Learning...," 4.
[36] Andrea Jane Braakhuis et al., "A Comparison between Learning Style Preferences," Sports 3, no. 4 (9 November 2015): 325, https://doi.org/10.3390/sports3040325.
[37] Andrea Braakhuis et al., "A Comparison...," 330.
[38] Andrea Braakhuis et al., "A Comparison...," 330.
[39] Richard Felder and Linda Silverman, "Learning and Teaching Styles in Engineering Education," Journal of Engineering Education 78, no. 7 (1988): 675.
[40] Fatos Xhafa, ed., Computational Intelligence for Technology Enhanced Learning (Berlin: Springer, 2010), 15; Cynthia Deale, "Learning Preferences...," 3.

preferences are flexible and not limited to a single category.[41] Chahida and Gleen justified the Felder-Silverman model's extensive use in the technology field, citing its ease of use with the Index of Learning Styles (ILS).[42] Furthermore, Gordana confirmed that this model is the most widely used in e-learning.[43] According to Nabila in her study, the reason for using the Index of Learning Styles is that it is a result of a combination of other important learning style models, such as Kolb's model.[44] Although the dimensions it uses are not new compared to other models, the way it blends and processes them is novel.[45] This has led to the following questions:

- What is the preferred learning style among sports students?
- Are there statistically significant differences in students' preferred learning styles based on the field of specialization?
- Are there statistically significant differences in students' preferred learning styles according to their academic level?
- Are there statistically significant differences in students' preferred learning styles according to diplomas?

2. Method

2.1. Participants

According to the G-Power analysis results, to detect a medium effect size (d = 0.5) with 80% power and a 5% significance level (two-tailed) when comparing the means of two independent groups of similar size, a total sample size of 128 is required, with 64 participants in each group. Similarly, the G-Power analysis results show that detecting a medium effect size (f = 0.25) with 5 groups, an alpha of 0.05, and a target power of 0.80 requires a total sample size of 200; With 40 participants in each of the 5 groups, the analysis indicated that a sample size of 268 is sufficient to conduct the study. The sample for this study was drawn from the Institute of Physical Activities and Sports Science and Technology in Setif City for the academic year 2022-2023. The participants were randomly selected and had an average age of 24 years.

Table 1. Research Participants.

		N	Percentage
Gender	Males	236	88,1%
	Females	32	11,9%
Specialization	Physical Training	116	43,3%
	Physical Education	152	56,7%
	Undergraduate	139	51,86%
	Master	129	48,13%
Place of Living	Countryside	112	41,8%

[41] Chee-Kit Looi, David H. Jonassen, and Mitsuru Ikeda, eds., Towards Sustainable and Scalable Educational Innovations Informed by the Learning Sciences (Amsterdam: IOS Press, 2005), 20.
[42] Beverly Woolf et al., eds., Intelligent Tutoring Systems: 9th International Conference, ITS 2008, Montreal, Canada, June 23 - 27, 2008; Proceedings (Berlin Heidelberg: Springer, 2008), 35.
[43] Maja Levi-Jakšić and Slađana Barjaktarović Rakočević, eds., Innovative Management & Business Performance [Symposium Proceedings] (Belgrade: University of Belgrade, Faculty of Organizational Sciences, 2012), 45.
[44] Nabila Bousbia, Analyse des traces de navigation des apprenants dans un EIAH (Editions universitaires europeennes, 2011), 50.
[45] Nabila Bousbia, Analyse des traces..., 50.

	City	156	58,2%
Level	First year undergraduate	52	19,4%
	Second year undergraduate	45	16,8%
	Third year undergraduate	43	16,0%
	First year master	65	24,3%
	Second year master	63	23,5%

2.2. Instruments

The Index of Learning Styles Questionnaire, abbreviated as "ILS" and developed by Felder and Silverman in 1998, is a tool consisting of 44 items designed to assess an individual's preferences across four dimensions: active-reflective, sensing-intuitive, visual-verbal, and sequential-global. Each dimension is represented by 11 mandatory items where the respondent must choose between two options (a) or (b). Learning styles are expressed in values ranging from +11 to -11 for each dimension, with increments of +2 or -2 to achieve three levels of preference: strong, moderate and balanced as shown in the following diagram [46]; [47].

2.3. Study procedure

In our study, we initially delved into the theoretical foundations of learning styles before employing the Index of Learning Styles Questionnaire by Felder and Silverman for our survey research.[48] To validate the relevance and clarity of the scale's items, we consulted with field experts. We then distributed 27 questionnaires to students at the Sports Institute at the University of Setif as part of our preliminary survey. After gathering the responses, we conducted a thorough analysis to ascertain the time required to complete the questionnaire. We evaluated the psychometric properties of the tool before administering it to the primary sample of 268 students.

2.4. Psychometric properties Validity

We computed the Pearson correlation coefficient to evaluate the validity of the instrument, as indicated in Table 2.[49]

Table 2. Correlation coefficients between dimensions

[46] Nabia Luqman Siddiquei and Ruhi Khalid, 'Development and Validation of Learning Style Scale for E-Learners', *SAGE Open* 11, no. 2 (April 2021): 215824402110223, https://doi.org/10.1177/21582440211022324.

[47] Jim Haug, David Fischer, and Georg Hagel, 'Development of a Short Form of the Index of Learning Styles for the Use in Adaptive Learning Systems', in *Proceedings of the 5th European Conference on Software Engineering Education* (ECSEE 2023: European Conference on Software Engineering Education, Seeon/Bavaria Germany: ACM, 2023), 194–98, https://doi.org/10.1145/3593663.3593675.

[48] Richard Felder and Linda Silverman, "Learning and Teaching Styles in Engineering Education," Journal of Engineering Education 78, no. 7 (1988): 676.

[49] Myles Hollander, Douglas A. Wolfe, and Eric Chicken, Nonparametric Statistical Methods, 1st ed. (Wiley, 2015), 150, https://doi.org/10.1002/9781119196037.

		Active /Reflective	Sensing /Intuitive	Visual /Verbal	Sequential /Global
Active Reflective	Pearson Correlation	1	,532**	,585**	,406*
	Sig. (2-tailed)		,002	,001	,026
	N	30	30	30	30
Sensing Intuitive	Pearson Correlation	,532**	1	,524**	,485**
	Sig. (2-tailed)	,002		,003	,007
	N	30	30	30	30
Visual Verbal	Pearson Correlation	,585**	,524**	1	,431*
	Sig. (2-tailed)	,001	,003		,017
	N	30	30	30	30
Sequential Global	Pearson Correlation	,406*	,485**	,431*	1
	Sig. (2-tailed)	,026	,007	,017	
	N	30	30	30	30

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

The table shows that the correlation coefficients between the dimensions and others range from 0.406 to 0.585. As a result, the findings show that the instrument has a high internal consistency.

Reliability

To examine the instrument's reliability, we calculated the Cronbach's alpha coefficient for each dimension, as indicated in Table 3.[50]

Table 3. Reliability coefficients for the Index of Learning Styles Questionnaire

Dimension	N	Numbers	Cronbach's Alpha
Active/Reflective	11	1-5-9-13-17-21-25-29-33-37-41	,727
Sensing/Intuitive	11	2-6-10-14-18-22-26-30-34-38-42	,730
Visual/Verbal	11	3-7-11-15-19-23-27-31-35-39-43	,727
Sequential/Global	11	4-8-12-20-24-28-32-36-40-44	,781

The reliability coefficient for the ILS instrument was high and good, ranging from 0.727 to 0.781, indicating that the scale is stable and dependable in measuring the variable under research.

2.5. Statistical analysis

[50] Myles Hollander et al., Nonparametric Statistical Methods, 155.

The data were statistically evaluated with SPSS version 28 software. Several statistical tests were used, including correlation coefficients, Cronbach's alpha for reliability, means, and standard deviations,[51] an independent samples t-test to assess differences between groups, the Kolmogorov-Smirnov and Shapiro-Wilk tests of normality,[52] and an ANOVA test to identify differences among groups based on their academic level.[53]

3. Result

To determine the preferred learning style among the sample individuals, the researcher calculated the arithmetic means and standard deviations of the scores achieved by the sample individuals for each learning style.

Table. 4: means and standard deviation of the scores achieved by the sample individuals for each learning style and the descending order

	N	Minimum	Maximum	Mean	Std. Deviation	Order
Active	268	0	10	5,91	2,554	4
Reflective	268	1	11	5,01	2,397	5
Sensing	268	0	90	7,75	7,541	2
Intuitive	268	0	7	3,18	1,673	7
Visual	268	4	11	8,02	1,883	1
Verbal	268	0	7	2,96	1,868	8
Sequential	268	3	11	7,28	1,914	3
Global	268	0	8	3,70	1,906	6

It is clear from Table 4 that the most preferred learning style among students is the visual style, followed by the sensing style in second place, while the sequential style occupies the third rank, then the active style in the fourth rank, the reflective style in the fifth rank, and the holistic style in the sixth rank, with the intuitive style coming in seventh, and finally, the verbal style.

[51] Jerome L. Myers, Arnold D. Well, and Robert F. Lorch Jr., Research Design and Statistical Analysis (Routledge, 2013), 45, https://doi.org/10.4324/9780203726631.

[52] John E. Hunter and Frank L. Schmidt, Methods of Meta-Analysis: Correcting Error and Bias in Research Findings, 2nd ed. (Thousand Oaks, CA: Sage, 2004), 120.

[53] R. Carmona, Statistical Analysis of Financial Data in R, 2nd ed. (New York: Springer, 2014), 78.

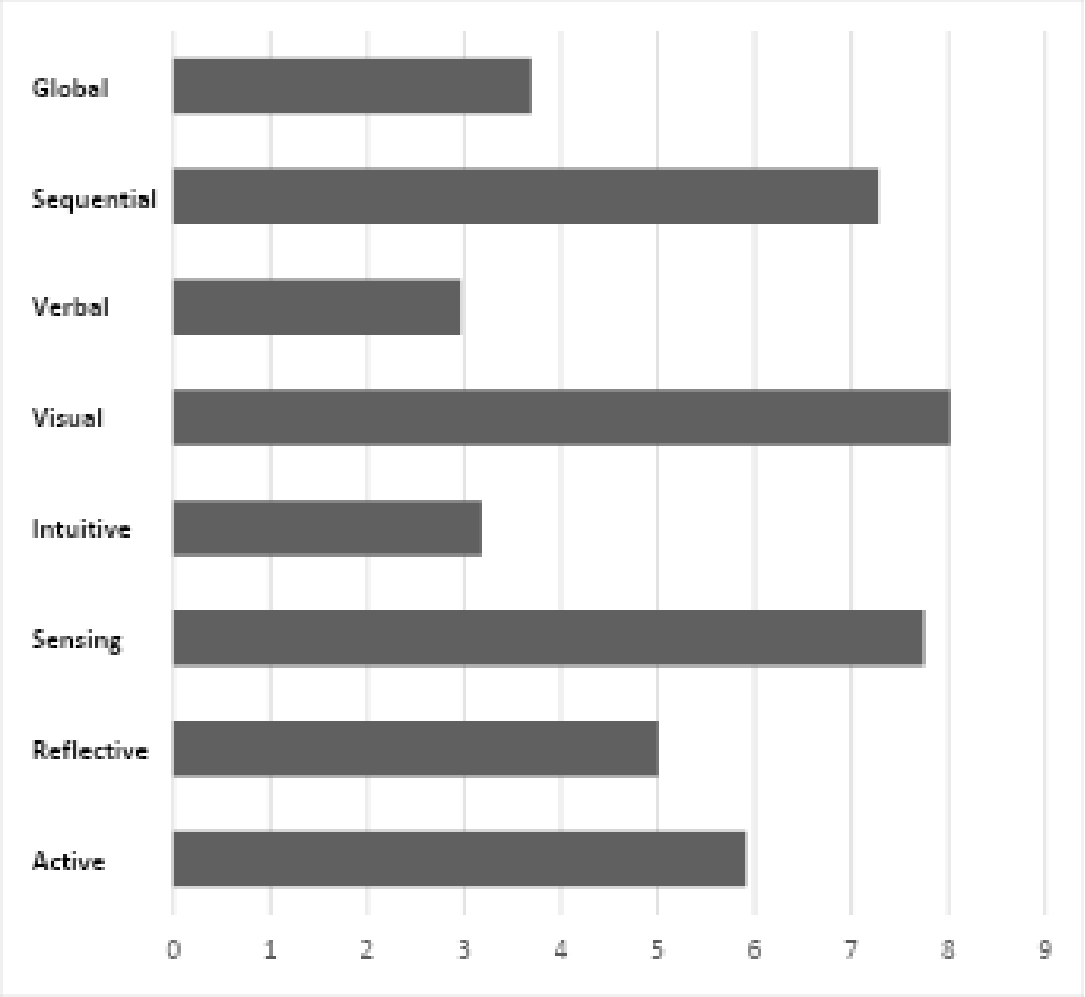

Figure. 1: Shows the percentage rates achieved for each learning style

To know more about the preferred dimension, the researcher calculated the arithmetic means and standard deviations for each dimension separately, as well as the descending order of these dimensions.

Table. 5: Means and Standard Deviations of the Scores Achieved by the Sample Individuals for Each Dimension Separately and the Descending Order.

	N	Minimum	Maximum	Mean	Std. Deviation	
Active/Reflective	268	1	11	3,50	2,603	4
Sensing/Intuitive	268	1	11	4,60	2,969	3
Visual/Verbal	268	0	11	5,22	3,214	1
Sequential/Global	268	1	11	4,64	2,635	2

And through Table 5 the most preferred is the verbal-visual dimension in the first rank, followed by the Sequential/Global dimension, and in the third rank is the Sensing/Intuitive dimension, and finally, the active-reflective dimension.

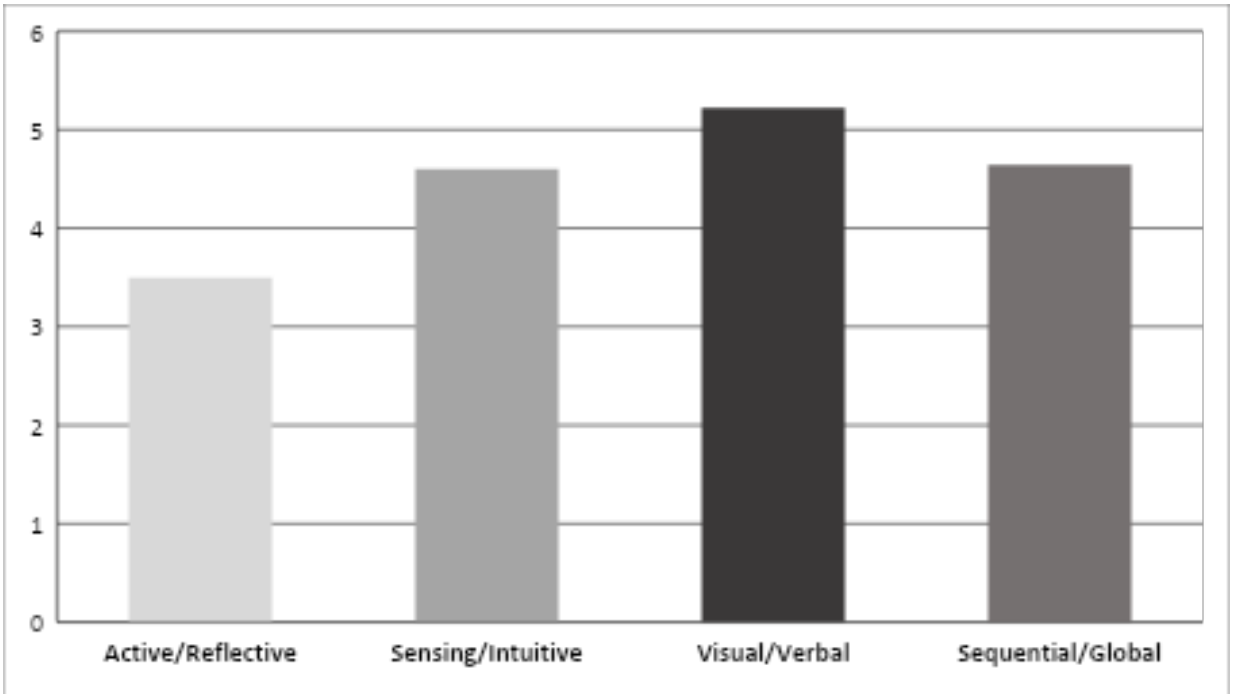

Figure. 2: Learning Styles by Each Dimension

To determine the differences between learning styles within the same dimension, the researcher calculated the value and significance level of the differences between students.

Table No. 6: Value and Significance Level of the Differences between Students in Learning Styles

		Mean	N	Std. Deviation	T	df	sig
Pair 1	**Active**	5,91	268	2,554	2,976	267	,003
	Reflective	5,01	268	2,397			
Pair 2	**Sensing**	7,75	268	7,541	9,290	267	,000
	Intuitive	3,18	268	1,673			
Pair 3	**Visual**	8,02	268	1,883	22,410	267	,000
	Verbal	2,96	268	1,868			
Pair 4	**Sequential**	7,28	268	1,914	15,345	267	,000
	Global	3,70	268	1,906			

It is evident from Table that there are statistically significant differences between the groups of dimensions of learning styles as follows:

- The active style over the reflective style.
- The intuitive style over the sensory style.
- The visual style over the verbal style.
- The sequential style over the global style.

An independent sample t-test on the learning styles was used to evaluate if there were any individual differences between specialist sport training and sport education.

Table 7. Difference in learning styles between groups (training, education)

	Type of sport	N	Mean	Std. Deviation	Df	T	Sig
Active-Reflective	training	116	3,55	2,397	266	,284	,777
	education	152	3,46	2,757			
Sensing-Intuitive	training	116	4,66	3,101	266	,262	,794
	education	152	4,56	2,874			
Visual-Verbal	training	116	5,78	3,206	266	2,497	,013
	education	152	4,80	3,165			
Sequential-Global	training	116	4,31	2,447	266	-1,786	,075
	education	152	4,89	2,751			

The t-test for the Active/Reflective learning style shows no significant difference between the training and education groups, as indicated by the similar mean scores and standard deviations. Similarly, the Sensing/Intuitive learning style does not show a significant difference between the two groups (p=0.794). For the Visual/Verbal learning style, there is a significant difference between the training and education groups (p=0.013), with the training group scoring higher. The Sequential/Global learning style shows no significant difference between the training and education groups (p=0.075).

An independent sample t-test on the learning styles was used to evaluate if there were any individual differences between undergraduate and master students.

Table 8. Difference in learning styles between groups (undergraduate, master)

	Diploma	**N**	**Mean**	**Std. Deviation**	**Df**	**T**	**Sig**
Active-Reflective	undergraduate	139	3,35	2,358	265	-1,073	,284
	Master	128	3,69	2,844			
Sensing-Intuitive	undergraduate	139	4,35	3,076	265	-1,506	,133
	Master	128	4,90	2,828			
Visual-Verbal	undergraduate	139	5,30	3,193	265	,351	,726
	Master	128	5,16	3,238			
Sequential-Global	undergraduate	139	4,08	2,375	265	-3,680	,000
	Master	128	5,24	2,786			

The t-test for the Active/Reflective learning style shows no significant difference between undergraduate and master's students (p=0.284). Similarly, the Sensing/Intuitive learning style does not show a significant difference between the two groups (p=0.133). For the Visual/Verbal learning style, there is also no significant difference between undergraduate and master's students (p=0.726). However, the Sequential/Global learning style shows a significant difference between undergraduate and master's students (p=0.000), indicating that master's students tend to score higher on this dimension.

To determine if there were differences in learning style based on level of education, we conducted an ANOVA test on the sample.

Table 9. The results for the ANOVA test between groups

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Active-Reflective	Between Groups	20,639	4	5,160	,759	,553
	Within Groups	1788,361	263	6,800		
	Total	1809,000	267			
Sensing-Intuitive	Between Groups	131,983	4	32,996	3,905	,004
	Within Groups	2222,297	263	8,450		
	Total	2354,280	267			
Visual-Verbal	Between Groups	55,067	4	13,767	1,340	,256
	Within Groups	2702,944	263	10,277		
	Total	2758,011	267			
Sequential-Global	Between Groups	130,991	4	32,748	4,999	,001
	Within Groups	1722,901	263	6,551		
	Total	1853,892	267			

The ANOVA results indicate that there are no statistically significant differences in the Active/Reflective dimension, as evidenced by an F-value of 0.759 and a significance level of 0.553, suggesting similar variances within and between groups, implying uniformity in this learning style among the groups. Conversely, the Sensing/Intuitive dimension shows a significant variance with a p-value of 0.004 and a higher F-value, indicating that this learning style significantly varies among the groups, with greater differences between groups than within. However, the Visual/Verbal dimension, with an F-value of 1.340 and a significance level of 0.256, shows no significant differences, indicating consistency in this learning style across the groups.
To accurately identify which groups demonstrated statistically significant differences in their performance, the Tukey HSD test was meticulously applied as shown in the table.

Table. 10 The results for the tukey test between groups

Dependent Variable	(I) diploma	(J) diploma	Mean Difference (I-J)	Std. Error	Sig.
Sensing-Intuitive	First year undergraduate	Second year undergraduate	-,775	,592	,685
		Third year undergraduate	,618	,599	,841
		First year Master	,085	,541	1,000
		Second year Master	-1,366	,545	,092
	Second year undergraduate	First year undergraduate	,775	,592	,685
		Third year undergraduate	1,393	,620	,166
		First year Master	,860	,564	,547
		Second year Master	-,590	,567	,836
	Third year undergraduate	First year undergraduate	-,618	,599	,841
		Second year undergraduate	-1,393	,620	,166
		First year Master	-,533	,571	,884
		Second year Master	-1,984*	,575	,006
	First year Master	First year undergraduate	-,085	,541	1,000
		Second year undergraduate	-,860	,564	,547
		Third year undergraduate	,533	,571	,884
		Second year Master	-1,450*	,514	,041
	Second year Master	First year undergraduate	1,366	,545	,092
		Second year undergraduate	,590	,567	,836
		Third year undergraduate	1,984*	,575	,006
		First year Master	1,450*	,514	,041
Sequential-Global	First year undergraduate	Second year undergraduate	-,008	,521	1,000
		Third year undergraduate	,355	,528	,962
		First year Master	-,515	,476	,816
		Second year Master	-1,601*	,480	,008
	Second year undergraduate	First year undergraduate	,008	,521	1,000
		Third year undergraduate	,363	,546	,964
		First year Master	-,508	,496	,845
		Second year Master	-1,594*	,500	,014
	Third year undergraduate	First year undergraduate	-,355	,528	,962
		Second year undergraduate	-,363	,546	,964
		First year Master	-,870	,503	,417
		Second year Master	-1,956*	,506	,001
	First year Master	First year undergraduate	,515	,476	,816
		Second year undergraduate	,508	,496	,845
		Third year undergraduate	,870	,503	,417
		Second year Master	-1,086	,453	,119
	Second year Master	First year undergraduate	1,601*	,480	,008
		Second year undergraduate	1,594*	,500	,014
		Third year undergraduate	1,956*	,506	,001
		First year Master	1,086	,453	,119

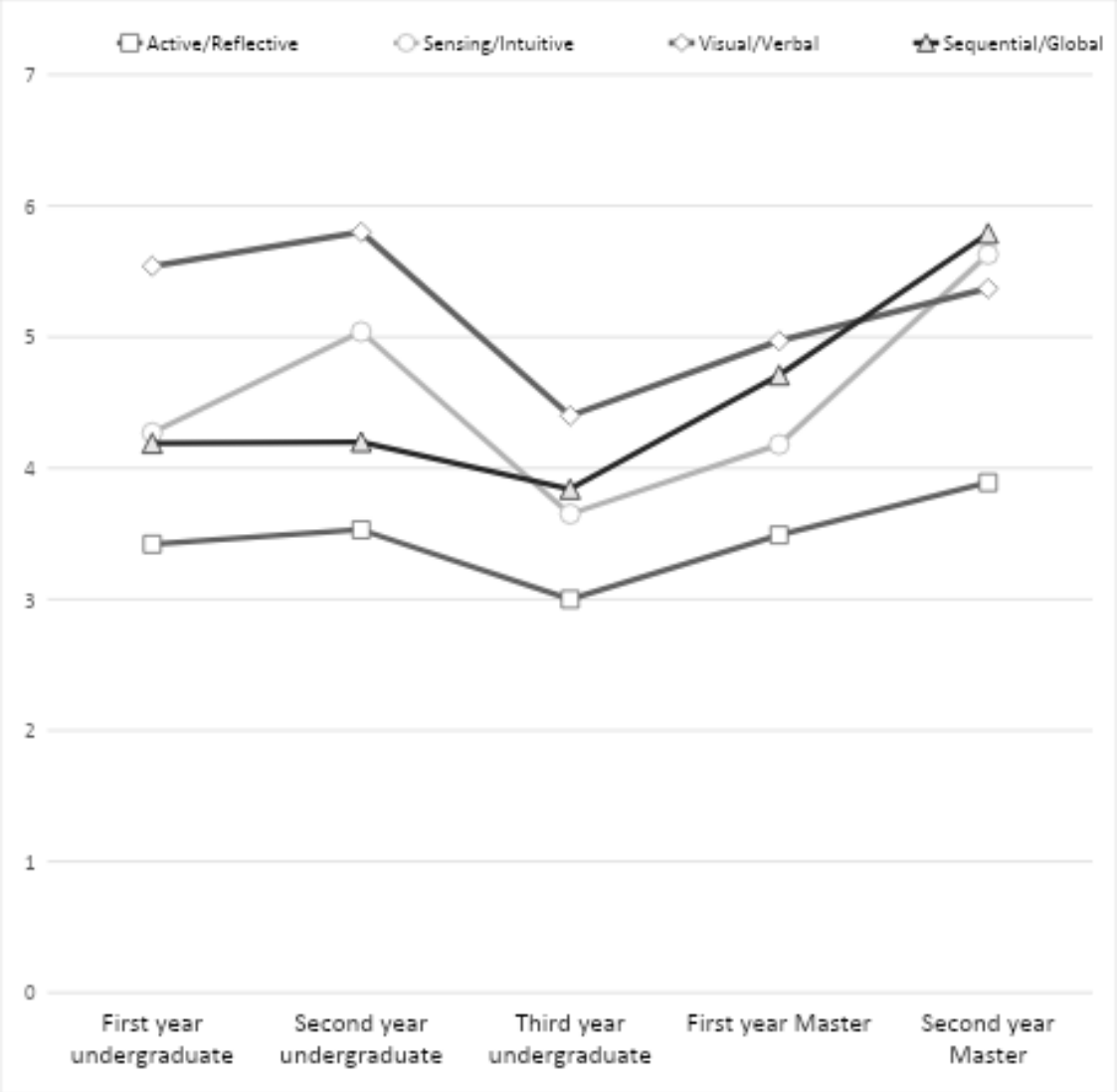

Figure 3. Means showed differences between groups (academic level)

4. Discussion

The objective of the research is to examine at the preferred learning styles of sports students in higher education. Using the Felder-Silverman model, which divides learning styles into four dimensions: active-reflective, visual-verbal, sensing-intuitive, and sequential-global, the study explored variations in learning styles depending on specialization, academic level, and graduation. The study included 268 students from the Sports Institute; The results of Table N.4 indicate that the preferred learning style among students at the Institute of Physical Activities and Sports Science and Technology is the visual style, this may be attributed to the significant importance of the sense of sight in learning and mastering movements and in learning in general. Seeing different movements performed as a model in front of the learner, whether by a peer or a coach, through films, drawings, or pictures, allows the learner to form an initial perception of the new movement in its general form. The learner can also grasp the general parts of the new movement and retain a mechanical impression of that movement or skill. If the model is repeated slowly, the learner can form a clearer picture of the movement and always strives to reach it through practice and training.

The sensory style ranks second, this may be due to the nature of the specialization, which involves extensive use of the senses and dealing with tangible objects. Table N.5 indicates that the most preferred dimension is the verbal-visual dimension, followed by the sensory-intuitive dimension in second place, the sequential-global dimension in third place, and finally, the active-reflective dimension.

Table N.6 Shows the value of "T" and its significance for differences in learning styles within each dimension as follows:

- Visual-Verbal Dimension: The differences favored the visual style over the verbal style, meaning that visual students prefer information presented visually through pictures, presentations, and models. They use strategies that involve using colors to organize materials, drawing, and charts, and they prefer seeing relationships and using videos and films[54].
- Active-Reflective Dimension: The differences favored the active style over the reflective style, meaning that active students understand better by doing something using the means they study with: experimenting, talking about it, explaining it to others, and being placed in a problem situation [55].
- Sensory-Intuitive Dimension: The differences favored the sensory style over the intuitive style, as sensory students tend to apply what they learn and are oriented towards facts and procedures. Their preferred information comes through their senses[56].
- Sequential-Global Dimension: The differences favored the sequential style over the global style, meaning that sequential students prefer following precise sequential steps, following a logical path through different parts of the curriculum to find the appropriate information and solution. [57]

The t-test results indicate no significant difference between the training and education groups in the Active/Reflective learning style, suggesting that both groups process information similarly, whether through active engagement or reflective observation, this uniformity might be due to the general nature of these cognitive processes, which are fundamental to learning at all educational levels and are not significantly influenced by the specific focus of training or education. Similarly, the Sensing/Intuitive learning style shows no significant difference between the training and education groups, implying that both groups have comparable preferences for either concrete, practical information (sensing) or abstract, theoretical information (intuitive). This consistency could be attributed to the balanced curriculum that addresses both practical and theoretical aspects, making these preferences stable across different educational and training contexts. For the Visual/Verbal learning style, the significant difference between the training and education groups, with the training group scoring higher, suggests that the training programs may place a

[54] Britt Andreatta, *Navigating the Research University: A Guide for First-Year Students*, 3rd ed (Boston, MA: Wadsworth/Cengage Learning, 2012).
[55] Bette LaSere Erickson et al., *Teaching First-Year College Students*, Rev. and expanded ed, Jossey-Bass Higher and Adult Education Series (San Francisco, CA: Jossey-Bass, 2006).
[56] Mahesh S. Raisinghani, ed., *Curriculum, Learning, and Teaching Advancements in Online Education:* (IGI Global, 2013), https://doi.org/10.4018/978-1-4666-2949-3.
[57] Petros Katsioloudis and Todd D. Fantz, 'A Comparative Analysis of Preferred Learning and Teaching Styles for Engineering, Industrial, and Technology Education Students and Faculty', *Journal of Technology Education* 23, no. 2 (1 May 2012), https://doi.org/10.21061/jte.v23i2.a.4.

greater emphasis on visual learning methods. This could be due to the nature of training, which often involves practical demonstrations, visual aids, and hands-on activities that enhance visual learning. In contrast, education programs might rely more on verbal instruction, such as lectures and readings, which could explain the lower scores in this dimension for the education group. The Sequential/Global learning style shows no significant difference between the training and education groups, indicating that both groups have similar preferences for either sequential learning (following linear, step-by-step processes) or global learning (understanding the big picture and making connections), this uniformity might reflect the structured nature of both training and education programs, which likely incorporate elements that cater to both sequential and global learners.

The t-test results indicate no significant difference between undergraduate and master's students in the Active/Reflective learning style, suggesting that both groups process information similarly, whether through active engagement or reflective observation. Similarly, the Sensing/Intuitive learning style shows no significant difference, implying comparable preferences for either concrete, practical information or abstract, theoretical information. This consistency could be due to a balanced curriculum addressing both aspects. For the Visual/Verbal learning style, the lack of significant difference indicates similar preferences for visual aids or verbal information, reflecting the widespread use of both instructional methods in higher education. However, the significant difference in the Sequential/Global learning style, with master's students scoring higher, suggests a stronger preference for global learning (understanding the big picture and making connections) among master's students. This could be due to the advanced nature of master's programs, which often require integrating and synthesizing complex information, fostering a more global approach to learning.

The ANOVA results indicate that some learning styles, such as Active/Reflective and Visual/Verbal, are uniformly distributed among different student groups. This uniformity suggests that these learning styles are consistently preferred across various groups, implying that educational strategies addressing these styles can be broadly applied without significant customization for different groups. However, other learning styles, specifically Sensing/Intuitive and Sequential/Global, show significant variations among the groups. This indicates that preferences for these learning styles differ notably between groups; such differences suggest that educational strategies need to be tailored to accommodate these varying preferences. For instance, students at higher academic levels might benefit more from abstract and integrative learning approaches, which align with the Intuitive and Global learning styles. In summary, while some learning styles can be addressed with general strategies, others require more customized approaches to effectively meet the diverse needs of students, particularly those at advanced levels who may benefit from more complex and integrative learning methods.

The current study's finding of a predominant visual learning style preference among students at the Institute of Physical Activities and Sports Science and Technology contrasts with several previous studies that highlight a preference for kinesthetic learning styles among sports science students and athletes. For instance, the Bostanci study found a significant preference for kinesthetic styles among sports

sciences students,[58] while Braakhuis indicated elite and sub-elite athletes favored kinesthetic and multimodal methods.[59] Similarly, Peters et al. noted an inclination towards kinesthetic styles in sports programs.[60] The preference for kinesthetic learning was also observed by Ashadi et al. among college student athletes.[61] This discrepancy between the current study and previous research suggests that learning style preferences may vary based on factors such as the specific sample population (e.g., general sports science students vs. elite athletes) and the context of the study. However, the current findings align with Fuelscher et al.'s emphasis on a nuanced understanding of learning styles, as the visual preference highlights the potential benefit of incorporating visual aids in certain educational settings related to sports and physical activities.[62]

The findings of this study on learning style preferences among students in physical activities and sports science programs hold significant importance for enhancing teaching and learning effectiveness in this field. The predominant preference for visual learning styles, in contrast with previous research highlighting kinesthetic preferences, underscores the need for tailored educational strategies that cater to the specific needs of this student population. By incorporating more visual learning aids, such as video demonstrations, diagrams, and interactive simulations, into sports science curricula, educators can better engage students and optimize their learning outcomes. This approach aligns with the visual learning style preference found in this study and has the potential to improve student performance and skill acquisition in sports-related fields. Furthermore, understanding the relationship between learning style preferences and academic achievement can inform the development of evidence-based teaching methods that match students' preferred styles. By adapting instructional approaches to accommodate diverse learning preferences, educators can create more inclusive and effective learning environments that foster student success in sports science education. The findings also highlight the need for further research to replicate the study with larger and more diverse samples across different institutions and countries. This would help assess the generalizability of the visual learning style preference and provide a more comprehensive understanding of learning styles in sports science education. Additionally, longitudinal studies examining how learning style preferences evolve over the course of a student's academic journey in sports science programs could offer valuable insights for curriculum design and teaching strategies. In conclusion, the results of this study on learning style preferences among students in physical activities and sports science programs have significant implications for enhancing teaching effectiveness and student learning in this dynamic field; By incorporating visual learning strategies, adapting instructional methods to match students' preferred styles, and conducting

[58] Özgür Bostanci, "Learning Style Preferences of Prospective Teachers," Asian Journal of Education and Training 6, no. 2 (2020): 232, https://doi.org/10.20448/journal.522.2020.62.231.236.

[59] Andrea Jane Braakhuis, "Learning Styles of Elite and Sub-Elite Athletes," Journal of Human Sport and Exercise 10, no. 4 (2015): 850, https://doi.org/10.14198/jhse.2015.104.08.

[60] Derek Peters, Gareth Jones, and John Peters, "Preferred 'Learning Styles' in Students Studying Sports-related Programmes," Studies in Higher Education 33, no. 2 (April 2008): 160, https://doi.org/10.1080/03075070801916005.

[61] Kunjung Ashadi et al., "Analysis of the Learning Style of College Student Athletes," in Proceedings of the International Conference on Research and Academic Community Services (ICRACOS 2019) (Surabaya, Indonesia: Atlantis Press, 2020), 25, https://doi.org/10.2991/icracos-19.2020.6.

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further research to expand our understanding of learning styles in sports science education, educators can optimize student success and contribute to the advancement of this discipline.

Conclusion

The study applied the Felder-Silverman learning styles model to investigate learning preferences among sports students.[63] Results revealed a predominant visual learning style, followed by sensing and sequential styles. Significant differences emerged across academic levels, with master's students exhibiting more global and intuitive approaches compared to undergraduates. These findings highlight the importance of considering diverse learning styles when designing educational strategies, especially in sports and physical education contexts. The study recommended the following:

- Working on creating training courses for teachers that adopt modern methods and encouraging teachers to consider the learning styles of each student.
- Teachers should identify and understand the learning styles of students during the teaching process.
- Researchers are invited to explore the topic from other perspectives and to start applied studies specific to the specialization.

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