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Determining factors in the systematization of investigative pedagogical practice in physical education, recreation, sport, and sports administration

Factores determinantes en la sistematización de la práctica pedagógica investigativa en educación física, recreación, deporte y administración deportiva

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Abstract. The objective of this work has been to analyze the factors of the systematization of the investigative pedagogical practice in physical education, recreation, sport and sports administration of physical education students at the University of Córdoba, Colombia. The population is made up of 41 students of the program, 100% of the 10th semester students distributed in seven groups of classes that are completing the systematization of pedagogical practices, in the Physical Education, Recreation and Sports program of the University of Córdoba, Colombia. Six dimensions were enabled, extracted from the learning outcomes evaluation rubrics of said program, each of them has four variables which will allow the factorial study. High reliability of the scale was obtained with a Cronbach's Alpha of 0.927, using SPSS 28.0 statistical software, and no value was excluded. The result of the factor analysis demonstrated the one-dimensionality of the variables studied, except for the students' motivation to graduate. Demonstrating that these effectively determine formative research in physical education. The evaluation matrices generated in the factor analysis showed that only physical education and sport are correlated as training needs, the writing of research reports with participation in scientific events, the creation of companies with research projects and research-based learning with project based. Correlating these last two with formative research. In conclusion, the analysis showed that the highest factor loading is research-based learning with a value of 0.936.
Keywords: Pedagogical practices, formative research, physical education, recreation, sports, learning needs, sports administration.

Resumen. El objetivo de este trabajo ha sido analizar los factores de la sistematización de la práctica pedagógica investigativa en educación física, recreación, deporte y administración deportiva de los estudiantes de educación física de la Universidad de Córdoba, Colombia. La población está conformada por 41 estudiantes del programa, el 100% de los estudiantes de 10mo semestre distribuidos en siete grupos de clases que se encuentran culminando la sistematización de prácticas pedagógicas, en el programa de Educación Física, Recreación y Deporte de la Universidad de Córdoba, Colombia. Se habilitaron seis dimensiones, extraídas de las rúbricas de evaluación de resultados de aprendizaje de dicho programa, cada una de ellas cuenta con cuatro variables las cuales permitirán el estudio factorial. Se obtuvo una alta confiabilidad de la escala con un Alfa de Cronbach de 0.927, utilizando el software estadístico SPSS 28.0, y no se excluyó ningún valor. El resultado del análisis factorial demostró la unidimensionalidad de las variables estudiadas, a excepción de la motivación de los estudiantes por graduarse. Demostrando que estas determinan efectivamente la investigación formativa en educación física. Las matrices de evaluación generadas en el análisis factorial mostraron que solo la educación física y el deporte se correlacionan como necesidades de formación, la redacción de informes de investigación con la participación en eventos científicos, la creación de empresas con proyectos de investigación y el aprendizaje basado en investigación con el basado en proyectos. Correlacionando estos dos últimos con la investigación formativa. En conclusión, el análisis mostró que la carga factorial más alta es el aprendizaje basado en investigación con un valor de 0,936.
Palabras clave: Prácticas pedagógicas, investigación formativa, educación física, recreación, deporte, necesidades de aprendizaje, administración deportiva.

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Introduction

Physical education is a fundamental discipline in the educational process of students, it covers physical, cognitive, social and emotional aspects. In this context, the role of the physical education teacher takes on special importance, since he oversees guiding and accompanying students throughout their learning process. In recent years, various studies have analyzed the pedagogical practices of physical education teachers (Betancur-Agudelo et al., 2018), to better understand the challenges and opportunities they face in their work from the approach of experiential knowledge, its impact on the teaching-learning process, reflective practice

For a better development of investigative pedagogical practice, the first step is for it to be included and analyzed from the curriculum in a comprehensive way (Duclos Bastías et al., 2023). Sometimes this is a stigmatized profession from a gender perspective, barriers to overcome (Matus-Castillo et al., 2023) even from research. When the studies by Betancur-Agudelo et al. are analyzed together. (2018), the emergence of a theoretical approach to knowledge in physical education could be established, based on practical experience, reflection on action and adaptation to various educational contexts to respond effectively to the needs of its students.

Another relevant aspect in the training of physical education teachers is the articulation between theory and practice during initial training. Studies such as that of Rodrigues and Ferreira (2022) have addressed this issue, highlighting the importance of future teachers having opportunities to carry out supervised pedagogical practices, where they can apply the theoretical knowledge acquired and develop practical skills. Rodrigues and Ferreira (2022) pointed out that this is a key

space for future teachers to articulate their knowledge with the environment. These investigations have also changed teachers' perceptions of physical education and its impact on other phenomena (Shutova et al., 2018).

It is important that the training needs of students are linked to the planning of pedagogical practices, a student-centered investigation. Another important trend is the inclusion of information technologies (Sousa and Santos, 2021; Shutova, et al., 2018). There are current challenges and problems of physical education in the era of digital and technological changes. Mapping current problems related to physical education in the era of digital and technological changes based on theoretical and research findings is a necessity (Lesková et al., 2023).

It means that there is a wide range of factors that could be present in investigative pedagogical practices to achieve better efficiency in formative research. Research question: What are the factors that affect the systematization of research-based pedagogical practices in the Physical Education, Recreation and Sports program at the University of Córdoba? Considering everything previously stated, we formulate the following general objective: Analyze the factors of the systematization of investigative pedagogical practices in the physical education, recreation, sports and sports administration program. Specific objectives:

1. Identify the underlying structure of the variables related to research-based pedagogical practices, using robust statistical methods.
2. Determine the optimal number of factors that represent research-based pedagogical practices in the program studied.
3. Validate the proposed factor model through a confirmatory factor analysis to ensure the reliability of the proposed model.

Materials and Method

The article is structured in an individual factor analysis of each dimension studied. The correlation matrices are included to determine, in addition to the factor loadings within the factor, also the relationship of the variables. Factor analysis is a complex technique, so it is important to check its theoretical and practical elements of multivariate statistics to carry out this analysis effectively.

In this sense, the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO), Bartlett's Test of Sphericity and the total explained variance will be checked, as statistics that establish whether factor analysis is feasible or not (López-Aguado & Gutiérrez -Provecho, 2019).

Procedure

The procedure consisted of seven stages, each of them validated and applied, with the collaboration of the teachers of the groups studied:

Stage 1. Data preparation: The instrument was applied in questionnaire format in each of the seven groups that made up the sample.

Stage 2. Selection of the type of factor analysis: It was determined that in the first phase an exploration factor analysis (EFA) would be applied to later develop a confirmatory factor analysis (CFA). The EFA would identify the underlying structure of the variables, while the CFA validated the predefined factor structure.

Stage 3. Evaluation of the adequacy of the data: Before conducting the factor analysis, it was important to evaluate the adequacy of the data for this type of analysis. This included verification of adequate correlation between variables, scale reliability, Kaiser-Meyer-Olkin Measurement testing of sampling adequacy, Bartlett Sphericity, and total variance explained.

Stage 4. Selection of factor extraction method: Various factor extraction methods were chosen, such as principal components method (Least number of possible factors), maximum likelihood (Best-fitting factors), principal axis factoring (Factors latent) and Alpha factorization (Maximizing Factors), involving the reduction of the dimensionality of the data to identify the underlying factors (López-Aguado & Gutiérrez -Provecho, 2019):

1. Principal components: This method establishes uncorrelated linear combinations of observed variables, where the first component explains the maximum variance and the subsequent ones explain progressively smaller proportions. Although it is the default method in software and always provides a solution, it is more suitable for reducing the number of variables than for estimating factor models.
2. Maximum likelihood: This method provides estimates of parameters that are most likely to have produced the observed correlation matrix, assuming a multivariate normal distribution. Its advantages include independence from the measurement scale and the ability to assess model fit using a χ^2 indicator. However, it requires multivariate normality, although some authors suggest that it is robust to violate this requirement if the variables are univariately normally distributed.
3. Principal axis factoring: Is a method based on the Least Squares model. Initial estimates of communalities come from the original correlation matrix, with multiple correlation coefficients placed on the diagonal. The resulting factor loadings are used to re-estimate the communalities, replacing the previous estimates on the diagonal. Iterations continue until the change in communalities from one iteration to the next meets the convergence criterion for extraction. It is also based on factor analysis, making it one of the best options for analysis, especially when the assumption of normality is not met. Its main drawback is that it can produce convergence issues, particularly if the sample size is small.
4. Alpha Factorization (Maximizing Factors) focuses on

maximizing the variance explained by the extracted factors. This method is based on the idea that factors should be selected in a way that achieves the greatest amount of information possible from the data. Unlike other factorization methods, such as principal axis factoring or principal component analysis, Alpha Factorization emphasizes maximizing variance rather than dimensionality reduction.

Stage 5. Determination of the number of factors: Using the most common methods, which is Varimax rotation, minimizes the number of variables that have high loadings on each factor (López-Aguado & Gutiérrez -Provecho, 2019).

Stage 6. Interpretation of the results: Once the factor loadings in each method have been examined, it is necessary to interpret the relationship between the observed variables and the identified factors, also considering the variances explained by each factor. Appropriate tests were conducted to verify the suitability of the data for factor analysis, such as the KMO and Bartlett's test of sphericity. Although some factors did not meet all the criteria, informed decisions were made regarding the elimination of items to improve unidimensionality. Furthermore, the exploration of correlations between variables provides valuable information about the relationships between dimensions, which can help identify areas for improvement. The analysis of factor loadings allows for understanding which indicators are most related to each dimension, which is essential for effectively interpreting the results. The study not only presents findings but also suggests areas for improvement, which is crucial for the ongoing development of the program.

Stage 7. Validation of the model with confirmatory factor analysis (CFA): Generating the models using the Lisrel8.80 software (Student), the resulting model was validated using fit indices such as the RMSEA, the CFI, the TLI, among others.

Participants

The population and sample included 41 students who are completing the subject of systematization of pedagogical practices, in the Physical Education, Recreation and Sports program of the University of Córdoba, Colombia in the 10th semester distributed in seven groups of classes. 89% of the sample are men, with an average age between 17-20 years, the rest are women, I feel like they are the minority. 96% of the students come from economic strata 1 to 3, according to Colombian nomenclature. This indicates their low purchasing power. In 85%, the career in physical education, recreation and sports was their first choice, which could be a significant factor in terms of their passion or identification with the profession.

Instrument: Stage 1. Data preparation

The information collection instrument is divided into 6 dimensions and 24 indicators (Table 1) that are broken down into the factors of investigative pedagogical practices and that contribute to the research hypotheses. Furthermore, the dimensions correspond to the identity factors of the program and the mission axes of the investigative pedagogical practices of the Physical Education, Recreation and Sports program of the University of Córdoba, Colombia.

Next, to understand the procedure carried out, it is summarized in a table detailed description of sampling and data collection procedures (Table 2).

Table 1.
Information collection instrument Systematization of investigative pedagogical practice

Variable (Spanish acronyms)	SPPI Dimensions	Ítem	Indicators	Cronbach's alpha	Qualitative assessment
NFE	Student training needs	NFE1	Physical education	0,776	good internal consistency.
		NFE2	Recreation		
		NFE3	Sports		
		NFE4	Sports administration		
CPFI	Continuity of the training process from research	CPFI1	Writing research reports	0,722	good internal consistency.
		CPFI2	Linking to research hotbeds		
		CPFI3	Participation as speakers in scientific events		
		CPFI4	Generation of research products		
EIG	Generative research experience	EIG1	Number of articles published	0,718	good internal consistency.
		EIG2	Number of books published		
		EIG3	Number of book chapters published		
		EIG4	Number of research projects		
MGOP	Student motivation to graduate with degree options for investigative pedagogical practices	MGOP1	Investigation project	0,733	good internal consistency.
		MGOP2	Monograph		
		MGOP3	Company creation		
		MGOP4	New knowledge product (research seedbed)		
APPI	Learning in investigative pedagogical practices	APPI1	Problem-based learning	0,873	high internal consistency.
		APPI2	Research-based learning		
		APPI3	Project based learning		
		APPI4	Formative research		
GCP	Generates practical knowledge	GCP1	Planning physical education classes for different educational levels	0,824	high internal consistency.
		GCP2	Sports training planning for different levels		

	GCP3	Planning recreational programs for different ages and communities		
	GCP4	Administrative management for educational, sports and recreational institutions		
Total		24	0,927	high internal consistency.

Source: Own elaboration and processing in SPSS 28.0

Table 2.
Detailed description of sampling and data collection procedures

Data collection procedures		Description
Sampling Design	Target Population	The target population of the study included all students in the Physical Education, Recreation and Sports program at the University of Córdoba, specifically those in the tenth semester and involved in the subject of systematization of pedagogical practices.
	Sample	41
	Sampling Technique	A non-probabilistic convenience sampling was used, choosing students who were available and willing to participate in the study. This approach allowed access to an accessible and relevant sample for the research objectives
Data Collection	Collection Instrument	Structured questionnaire
	Questionnaire Format	The questionnaire was administered in digital and person format, ensuring that all students had access to the tool.
Application Procedure	Preparation Phase	Before the application of the questionnaire, a brief training course was conducted for the teachers involved, explaining the importance of the study and how data collection would be carried out.
	Questionnaire Application	The questionnaire was administered in a controlled environment, where students completed the instrument in the presence of a facilitator who guaranteed understanding of the questions and confidentiality of the answers.
	Response Time	Adequate time was allocated for students to complete the questionnaire, ensuring that they had sufficient time to reflect on their responses.
Data Analysis	Data Processing	Once the questionnaires were completed, the data were entered into SPSS 28.0 software for analysis. Reliability tests (Cronbach's Alpha) and factor analysis (EFA and CFA) were performed to assess the structure of the data and the validity of the instrument.
Ethical Considerations	Informed Consent	Informed consent was obtained from all participants, assuring them that their participation was voluntary and that their responses would be treated confidentially.
	Anonymity	The anonymity of the participants was guaranteed in the analysis and presentation of results, protecting their identity and ensuring the integrity of the study.

Results

Stage 2. Selection of the type of factor analysis

The evaluation scale that we will use is 1 – 5, where 1 is very bad, 2 is bad, 3 is average, 4 is good and 5 is very good (1-MM 2-M 3-R 4-B 5-MB). The reliability statistics, considering the selected indicators, we have a Cronbach's Alpha of 0.927, which is positive as it rises above 0.7 according to the scientific literature (Hinton et al. 2014). In accordance with the previous approach, the reliability statistics presented are reliable with high internal consistency.

Stage 3. Evaluation of the adequacy of the data

The first step to develop a factor analysis is to verify that it is possible using the Kaiser-Meyer-Olkin Measure of Sampling Adequacy, Bartlett Sphericity, and the total variance explained tests (Table 3).

Table 3.
KMO test, Bartlett and total variance explained by extraction method.

Statistics		NFE	CPFI	EIG	MGOP	APPI	GCP
Kaiser-Meyer-Olkin measure of sampling adequacy		0,734	0,723	0,677	0,556***	0,795	0,770
Bartlett's test of sphericity	Aprox. Chi-cuadrado	49,065	31,578	40,437	30,998	99,085	76,424
	gl	6	6	6	6	6	6
	Sig.	0,000	0,000	0,000	0,000	0,000	0,000
Total explained variance % according to extraction method	Principal component analysis	61.202	55,272	55,576	77,822	74,826	69,878
	Principal Axis Factoring	50.689	51.501	44.986*	55.772	67.879	61.388
	Alpha Factorization	51.314	51.208	65.739 (Excluded EIP1, EIP2)	55.672	68.202	62.437
	Maximum likelihood	50.707	41.568*	**	**	68.048	61.481

*Does not comply ** The number of degrees of freedom (0 or -1) is not positive. This factor analysis may not be appropriate in this extraction method.
*** Several factors are generated.
Source: Own elaboration and processing in SPSS 28.0

The EIP and MGOP do not meet all the criteria for factor analysis in all extraction methods, so their subsequent development requires the elimination of some items so that the factorial one-dimensionality criterion can be met. With the KMOEIP=0.677 (good) and KMOMGOP=0.556 (acceptable), we can proceed with the factor analysis of these variables considering that the results may not be as robust as desired given that the appropriate value is a KMO value for above 0.70. From both, only the loadings from the extraction of principal components will be taken, given that the others do not meet the total explained variance of more than 50%. Before beginning the in-depth study of the loads, the internal correlation analysis of the variables was carried out

(Table 4).

Table 4.
Correlation matrices of items by factors.

NFE	NFE1	NFE2	NFE3	NFE4	CPFI	CPFI1	CPFI2	CPFI3	CPFI4
NFE1	1,000	,465	,514	,264	CPFI1	1,000	,415	,558	,419
NFE2		1,000	,701	,390	CPFI2		1,000	,336	,365
NFE3			1,000	,494	CPFI3			1,000	,312
NFE4				1,000	CPFI4				1,000
EIG	EIG1	EIG2	EIG3	EIG4	MGOP	MGOP1	MGOP2	MGOP3	MGOP4
EIG1	1,000	,109	,160	,329	MGOP1	1,000	-,053	,561	,189
EIG2		1,000	,522	,499	MGOP2		1,000	,212	,436
EIG3			1,000	,658	MGOP3			1,000	,408
EIG4				1,000	MGOP4				1,000
APPI	APPI1	APPI2	APPI3	APPI4	GCP	GCP1	GCP2	GCP3	GCP4
APPI1	1,000	,675	,606	,453	GCP1	1,000	,580	,579	,346
APPI2		1,000	,853	,683	GCP2		1,000	,752	,607
APPI3			1,000	,685	GCP3			1,000	,691
APPI4				1,000	GCP4				1,000

Source: Own elaboration and processing in SPSS 28.0

As observed in NFE, the need for training in Physical Education (NFE1) is related to sport (NFE3), and the latter also with Recreation (NFE2), not showing any relationship with Sports Administration (NFE4), despite being transversal training in the program. In the variable continuity of the training process from research (CPFI), only CPFI1 and CPFI3 are correlated, indicating that there are weaknesses in terms of the link in seedbeds and the generation of research products.

In the generative research experience (GIE), valued from the students' perception, three variables are related, the most significant relationship being the number of book chapters with research projects. MGOP, the weakest variables, according to their results, has only one relationship, which demonstrates its need for improvement. However, in APPI and GCP, the correlations are high, the most significant being Research-Based Learning (APPI2) with Project-Based Learning (APPI3).

Stage 4. Selection of factor extraction method

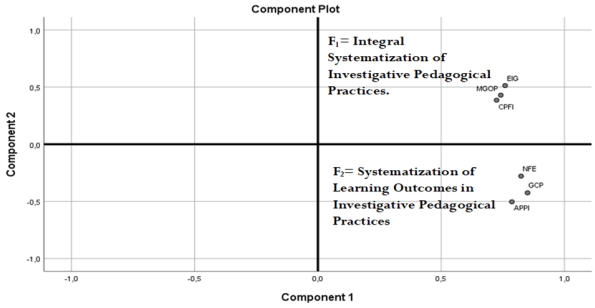
The training needs of the student is one of the variables that must be considered the most, and this is reaffirmed in the value of the factor loadings in the four extraction methods used. In all factors, except for MGOP, the unidimensionality of the variable was met, although eliminating MGOP2, if a single factor was generated. In the case of EIG, it is suggested to eliminate EIG4, since it does not have a factor loading greater than 0.5 (table 5).

By extracting each component of the variables identified as part of the systematization of the research pedagogical practice, it is essential to determine whether at the same time these explain the central variable. The factor analysis determined with a Kaiser-Meyer-Olkin Measure of Sampling Adequacy equal to 0.727, a Bartlett's Test of Sphericity, with Approx. Chi-Square equal to 145.699, df= 15, Sig.=0.000 and a total explained variance of 79.674, that the systematization is not unidimensional, but that 2 components are extracted. Factor 1 (F1), given its composition of variables and factor loading, would be called Integral Systematization of Investigative Pedagogical Practices. While Factor 2 (F2) would be Systematization of Learning Outcomes in Investigative Pedagogical Practices (Figure 1):

Table 5.
Summary matrix of factor loadings by component.

Variables	Extracted component	Extraction method [a]			
		Principal Component Analysis	Principal Axis Factoring	Alpha Factoring	Maximum Likelihood
NFE1	1	0,889	0,916	0,934	0,914
NFE2		0,841	0,776	0,789	0,769
NFE3		0,710	0,567	0,556	0,567
NFE4		0,663	0,513	0,500	0,528
CPFI4	1	0,690	0,541	0,557	0,524
CPFI3		0,752	0,646	0,617	0,665
CPFI2		0,699	0,552	0,575	0,531
CPFI4		0,690	0,541	0,557	0,524
EIG1	1	0,875	not applicable	not applicable	not applicable
EIG2		0,847			
EIG3		0,755			
EIG4		0,413 (Eliminate)			
MGOP1	1	0,881	0,787	0,741	not applicable
MGOP3		0,778	0,604	0,651	
MGOP4		0,640	0,595	0,604	
MGOP2	2	0,510	0,583	-0,497(eliminate)	
APPI1	1	0,936	0,956	0,968	0,950
APPI2		0,918	0,910	0,918	0,901
APPI4		0,814	0,720	0,711	0,728
APPI3		0,781	0,673	0,665	0,693
GCP2	1	0,914	0,927	0,953	0,922
GCP3		0,888	0,857	0,894	0,827
GCP4		0,794	0,697	0,663	0,730
GCP1		0,735	0,613	0,593	0,626

Source: Own elaboration and processing in SPSS 28.0



F_1	F_2
EIG = $0{,}907F_1+u$	NFE= $0{,}947F_2+u$
MGOP = $0{,}861F_1+u$	GCP= $0{,}920F_2+u$
CPFI= $0{,}827F_1+u$	APPI= $0{,}876F_2+u$

Figure 1. Factor loadings. Source: Generated using SPSS 28.0

Stage 5. Determination of the number of factors and Stage 6. Interpretation of the results

All significance values are greater than 0.5, so it is not possible to reject the null hypothesis. This means that the data fit well to the model or distribution being evaluated for each factor. Confirmatory factor analysis. For confirmatory factor analysis, the structural equations method was applied using Lisrel 8.80 (Student). Structural equation analysis followed the same logic of individual equations and then the general equation. In the individual analysis by variables, as can be seen, the MGOP model was not generated (Figure 2).

In this stage of the factor analysis in the NFE model, the needs related to physical education were the one with the highest incidence and in this variable all the relationships were positive. In CPFI, the generation of research products is the variable that has the most impact on the factor, all being equally positive. In APPI, the p-values were low, however, all were positive, with formative research being the strongest. The factor demonstrated needs improvement in the APPI3 and APPI2 variables. The EIG factor is more affected by the number of book chapters published. Finally, GCP, whose most significant variable is GCP4, Administrative management for educational, sports and recreational institutions, has a negative relationship with GCP3, Planning of recreational programs for different ages and communities.

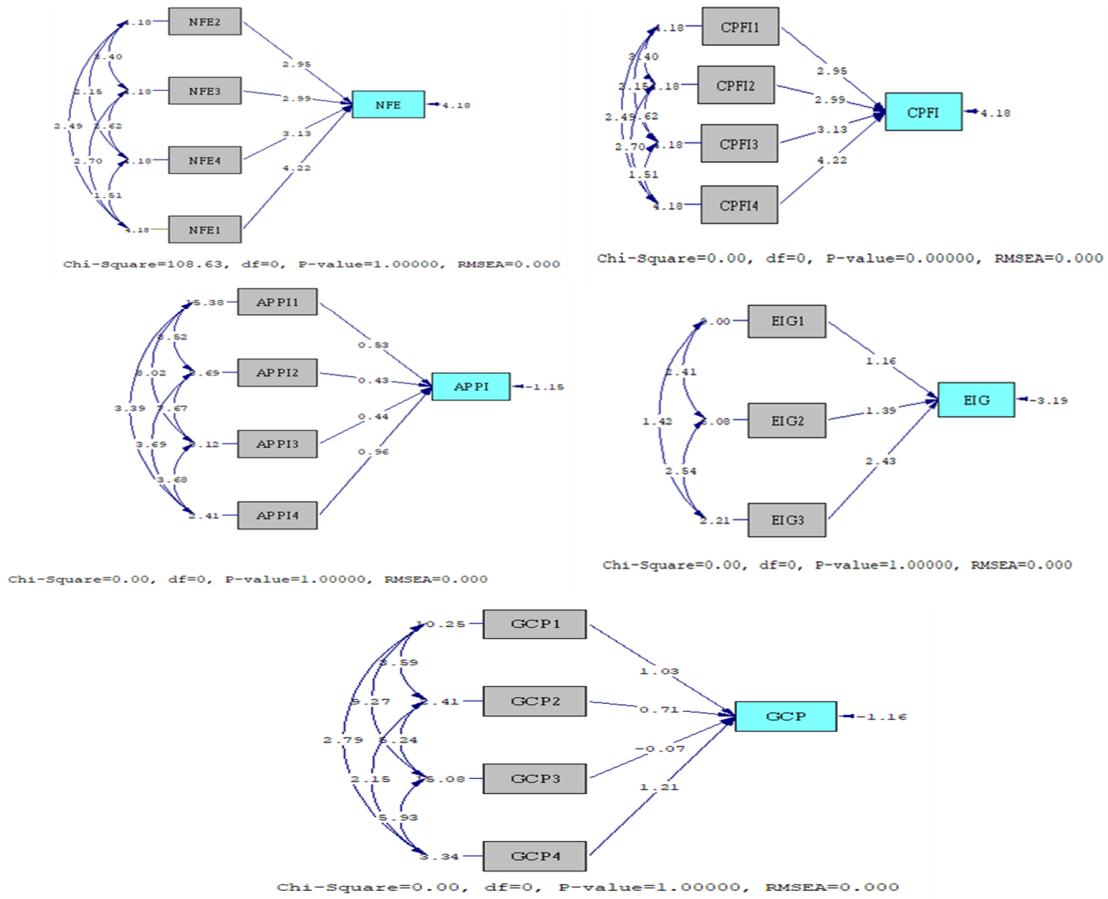
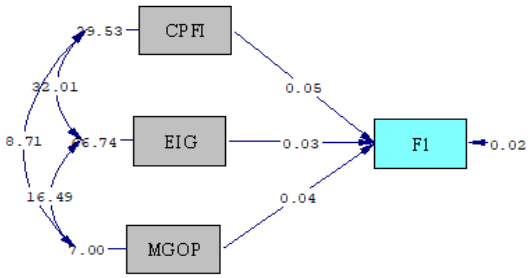


Figure 2. Structural equations Submodels. Source: Generated using Lisrel 8.80 (Student).

Stage 7. Validation of the model with confirmatory factor analysis (CFA)

The errors indicate the variability of the estimated coefficients. R2=0.94 indicates that 94% of the variability in F1 is explained by the variables CPFI, EIG and MGOP, hence a good fit of the model. On the other hand, the highest t values (in absolute value) indicate that there is a statistically significant relationship between independent and dependent variables. The results indicate that they are relevant to predict F1, with a high level of fit and statistical significance (Figure 3).

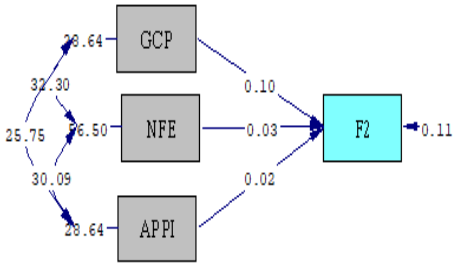


Chi-Square=0.00, df=0, P-value=1.00000, RMSEA=0.000

Figure 3. Structural equations Submodels F1. Source: Generated using Lisrel 8.80 (Student).

$F_1 = 0.046*CPFI + 0.034*EIG + 0.042*MGOP$, Errorvar = 0.02, $R^2 = 0.94$
(0.0066) (0.0054) (0.014) (0.0052)
7.00 6.31 2.94 4.30

The standard errors of the GCP, NFE, and APPI coefficients, respectively, indicate the precision of the coefficient estimates. The error variance is positive, indicating that the model has a level of error that can be considered acceptable. The R2 value indicates that 88% of the variability in F2 is explained by GCP, NFE, and APPI. An R^2 close to 1 suggests that the model fits the data well. However, APPI does not seem to have a significant effect (Figure 4).



Chi-Square=0.00, df=0, P-value=1.00000, RMSEA=0.000

Figure 4. Structural equations Submodels F2. Source: Generated using Lisrel 8.80 (Student).

$F_2 = 0.098*GCP + 0.034*NFE + 0.025*APPI$, Errorvar.= 0.11 , $R^2 = 0.88$
(0.026) (0.012) (0.023) (0.025)
3.82 2.83 1.08 4.30

The general model of structural equations generated by R shows that the factor with the greatest impact on the Systematization of research-based pedagogical practice is factor F1. This has to do with the comprehensiveness of the systematization (Figure 5).

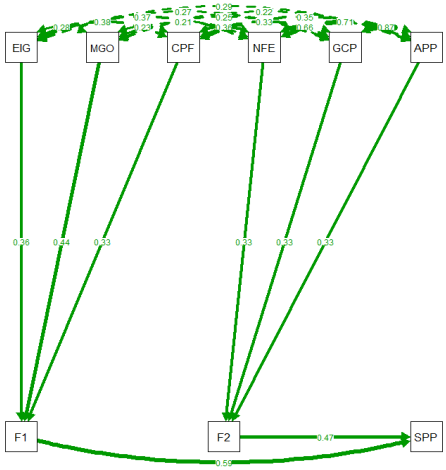


Figure 5. Structural equation model. Source: Generated using R.

Discussion

Physical education and pedagogical practices in the university environment have been the subject of numerous studies that seek to improve the quality of teaching and learning. In this report, the similarities and differences found in the results of several recent studies are discussed, highlighting the implications of these findings for teacher training and the implementation of effective pedagogical practices.

In a Latin American context, this could constitute a valuable analysis of the teacher's role and the dynamics of teaching (Betancur-Agudelo, et al., 2018). Teacher reflective practice and its relationship with professional development is crucial in education (Marín Cano et al., 2018; Alatrista-Aguilar, & Saavedra-Carrion, 2024). On the other hand, Bermúdez Rico et al. (2021) highlight the importance of considering gender equity in higher education; physical education practice must always take this element into account (Pérez Herrera & Cadavid Velásquez, 2024).

It should also be noted that conceptions of childhood influence the pedagogical practices of early childhood education teachers (García Martínez and Osorio Díaz, 2020). Therefore, it is necessary to always have, according to Orozco-Sánchez and Ayala-Zuluaga (2020), feedback on the practices, thus allowing their enrichment. This has allowed for different innovative approaches in self-assessment processes within a physical education program (Betancur-Agudelo et al., 2021).

One of the main similarities between the studies is the importance attributed to the practical experience of teachers in the training of students. This finding is consistent with the study by Betancur-Agudelo et al. (2018), who also highlights the relevance of the pedagogical strategies used by physical

education teachers and their impact on student learning.

Another common point is the positive perception of students about competency-based curricula. Duclos Bastías et al. (2023) analyze the perception of university students about the competency-based Physical Education curriculum, finding that students positively value this approach due to its relevance and applicability in the professional context. This result is supported by identify effective pedagogical practices in the initial training of physical education teachers, highlighting the importance of a competency-based approach to prepare future teachers.

The influence of basic physical skills on the cognitive process is another recurring theme. Despite the similarities of our results with the references investigated, there are also notable differences between our results and these studies. A significant difference refers to the use of technology in physical education.

While some teachers viewed TIC as a valuable tool for maintaining educational continuity, others faced significant challenges related to the access and effectiveness of these technologies. This aspect was not addressed in other studies reviewed, highlighting a difference in research approach.

Another point of divergence is the gender perspective in physical education. Matus-Castillo et al. (2023) investigate the beliefs and practices about the gender perspective in Physical Education Pedagogy teachers in Chile, finding that, although there is progress, significant barriers persist for the full integration of the gender perspective in pedagogical practices. López Trujillo et al. (2022) demonstrate the importance of pedagogical practice and educational games in schools. This specific focus on gender perspective is not found in other studies reviewed, underscoring a less explored but crucial area of research for equity in education.

Additionally, Cortés Muñoz (2021) presents a state of the art on the relationship between research and educational policies in Colombia. Among his conclusions, he highlights the close relationship that exists between these categories in the country, which leads to the fact that public policies are essential in all educational branches at the national level.

Furthermore, the transition from instrumental pedagogical practice to reflective practice is another issue that shows differences. This reflective approach contrasts with studies that focus more on the application of specific pedagogical practices and less on critical reflection on those practices.

The findings of these studies have important implications for teacher training and the implementation of pedagogical practices in physical education. First, the integration of practical experiences and experiential knowledge should be a priority in teacher training programs, as this enriches learning and better prepares future professionals. Programs should include opportunities for students to participate in supervised practice and reflect on their experiences.

A competency-based approach is crucial for the training of physical education teachers. This approach not only ensures that future teachers acquire the necessary skills, but also promotes more relevant and applicable learning in the professional context. Curricula should be designed to include key competencies and assess students' progress in these areas.

The integration of technologies in physical education must be approached strategically. Since perceptions and adaptations to TIC vary, it is important to provide adequate training and resources to teachers so that they can use these tools effectively. Additionally, access barriers must be considered and work to overcome them, ensuring that all students can benefit from TIC.

The gender perspective and reflective practice must be integral components of teacher training. Physical education must be inclusive and equitable, and teachers must be prepared to address and overcome gender barriers. Encouraging reflective practice will allow teachers to better adapt to the needs of their students and continually improve their pedagogical methods.

Based on the previous discussion of the results, promising future lines of research can be identified in the scientific area of physical education and pedagogical practices in the university setting. Some of the possible areas of research include:

- Impact of technologies on Physical Education: Further investigate the impact of information and communication technologies (TIC) on the teaching and learning of physical education, especially in crisis contexts such as the COVID-19 pandemic. 19. You can explore how TIC can improve accessibility, quality and equity in physical education.

- Gender perspective in Physical Education: Deepen the study of the gender perspective in physical education and pedagogical practices, investigating how gender barriers can be effectively addressed and promote equity in this field. You can explore how gender inclusion impacts student learning and engagement.

- Development of teaching competencies: Investigate the necessary competencies for physical education teachers in a constantly changing educational environment. Consideration can be given to how these competencies can be developed and assessed to ensure that practitioners are prepared to meet current and future challenges in physical education teaching.

- Reflective practice in Physical Education: Explore in greater depth the importance of reflective practice in teacher training and its impact on the continuous improvement of pedagogical practices in physical education. You can investigate how to encourage critical reflection among teachers and how this influences student learning.

- Innovation in the Teaching of Physical Education: Investigate new methodologies and innovative approaches for teaching physical education that promote more meaningful and motivating learning. You can explore how the integration of new technologies, competency-based approaches and effective pedagogical practices can transform teaching and

learning in this field.

These future lines of research can contribute significantly to the advancement of knowledge around physical education and pedagogical practices, providing new perspectives and approaches to improve the quality of teaching and promote more inclusive, equitable and effective learning in the university community. Another new line of research is how pedagogical practice can contribute to the creation of a teacher's personal brand. This research could explore aspects such as the impact of these practices on teaching, analyzing how the methodologies and pedagogical approaches used by teachers influence their public perception and the construction of their professional identity. Variables such as the use of social media would also be relevant, investigating how teachers can use digital platforms to share their pedagogical practices and build a community around their personal brand, as well as their teaching skills to create and maintain an effective personal brand, such as communication, leadership, and innovation.

Conclusions

The observed variables, later identified as factors, allowed us to determine that the systematization of pedagogical practice, with good internal consistency, can be verified through the student training needs, the continuity of the training process from research, the generative research experience, student motivation to graduate with degree options in investigative pedagogical practices, learning in investigative pedagogical practices and the generation of practical knowledge. Since all the variables allowed their analysis using the principal components extraction method.

Student motivation to graduate with degree options in investigative pedagogical practices is the factor that needs the greatest improvements in the program. This may be since a significant percentage of students end up choosing the diploma option as a form of degree, because the time is shorter, and they can obtain their desired university degree in the shortest time.

Therefore, the program must outline strategies to increase student motivation. These strategies could be providing more personalized guidance and mentoring, curricular flexibility through integrative projects, offering resources and support tools, generating communities of systematization of practice on the institution's virtual platform where program students can share ideas, solve problems and provide mutual support during the process. Another important strategy is the linking of graduates to the feedback process of the systematization of pedagogical practice, mainly success stories.

Another important conclusion is that the variables with the highest internal correlation are learning in investigative pedagogical practices and the generation of practical knowledge. The other variables have a moderate internal correlation. The greatest concern could be in the training needs, which according to the name of the program should be the most correlated, showing sport as the central axis and recreation as the most correlated. This could constitute a contradiction because it is a bachelor's degree, and this should be the focus of the pedagogical activity to be developed. Although the program in its curricular framework has a high sports administration component, in the systematization of practice this element is not correlated with any other training needs.

According to the extraction method, generative research experience and student motivation are not feasible to obtain factors that best fit, they do not have latent or maximizing factors. Students are not generating feasible research projects and again the lack of motivation is reflected. The fundamental finding found is that the systematization of the investigative pedagogical practice in physical education, recreation, sport and sports administration, is divided into two fundamental determining factors: Factor 1 (F1), Integral Systematization of Investigative Pedagogical Practices and Factor 2 (F2) Systematization of Learning Outcomes in Investigative Pedagogical Practices.

The limitations of the research are that the population is so small, although it represents 100% of the students in the internship program. Longitudinal research could be carried out to extend the study to other years. There was a risk that participants would provide answers that they consider socially desirable, feeling that they could be evaluating the work of their teachers. The findings are contextualized in the University of Córdoba, which could limit the applicability of the results to other educational institutions with different programs and pedagogical approaches. Some variables, such as students' motivation to graduate, showed lower performance in the factor analysis, suggesting that they may not be fully represented in the model.

As a future line, long-term research could be carried out to evaluate how pedagogical practices evolve and their impact on the professional development of teachers and the training of students. Compare research-based pedagogical practices across different universities or physical education programs to identify best practices and areas for improvement. Include graduates of the practices to understand their motivation as employees. Extend the studies to pedagogical interventions and investigate the competencies needed by physical education teachers in a constantly changing educational environment.

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