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Pedagogical practice and academic performance in mathematical processes: A descriptive - correlational analysis

C A Hernández Suarez¹, R Fernández Cèzar², and R Prada Nuñez¹

¹ Facultad de Educación, Artes y Humanidades, Universidad Francisco de Paula Santander, San José de Cúcuta, Colombia

² Facultad de Educación, Universidad de Castilla-La Mancha, Toledo, España

E-mail: cesaraugusto@ufps.edu.co

Abstract. This report has aimed to analyze students' perceptions of pedagogical practice in teachers' mathematical processes and analyze the link with their academic performance. The methodology used is quantitative, articulated with two study analyses, descriptive and correlational, under a non-experimental, correlational-causal cross-sectional design, since it seeks to explain the relationship between the variables. The technique used for data collection was a structured questionnaire, of 47 questions of the Likert Scale type, which was applied to 103 students of the basic education level, belonging to an educational institution located in the "Departamento del Norte de Santander, Colombia", selected by non-probabilistic sampling. This instrument was subjected to the respective analyses that determined its validity and reliability. For the academic performance the average of the accumulated grades obtained at the end of the third academic period, year 2019, was used. The results show that the pedagogical practices on the mathematical processes implemented by the teachers, from the perspective of the students, are a factor in the academic performance of that area.

1. Introduction

Education is the means to humanize society, it is indispensable to build the formative processes, and in this way the progress and advances for the development of people. It has a decisive role in strengthening competencies, knowledge and attitudes which guarantee the stability and permanence of the students. Therefore, the educational approach calls for transcending pedagogical practices. It is observed how the practices are not updated, they are still traditional and instrumental, disjointed from the theory, where the student adopts a passive posture, conforming to receiving only instructions that are not reflected. Despite the existence of this reality, there is no evidence of changes to the educational process from the curricula, in addition to this the teachers seem to have naturalized the problem, reflecting in the student demotivation and limitations in their academic performance, evidencing in the dropout, that it manifests itself with, recidivism in the insufficient or low, high level of requests for academic recoveries, school absenteeism, bad relations with teachers, inappropriate learning environments, among others, especially in subjects such as mathematics.

Therefore, the understanding of the pedagogical practices is required in such a way that they become reflective, both for the teacher and for the student, justifying new ways to create and innovate the teaching-learning processes. Pedagogical practices must be reconsidered from pedagogy, involving their institutional framework, systematization and organization around the teaching-learning processes, based



on the pedagogical interventions that emerge in the experiences of training of integral and autonomous subjects, capable of solving the different situations that arise in their educational and personal context.

In this context, it is intended to recognize the role that actors play in the teaching-learning process and its relationship with the evaluation: teacher student. The teacher seen from his pedagogical practices, understood these as the thought and action of this in the classroom. On the other side is the student seen from his academic performance, this, understood from his academic work in the classroom. This is how it is intended to identify the meaning that teachers and students give to their pedagogical actions, where the permanent dialogue generates knowledge that helps make sense of the student's training process. Given the above, the question arises: What are the pedagogical practices on the mathematical processes implemented by teachers at the level of basic education and its relation to academic performance?

2. State of the art and theoretical framework

In most of the works in which students 'academic performance is analyzed, students' sociodemographic variables are considered: personality, intelligence, anxiety, self-concept, socioeconomic level among others [1], but scarcely with aspects related to teachers (as is the pedagogical practice) seen from the perspective of the students; relationship that is widely debated, but not studied because empirical tests are few. In this sense, it is decided to explain how pilot study the relationship between pedagogical practice in the mathematical processes of mathematics teachers, seen from the perspective of the student and their academic performance, and compare with other similar studies conducted in other contexts Educational In this way it was tried to confirm or not the relationship between two variables that are part of the educational process.

This work was carried out in an educational institution of basic and medium of the Colombian context, to determine to what extent there is a relationship between the pedagogical practice of the teacher of mathematics, in relation to the mathematical processes and the academic performance of the student considering that in the last decades the “Ministerio de Educación Nacional de Colombia (MinEducación)”, is updating the regulations for national curricula in the levels of basic and secondary education (“lineamientos curriculares de matemáticas” [2], “estándares básicos de competencias en matemáticas” [3], “los derechos básicos de aprendizaje en matemáticas” [4], among others), it is considered important to work on this relationship as devices that can strengthen student permanence and avoid student repetition and dropout.

In reviewed studies it was found that there are other researchers who formulate questions related to pedagogical practices and academic performance in various areas of training, which can be evidenced in the following investigations: [5-7], and especially in mathematics [8-10] among others. This route shows that the problem posed has been studied in other contexts, since it allows expanding the research heritage on the subject, therefore, it will be for the benefit of the academic community, and the findings will contribute to success in the training processes and to rethink the didactics for its transformation in pedagogical practices and in the educational context in order to improve the academic performance of students.

The complexity of academic performance starts from its conceptualization, it is sometimes called school aptitude, academic performance or school performance, but generally the differences in concept are only explained by semantic issues, since generally, in the texts, the school environment and the teaching experience, are used as synonyms [11]. It is stated that one of the variables most used or considered by teachers and researchers to approximate academic performance are grades; therefore, there are studies that aim to calculate some reliability and validity indices of this criterion considered as 'predictive' of academic performance. The grades reflect the assessments and/or exams where the student must demonstrate their knowledge of the different areas or subjects [12].

Academic performance is conceptualized as a “construct capable of adopting quantitative and qualitative values, through which there is an approximation to the evidence and dimension of the profile of skills, knowledge, attitudes and values developed by the student in the teaching-learning process” [11]. Several factors are involved in academic performance, including personal aspects (cognitive, biological and socio-affective) of the student and contextual aspects (social and cultural) [13]. In a

student, an "unsatisfactory academic performance is one that falls below the expected performance" [14]. It is understood that the qualifications obtained by the students who participated in this research, the teachers should have considered the aspects mentioned above. In this way, it is essential to analyze how the pedagogical practices of mathematical processes are related and their relationship with academic performance, the latter, related to the integral training in the significant learning of students and to be able to approximate some emerging categories of this relationship.

On the other hand, with respect to the term pedagogical practice, departing from the conceptual and theoretical differences that may appear (pedagogical, educational, teaching, professional practice), it will be assumed as a concept of pedagogical practice, the set of actions performed by the teacher, in those that involve conceptions of curriculum, pedagogy, didactics and, in general, those constitutive fields of the teaching being [15]. In the words of this author, the pedagogical practice, not only involve techniques to teach, but also, the intention of teaching with a high dose of self-reflection, to review the positive and negative of them; and in this way innovate so that they generate impact and make a difference in the educational field. In this sense, the pedagogical practice must allow the process of integral formation in the student, since such practices are objectified to teach, communicate, socialize experiences and evaluate the formative processes of the student (academic performance).

The aforementioned about academic performance and pedagogical practice, make reference to the general, but this paper emphasizes the pedagogical practices of teachers who guide mathematics, which emphasizes the mathematical processes that students must develop to acquire the concepts and apply in the different contexts that are evaluated and allow to determine their academic performance in this area. The mathematical processes mentioned are problem solving; reasoning and proof; communication; connections and representation of the National Council of Teachers of Mathematics (NTCM), United States [16]. In Colombia, according to MinEducación they are resolution and problem solving; reasoning; communication; development, comparison and exercise of procedures and modelling [2-3].

But in this study, to investigate the perception of students about the pedagogical practice of mathematical processes in teachers, the processes of the NTCM, internationally recognized and which, together with the mathematical contents, constitute the set of mathematical knowledge that favor mathematical competence [17]. The mathematical processes of the NCTM are closely related to the mathematical competences in PISA [18], and with the regulations on the mathematics curricula proposed by MinEducación [2-3]. In accordance with the above, it is understood that the NTCM connection process is implicit in the MinEducación processes and similarly the development, comparison and exercise of MinEducación procedures are implicit in the NTCM processes.

3. Method

3.1. Approach and design

The research approach is quantitative; In terms of design, it is non-experimental, correlational-causal, as it allows determining the relationships between pedagogical practice in mathematical processes and academic performance.

3.2. Population and sample

The population was made up of students, between male and female gender, enrolled in 2019 at the "Institución Educativa Nuestra Señora de las Mercedes" in the municipality of Sardinata, Norte de Santander, Colombia. Likewise, teachers who were responsible for the orientation of the area of mathematics in grades 8th and 9th of basic education were considered. The sample was made up of 103 students who agreed to voluntarily participate in the study, aged between 13 and 15 years.

3.3. Techniques and instruments

The technique used to obtain the data of the present investigation was a survey. As an instrument for the pedagogical practical variable, a questionnaire divided into two parts was used: (1) general data of the student and (2) the dimensions of the pedagogical practical variable in the mathematical processes of

teachers, consisting of five Likert scales: formulation and problem solving (7 items), reasoning and testing (8 items), communication (9 items), representation (7 items), modelling (8 items) and connections (8 items), with a total of 47 items of five options of answers: 1 (Never, with very low rating), 2 (Rarely, with low rating), 3 (Sometimes, with average rating), 4 (Many times, with high rating) and 5 (Always, with a very high rating).

For the pedagogical practical variable in the mathematical processes of the teachers, the questionnaire was adapted and applied to the students of the original made based on the original of Alsina & Coronata [19-20], validated by expert judgment. To guarantee the statistical reliability of the scales, Cronbach's Alpha was calculated, obtaining 0.713 as a result, indicating that it is reliable.

For the academic performance variable, the average of the accumulated grades obtained at the end of the third academic period of the year 2019 was considered, through the bulletins provided by the academic secretariat of the educational institution under study. The assessment of the averages achieved is as follows: 1.0 – 6.9 low performance, 7.0 – 8.4 basic performance, 8.5 – 9.5 high performance and 9.6 – 10 superior performance. These assessments were adjusted to the national scale proposed by Decree 1290, which regulates the evaluation of student learning and promotion of the levels of basic and secondary education [21].

3.4. Process

The written permission and authorization were requested from the Rector of the educational institution. The data was obtained during class development, in coordination with the classroom teacher. Before the students answered the questionnaire, the pertinent indications were given. There was the collaboration of an assistant in the application of the questionnaire.

3.5. Information processing and analysis

SPSS software was used for statistical hypothesis contrasts and correlation calculations; and for the presentation of the results, Excel was used. To determine the degree of association (correlation coefficient) between the study variables, Spearman's Rho was used with which the dependence or independence of two random variables can be determined [22]. The Spearman Rho correlation coefficient is the coefficient using when the variables are ordinal and/or the normality assumption is breached (non-parametric approximation). This coefficient is very useful when the number of pairs of subjects to be associated is small (less than 30). It is a dimensionless value that ranges between -1 and $+1$. The zero value is given when there is no correlation between the analysed variables; the value -1 implies a perfect correlation of an inverse (or indirect) character and the value $+1$ a perfect correlation of a direct type (when one grows, so does the other) [23].

3.6. Hypothesis testing

Procedure that consists in contrasting a claim about the ownership of a population and using statistical evidence to confirm or refute it. In accordance with the above, for this pilot study, the following were proposed for the hypothesis test:

- H_1 : There is a relationship between pedagogical practice in the mathematical processes of teachers and the academic performance of students.
- H_0 : There is no relationship between pedagogical practice in the mathematical processes of teachers and the academic performance of students.

4. Results

4.1. Pedagogical practice in the mathematical processes of teachers

The perception of the students in relation to the level of pedagogical practice in the mathematical processes of the teachers in the studied population exposes that about 47.6% of the students think that the teacher has a medium level followed by 43.7% who consider that it is between high and very high.

4.2. Academic performance

Regarding the level of academic performance of the students under study, about half of them (43.7%) have a basic performance (7.7 on average), followed by high performance (26.2% with a 9 on average), and 11.7% with superior academic performance; while 18.4% of the students perform poorly.

4.3. Academic performance and pedagogical practice in mathematical processes

Table 1 shows the Rho correlation of Spearman between the pedagogical practice variables in the mathematical processes and the academic performance, a positive correlation is observed, that is, the teacher's better pedagogical practice, the better the academic performance of the students and vice versa. In addition, the strength of association between the study variables is strong ($r = 0.705$) and this correlation is very significant at the level of $p < 0.01$. The null hypothesis (H_0) is rejected if $p = 0.000 < 0.01$, resulting in a significant relationship between teacher teaching practice and academic performance in students in grades 8th and 9th during the third period of the institution's 2019-year Educational object of study.

Table 1. Relationship between the level of academic performance of students and pedagogical practice in the mathematical processes of teachers.

		Correlations	
		Academic performance	Pedagogical practice in mathematical processes
Rho de Spearman	Academic performance	Correlation coefficient	1.000
		Sig. (bilateral)	.
		N	103
	Pedagogical practice in mathematical processes	Correlation coefficient	0.705 ^a
		Sig. (bilateral)	0.000
		N	103

^athe correlation is significant at the 0.01 level (2 tails).

5. Discussion

In the present investigation the great majority (91.3%) consider that the pedagogical practices have a medium-high level. From the perspective of the students, the pedagogical practices of these teachers are innovative, which reject traditional teaching models and support a student-centered education and needs [24]. In relation to academic performance, 91.6% of the students are between the basic and higher levels, of which 43.7% are in the basic level with a 7.7 grade point average, a scale from 1 to 10. These results they seem to indicate that students have a passing performance level, influenced by pedagogical practices with mastery of math content by the teacher [25]; which allows a better understanding and learning of the topics of mathematics by students [26].

This study confirms the research hypothesis because there is a significant relationship between the pedagogical practice in the mathematical processes and the academic performance of students in grades 8th and 9th of basic education of the educational institution subject to study having obtained results that maintain that the teacher's innovative attitudes and teaching styles are related to high academic performance [27].

Likewise, the strength of association between the study variables is strong ($r = 0.705$), although other similar studies indicate very weak correlations, so the relationship is not significant between the study variables such as the teaching attitude with dimensions such as orientation. and school environment (linked to pedagogical practice) and the academic performance of students [28], which is why it is necessary to expand the study in question with more students and educational institutions, since it seems that there are other variables related to characteristics own, such as the beliefs and attitudes of teachers, important components to understand pedagogical practice. Teaching practice cannot be studied without analyzing the affective and personal component of the teacher [29]. Likewise, in the analysis of academic performance it is necessary to take into account, in addition to the teaching variable associated with the pedagogical practice of the teacher, more study variables such as student skills, academic

programs, educational policy, school climate, the various teaching and home strategies among others [30].

6. Conclusions

We analyzed the partial results (pilot study) of the relationship between pedagogical practice of mathematics teachers and analyzed the link with their academic performance in a basic education institution, specifically 8th and 9th grade. As corresponds to a pilot study, the purpose of this study has not been to generalize this relationship but to have an approximation (partial results) in order to determine more precisely the relationship between these variables in a subsequent study that includes a larger number of students of all the degrees of different educational institutions of the “Departamento del Norte de Santander, Colombia”, in order to establish a triangulation between the background and the theoretical positions that support it, to give an account of the logics that explain their perceptions about the pedagogical practice in the mathematical processes of teachers, depending on the academic performance and in light of each of the hypotheses raised.

This pilot study shows that there is a significant relationship between pedagogical practice in the mathematical processes of teachers and the academic performance of students in the educational institution under study, because the results show that 81.6% of students It has an academic performance of approved. Regarding their perception regarding the pedagogical practice in the mathematical processes of teachers, it is considered medium-high (91.3%). The above shows a positive correlation (the better pedagogical practice on the teacher's mathematical processes, the better the academic performance of the students and vice versa). In addition, the strength of association between the study variables is strong ($r = 0.705$) and this correlation is significant at the level of $p < 0.01$.

Finally, given that the present study offers evidence that suggests that the pedagogical practices on the mathematical processes implemented by the 8th and 9th grade teachers at the “Nuestra Señora de las Mercedes” Educational Institution of the municipality of Sardinata, Note de Santander, Colombia are a factor in the performance of this area and that they are endorsed by other studies, the mechanisms of mathematical training of teachers must be strengthened that allow to contribute to an improvement in the quality of education of students and the institution itself.

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