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Descriptive analysis of storytelling concepts in physics

J P Rojas-Suarez¹, H J Gallardo Pérez², and M Vergel-Ortega²

¹ Departamento de Construcciones Civiles, Vías y Transporte, Universidad Francisco de Paula Santander, San José de Cúcuta, Colombia

² Departamento de Matemáticas y Estadística, Universidad Francisco de Paula Santander, San José de Cúcuta, Colombia

E-mail: mawencyvergel@ufps.edu.co

Abstract. The research identifies storytelling concepts in Physics from university professors. The research follows a qualitative approach applied to 250 participants from universities in the department Norte de Santander, Colombia. The design implements as an interview technique the Socratic dialogue and as a quantitative support used elements of the correlational design. Interview and virtual survey instruments had a kappa index equal to 0.8 and $\alpha = 0.78$. The results identify three categories associated with the application of science, the function of the history of Physics and scientific production. It is concluded that participant's concept storytelling is the art of telling a story in motion and a didactic resource associated with approaches, the development of skills, useful to analyse the development of discoveries in Physics, its actors, its application in scientific advances and its contribution to innovation and community development. Classical mechanics, electricity and magnetism with storytelling, identifies in physical science axiological aspects associated with tradition; epistemological aspects associated with experimental physics; and critical aspects.

1. Introduction

Literature narrates the power of stories from anthropological, commercial, psychological views [1], it is from the importance given to metalinguistic phonological skills that in Physics is justified by the very alphabetic nature of the writing system, since in the alphabetic system graphic representations transcribe the sounds of oral language, Thus narration, visualization comes to life in Physics through stories that become useful in such diverse ways that some authors have necessarily wondered about their evolutionary function [2], storytelling is used without translation to refer to applied narration [3]; However, they can function in front of one audience or at a certain time and fail at another [4].

Their ability to achieve a given purpose depends on what the story tells, who tells it, how it is told, where it is told, when it is told, for whom it is told, with whom it is told and against whom it is told, among other symbolic and social variables. The study of oral narration invites interdisciplinary, and in articles we glimpse the historical, sociological and textual approach [5] immersed in theories of myth which interprets it as a form of explanation [6], a symbolic declaration whose function is not explanatory, but expressive [7], an expression of the unconscious [2], a function in the creation and maintenance of solidarity and social cohesion [1]; which emphasizes its legitimizing function of social institutions and practices [7]; a symbolic expression of the pre-structuralism social structure [8], from the sociological theories of myth emerge as a reaction to the non-sociological theories [6], which ignore the importance of the social contexts where they are generated, circulated and used [3] storytelling thus began to be used for forgiveness and catharsis as a therapeutic discourse that permeated organizations



from the truth and peace commissions, functioning as a disciplined power [9], rather than to confront questions of structural violence and political asymmetry [9]. Moerman [10], a physician in the emergence of narrative medicine, incorporated as a placebo effect the symbolic aspects that might be influencing the improvement of patients, attributing to it psychological and physiological effects of meaning in the treatment of illness to provide comfort and security in the patient medical relationship [11].

From the scope of the evaluation and results of national and international tests, it is shown [1] the need to generate a culture towards reading [12], to meet challenges that allow students in the fourth and fifth primary grades of basic education to awaken their love for the production of texts through self-learning, working in cooperative teams that allow them to develop thought and develop skills [13], that lives, thinks, feels, desires and their reality in life is more reflective, critical, analytical, considered, reasonable, formulates solutions to problems [13]. To identify conceptions from the storytelling master in such a way that an action that as scientists of other areas have done it in their context by changing methods of medical identification and treatment converges is an initial task that also potentiates and transforms into mathematical education the homeostatic cultures [14], anchored in the present, where memories considered not useful are continually discarded, identifying conceptions seeks to identify no longer asymmetrical and hierarchical visions but to conceive Physics from oral narration from language, a narrative, an experience that develops and shines for a brief period of time and then disappears or that which shines for a long time and lasts [14].

2. Methodology

This study was framed within a qualitative approach, using stages suggested by Massaro [15] to approach from a therapeutic effect of stories in Physics, where the interviewer listens without interruption, creating awareness where cultural and narrative competence emerges, in order to identify and take into account the student's cultural code for inferior meanings [16].

The process of exposition and interpretation of the results originated from the main research findings in relation to the interviews conducted with each key informant; Tables and graphs were constructed for systematic examination. In search of relevant information on conceptions for the implementation of a didactic model, we relied on participatory observations and field notes. In this sense, as a postulate of qualitative research, researchers are protagonists of experiencing the didactic task of key informants as a strategy to observe their practice in the context of teaching Physics, specifically in the revision of plans and the approach to learning projects considered as an important element of the research process.

In this way, the result of the categorization process is presented in search of exploring the influence of these environments on the appearance, development and results of student performance, and at the same time, in the opposite sense, of low performance in these environments co-created between teacher and student as was done between doctor and patient in medical studies [10], contributes to give meaning to the experience and to reformulate it with new meanings and bring them to expressive writing, relied on word circles [17] in discussion workshops, creative and artistic processes and projects of life stories and oral history, and the emphasis of some on the process (group methodologies) and others on the final product (vis a vis methodologies). The investigation was based on the design correlational type [4], participants [5] were gathered from teacher of Norte de Santander, Colombia.

The participants were given the e-mail address of the primary researcher and the thesis chair if they required any information after they had completed their participation [6]. Instruments were interviews and survey virtual. The sampling was stratified in three quotas, was carried out by municipality, commune and institution and, was constituted by 250 teachers. The reliability of the instruments was $\alpha = 0.78$ and $k = 0.8$.

The second phase of the methodology, which includes the identification of perceptions and associated conceptions in order to characterize them and identify key needs of these members of the academic community, outcome variables and the parameters or input variables that affect teaching and learning processes in physics from each pedagogical model implemented in each institution. The third stage comprises data analysis and implementation of cause and effect hypothesis tests. On the other

hand, phonological processing test [18] was applied to establish the ability to discriminate, segment and integrate the linguistic units or phonemes of the language, in order to decode the written language [19]. It consists of 5 subtests, each with maximum scores, in auditory discrimination (21 points), auditory-phonemic sequence (12 points), segmentation of words according to their phonemes (15 points), oral inversion of syllables and oral inversion of syllables (16 points). The data were submitted to a descriptive analysis to establish the corresponding statistics and to a correlational analysis that required, in the first instance, to verify the normality of the distribution of the data for the variables reading level, writing level and phonological consciousness level, by means of the Kolmogorov-Smirnov test [20], and then to use Pearson's parametric test [21] to establish the correlations at a significance level of $p < 0.05$.

3. Results

Around the physics elicited uncritical responses are evidenced in storytelling with terms associated with phenomena in physics, where issues of optics, quantum mechanics, by distractors that contain elements that are identified with more mechanical routines than experimental, while in classical mechanics, electricity and magnetism are identified axiological aspects associated with tradition, discourse and imagery that inhabit from applied mathematics, epistemological associated with experimental physics, as basic and applied science; and historical and critical aspects, where image and scenarios play an important role both in physics and in its teaching based on storytelling, development of the environment, generation of new elements or mechanisms that transform society and improve living conditions; that show conceptions in physics and in storytelling, where physics teachers enhance their creative and artistic activity based on their level of knowledge, experiences, capacities, level of experimentation, skills and level of depth in their actions as generators of knowledge in this science.

The qualitative analysis allows to distinguish categories, the first conception storytelling is considered as an art of storytelling and a didactic resource associated to approaches (Table 1) in which goes from a development process that initially, the intention of the teacher is that the student remembers to obtain a good performance through the reproduction as literal as possible of the information, then enters the phase of memoristic learning of the relevant information.

Table 1. Approaches from the conception of storytelling in teachers.

	Intention	Strategy	Attribute
Superficial	Memorization	The graph to attend the acceptable memory	Acceptable
Relationship pro-social	Communication motivation	History in the teacher-student relationship	Acceptable
Comprehension	Development of thought from memorization seeks	Comprehension understanding of meanings	Complies
Training	Development skills	contribution to integral formation	Complies
Deep	Capacity building	Capacity building, skills personal awareness meta-learning capacity	Complies

In the next stage the benefit of communication is discovered by trying to establish relationships of affection and student teacher motivation so that the student understands the subject before memorization. A next stage in which the intention is for the student to understand and obtain good results through the combination of visualization, comprehension and memorization. It recognizes the value of comprehension, but it is known the need to reproduce informative material for evaluation. Both states are intended to be conjugated. The fourth state is associated with training, where the teacher associates learning as an attempt or degree of organization or interrelation of concepts before its memorization oriented to the development of skills not only of drawing but of attention, domain of subject and concept.

Finally, the approach given by some teachers towards the direction of a deep critical approach is identified; the intermediate position is adopted by those who intend their students to understand the learning materials, but who are also interested because they manage to contextualize the conceptions from the historical narrative of their emergence and development so that they not only retain key information to successfully pass their exams or complete assigned learning tasks, but also transform the

historical becoming and seek its application in other areas or sciences or produce new knowledge from personal consciousness and meta-learning.

A second emerging category is associated with storytelling in the development of competencies (Table 2), from the acquisition of knowledge through the use of study skills in the preparation of assessment tasks that involves the appropriate use of strategies for learning texts, participation in reading and especially in preparation for tasks or exams, teachers mention the comic strip to improve analytical capacity, synthesis, productivity, communication where interpretative competence in Physics is transversal and associated with competences in written production, argumentative, critical reading and oral fluency, others as social, listening capacity, comprehension of texts.

In reading they narrate how slow, shared and silent reading can be improved and its relationship with the cognitive dimension, allows inferring that the teacher seeks that his students select characters or recreate them, organize information, select main ideas, create texts and be creative, be critical and synthesize were other emerging subcategories around stories of life and language. The subcategory creativity is highlighted, given textual production and collaborative work. In conception, learning is considered as the assimilation of new knowledge and the ability to explain it and apply it in professional areas. The focus is on content. Learning is demonstrated by the ability to explain important concepts or to apply what is taught in alternative contexts.

Table 2. Categories associated with competence development.

Categories	Characteristic	Distinctive	r $p < 0.05$
Capacity of self-critical analysis	Auto critical, argumentative	Sure, to decompose the whole in its parts and capacity to conceptualize	0.80
Synthesis	Orderly, concentrated	Organize and extract the best from information	0.90
Productivity	Independent and organized	Seeks understanding of meanings	0.71
Communication	Collaborative work, concrete, Effective use of language	Ability to have good relationships, accompany and have effective communication expresses reality, contextualize, critical reading, oral fluency	0.94
Science and creativity	Generation of ideas, characters in science, discoveries, motivation work capacity, orientation to achievement	Interprets, creates, teaches	0.92

In the third conception storytelling is considered as a function of the history of Physics, useful for analysing the development of discoveries in Physics, biographies of its actors, its application in scientific advances and its contribution to innovation and the development of communities. In this conception the creative capacity of the student to learn and recreate in a text through the application of skills in taking notes, reading texts, the development of experiments, the mathematical modelling that arises is highlighted. The use of appropriate analytical skills and the implementation of these graphic skills and the use of software or technology to enable more effective learning. In the conception learning is seen as the development of thinking skills, as a consequence, students develop cognitive structures indicating that high level learning has taken place, students are able to construct meanings of particular content in different subjects and demonstrate their knowledge. The focus is on thinking and abstraction skills. Storytelling as support for the ability to argue or respond reinforced through practical experience.

In the fourth conception storytelling is considered as the art that permeates the development of reflected competences through procedures through which they apply their knowledge in their professional activities, develop key concepts from history and solve future problems. The focus is on the development of skills for the professional context. Experiences are narrated that facilitate the exercise of basic skills and assimilation of concepts. These skills are developed through experiences with real life problems, stories told and revived, and the comparison of possible solutions with those of an expert.

A minimum proportion of Physics teachers with difficulties in assigning syntactic roles to words in grammatical structures was identified. On the other hand, there was little difficulty with punctuation signs, as a high percentage (97%) were successful in using pauses and intonations that indicate punctuation when reading. In the semantic processes, sentence comprehension, text comprehension, it was evident that a high percentage of the teachers' population (36%) presents difficulties in understanding narrative and expository texts by means of literal and inferential questions. Table 3 shows that the correlation between the variables reading and writing and phonological awareness is statistically significant, with a confidence of 95%, which shows that teachers who presented low scores in writing also denoted low results in phonological awareness.

Table 3. Correlation between phonological consciousness and literacy.

Variable	Correlation	p-value
Writing level	Pearson correlation	0.267
	next (bilateral)	0.047
Reading level	Pearson correlation	0.277
	next (bilateral)	0.041

The methodological triangulation points out language dimension in sciences with learning categories, perception, imaginary and learning of concepts and propositions with phonological, semantic, syntactic and pragmatic subcategories, defined the language dimension as the art of telling stories, seeks that the student achieves significant learning in manifest representations when attributing meaning to symbols. It also achieves a learning of concepts and propositions by training through direct and cooperative experience. Cognitive dimension structured with categories reads, analyses, reflects, selects, organizes with assimilated subcategories, gives meaning, generates ideas, creates, defined as the art that grants meanings that allow him to remember, transfer and assimilate information manifested in expressions, adequate use of language, fast and comprehensive reading, organizing ideas and allowing him to generate new knowledge.

Scientific production dimension and creativity with categories textual and oral production and subcategories life stories, critical reading and content generation defined as the art for the development of skills that allow you to create and modify your learning, the development of skills and abilities of a creative scenario; dimension competencies with pro social categories, language and attitude with subcategories, participation, socialization, accompaniment, functionality, interpretation, production defined as the ability to have good relationships, accompany, have effective communication and maintain respect for their peers and the ability to produce texts, interpret them and perform critical reading; dimension function of the history of physics and skills communicative category subcategory interacts, teaches and oral production defined as the capacity to promote social and effective interaction among peers and finally the empathy dimension is visible with categories motivation and support subcategories shares, communicates and accompanies defined as the history as the axis of emotional support and accompaniment to the personal and cognitive development of the student that enhances the relationship with the teacher.

4. Discussion

Like Senchi [22], for teacher's stories are linked to specific places of symbolic importance, the narrative becomes in this context a powerful tool to express and repair biographical disruption [23] and inspire transformation as a healing mechanism for individuals and communities. It was observed in teachers' conceptions of storytelling similar aspects to psycho-sociological schools that consider that the cause of conflict is in circumstances external to people, and the conflict is a consequence of misperception, miscommunication, neo-behavioural frustration, theories about perceptions, communications and images, the theory of games, the model of social learning, the model of frustration.

The manifest was not observed by structuralism theories where the cause of the conflict is in asymmetries of the social structure such as the unequal distribution of means of production and power, being a low technology tool, light, flexible and accessible, that does not require training, literacy or special equipment, that can assume a diversity of specific cultural forms, Some teachers associated it with humour and entertainment, and that can promote a safe context and stimulate empathy among participants similar to that manifested by Kkrishna [24]. Results contrary to those obtained by Guzmán according to Gallo [25] in textual narrative comprehension, textual narrative production, reading habit, whose objective is to focus comprehension and textual narrative production on students favoured by the support of parents in the process, which reinforces the thesis of Monsalve and Woodhouse [26] who associate storytelling with emotions and state that the most important thing is not to leave the students alone, but to accompany them towards an optimal use of them in order to achieve better results in the development of thought where collaborative work and experimental is promoted [27] and generates impact in pedagogical practice in physic.

5. Conclusions

Teachers conceive storytelling as the art of telling a story and a didactic resource associated with approaches, the development of competencies, useful for analyzing the development of discoveries in physics, their actors, their application in scientific advances and their contribution to innovation and community development. Origins of quantum mechanics was one of the themes that allowed for a higher level of skills in application, argumentation, problem solving, in understanding or managing physical problems, and in analyzing the relationship of quantum physics with classical physics.

Classical mechanics, electricity and magnetism from the storytelling of physic teachers, identifies in physical science axiological aspects associated with tradition, discourse and image that inhabit from applied mathematics in the resurgence of physics, therefore identifies epistemological aspects associated with experimental physics, as basic and applied science; and historical and critical aspects, where the image and the scenarios play an important role both in physics and in its teaching based on storytelling; conceptions of the teachers allow not only to tell stories, to remember the beginnings of physics but also to set and recreate the experimentation and generation of new elements or mechanisms that transform society and improve living conditions form art.

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