



Relationship to phonological awareness and engineering literacy

Relación con la conciencia fonológica y la alfabetización en ingenieros

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ABSTRACT

Keywords:

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The following research shows from a qualitative approach, how university engineering teachers conceptualize the narrative. Thus, 250 teachers from the department of Norte de Santander, Colombia, participated in different scenarios to collect information. Thus, the data yielded very valuable information. Three categories involved in the function of the storytelling of engineers, the production and application of science stand out. Therefore, it is concluded that the narrative is conceived as the art of telling a story; being an important pedagogical tool associated with the approach, the development of student capabilities, determinant to address engineering discoveries, to analyze scientific advances and their contribution to innovation and development of society. A statistically significant correlation is found between the variables of writing, reading and phonological awareness; demonstrating that engineers who present low scores in writing also present low results in phonological awareness.

RESUMEN

Palabras clave:

Ingeniería,
Variables
estadísticas,
Conciencia
fonológica,
Avance científico
e innovación.

La siguiente investigación muestra desde un enfoque cualitativo, como los docentes universitarios de ingeniería conceptualizan la narración. Con lo cual, 250 docentes del departamento Norte de Santander, Colombia; participaron en diferentes escenarios para recaudar la información. Es así, que los datos arrojaron información muy valiosa. Resaltan tres categorías involucradas en la función del storytelling en los ingenieros, la producción y aplicación de ciencia. Por tanto, se concluye que la narración se concibe como el arte de contar una historia; siendo una importante herramienta pedagógica asociado al enfoque, el desarrollo de capacidades del estudiante, determinante para abordar los descubrimientos ingenieriles, para analizar los avances científicos y su contribución en la innovación y el desarrollo de la sociedad. Se encuentra una correlación estadísticamente significativa entre las variables de escritura, lectura y conciencia fonológica; demostrando que los ingenieros que presentan baja puntuación en la escritura también presentan bajos resultados en la conciencia fonológica.

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Introduction

Multiple authors point out the power of stories from anthropological, psychological and commercial aspects [1], starting from the importance given to the metalinguistic phonological skills of engineers is justified by the very alphabetic nature of the writing system, since in the alphabetic system the graphic representations transcribe the sounds of oral language, with which, through visualization, the narrative makes sense to engineers. On the other hand, thanks to the fact that stories become useful in different forms, several authors have questioned their role in evolution [2]. Hence, the term "storytelling" (without translation) is assigned to applied storytelling [3]. It is worth mentioning, that, depending on the type of audience and depending on the moment, it can fail [4]. Likewise, the content of the story defines whether or not the stated objective is achieved, as well as who establishes the communication, how the story is told, where it is told, to whom the communication is addressed, when it is communicated, about whom it is about or against whom it is communicated, among other aspects (social and symbolic). An interdisciplinary approach is necessary in the study of oral narration; for this reason, the literature proposes a textual, historical and sociological approach [5] immersed in the theories of myth that interprets it as a form of explanation [6], a symbolic statement 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 social structure of pre-structuralism [8], from sociological theories of myth arise as a reaction to non-sociological theories [6], which ignore the importance of the social contexts in which they are generated, circulate and use [3] narrating thus began to be used for forgiveness and catharsis as a therapeutic discourse that permeated the organizations of truth and peace commissions, functioning as a disciplined power [9], instead of addressing the issues of structural violence and political asymmetry [9]. Moerman, a physician involved in the emergence of narrative medicine [10], incorporated the symbolic aspects that influence the recovery of patients, to the study of the "placebo effect" attributing to it psychological and physiological effects in the treatment of the disease, improving and strengthening the doctor-patient relationship [11].

In the case of the evaluation of the results of national and international tests, it is necessary [1] to generate the habit of reading [12]; in order to encourage students in the fourth and fifth years of primary school (basic education) to prepare manuscripts as a result of their self-learning and teamwork; thereby developing their thinking and skills [13], making their worldview more reflective, critical, analytical, reasonable, considerate, increasing their ability to solve difficulties, to desire, to live, think and feel [13]. That the teacher identifies the conceptions of the narrative; as researchers in other areas such as medicine have done, by changing the methods of identification and medical treatment. It is the beginning to empower and transform the homeostatic culture of mathematics education [14], fixed in the present, where knowledge considered not useful is discarded. Therefore, understanding the conceptions of narrative, seeks not to promote the asymmetric and hierarchical vision, but to enlighten engineers from the language, from the narrative, from an experience that grows and shines for a short time and disappears or one that shines for a long time and lasts [14].

Materials and methods

This study has a qualitative framework, as structured by Massaro [15], analyzing the therapeutic effect of stories on engineers. The interviewer listens without interruption, waiting for the moment when the capacity of expression and narrative emerges, in order to find the cultural structure assigned by the student to the lower meanings [16]. The analysis of the results was carried out according to the main findings found; generating tables and graphs for interpretation. As a result of the participatory observations and field notes, conceptions for the implementation of a didactic model were structured. Being this a qualitative research, the interviewers are essential in the interaction with the informants; since they observe the context of teaching engineers, especially raising different learning schemes, considered an essential element of the research process.

In this study, three stages were implemented to obtain and analyze the results. In the first instance, thanks to synchronous and asynchronous meetings, we explored through a series of questions the vision of engineers about the role of narrative in their professional profile, work area and in disciplines such as calculus applied in engineering. Secondly, maps were produced to show the data obtained in an easy and pleasant way. Also, the design of an app as a way to add the technological component to the project, and thanks to a forum, the data obtained were evaluated. Finally, in the third stage of the study, in order to produce and analyze the results obtained, the Philips 6.6 methodology was implemented through a virtual meeting with all those involved.

The management of the results, categorizing the iteration spaces between the teacher and the students, according to their effect on the good or bad performance of the students, taking as a framework the methodology applied to the study of the doctor-patient relationship [10]; makes the experience between both parties is redefined, with which, thanks to the use of discussion circles [17] in activities such as, reflection workshops, spaces for artistic expression, conversations to share life stories of those involved in the study (vis methodologies). Based on a non-experimental correlational quantitative design [4], which is composed of a first stage of requirements assessment, theoretical projection of each proposal; as well as, the determination of the social and economic feasibility of the implementation of the proposals presented [5]. Thus, tools were required to determine cost and time efficiency.

Consequently, the mechanism applied to 250 teachers in the department of Norte de Santander consisted of a checklist, interviews and a series of questions (survey), with a kappa index of 0.8 and a reliability of 0.78. Next, the different worldviews were characterized according to the requirements of the teachers, the similarity in educational services (output or result variables) and the agents that influence the execution of the teaching service (input variable). Then, several hypotheses about possible cause and effect phenomena were synthesized; evaluating the history and current results; with the help of statistical processes.

Finally, a phonological processing test [18] was implemented in order to determine the ability to discern the emitted message through the interpretation of the units or phonemes that make up the language. This test has 5 parts, each with its own measurement system. The first, "auditory-phonemic sequence" has a maximum of 12 points, the auditory discrimination test, 21 points; the oral inversion of syllables, and oral inversion of words, a range of 16 points each. Likewise, the section of segmentation of words according to their phonemes, 15 points. Consequently, the results were analyzed descriptively to obtain the relevant statistics; likewise, a correlational analysis was applied, consisting of a first phase, to verify the normality of the results of the variables reading level, phonological awareness level and writing level, thanks to the nonparametric Kolmogorov-Smirnov goodness-of-fit test [20], and then, thanks to the Pearson test [21] to find the significance of the correlations between variables with a $p < 0.05$.

Results and Discussion

Results

Given the qualitative nature of the study, we can segment it into different categories. Thus, the first conceptualization of storytelling is reflected by considering it as an artistic method by which to tell stories through a particular approach (table 1). Where the teacher expects the student to remember as accurately as possible the step by step of the information provided by him; to continue with a stage of memorization of this information, and then, through an assertive communication to achieve a phenomenon of motivation, looking for the student to understand the information before memorizing it. In the next stage, the aim is for the learner to master this information through visualization, comprehension and memorization. In this context, two states of conjugation of information stand out; the first is the need to understand the information and the second is the need to evaluate what one has learned. Next, a very important state is the one associated with information; where the teacher considers that the information truly learned is that which

possesses an organization and interconnection of concepts; even before memorization; where the student develops capacities of mastery and conceptualization of the topics seen. Finally, a deep critical approach was observed, as well as an intermediate point of this, where the teacher wants the student not only to understand the topics, but also to understand the historical context and their development, remembering not only the neuralgic information of the topic, but also that the student has a notion that can transform the course of the topics seen in the future, applying the synergy with other areas of knowledge, with a view to producing new knowledge, hand in hand with a personal approach and meta-learning.

Table 1. Approaches from teachers' conception of storytelling

| Approach | Purpose | Strategy | Feature |
|-------------------------|--------------------------------------------------------------|--------------------------------------------------------------------------------------|------------|
| Superficial | Memorizing | The chart to address acceptable memory | acceptable |
| Pro-social relationship | Motivation Communication | History in the teacher-student relationship | acceptable |
| Understanding | Aiming at increasing cognitive capacity through memorization | Understanding the meanings | Complies |
| Training | Development skills | contribution to comprehensive training | Complies |
| Deep | Development of capabilities | Development of capabilities, skills Meta-learning capacity of personal consciousness | Complies |

As a second category, we have the contextualization of the narrative to the development of practical skills (Table 2); in this scenario, teachers present the comic as an important tool, used in the appropriation of knowledge, evaluation, increase of functional reading; as well as preparation and study for exams; since it increases analytical, written production, literary interpretation, and in general communication in engineers, being this a transversal skill in argumentative literary production, a virtuous oral communication, good auditory attention capacity and interpretation of texts. According to the above, in this study we observe how teachers seek to improve communication skills, impacting reading as an indicator of cognitive level. Encouraging the student to get involved with the characters, assimilate their contexts, create creative texts and obtain an analytical and critical view of the information presented. It is important to mention the emergent subcategory of creativity, since it impacts on textual production and teamwork. Thus, learning is determined as the ability to contextualize and apply new knowledge to professional life. Focusing the importance on the content transmitted, and its application in different scenarios.

Table 2. Categories associated with competence development

| Dissertation | Characteristic | Distinguishing | Relation $p < 0.05$ |
|------------------------------------|---------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| Capacity of self-critical analysis | Self-critical, argumentative | Confidence to decompose the whole into its parts and ability to conceptualize | 0.80 |
| Synthesis | Orderly, focused | Organizing and extracting the best from information | 0.90 |
| Productiveness | Independent and organized | Seeks understanding of meanings | 0.71 |
| Communication | Collaborative, concrete work, Effective use of language | Ability to have good relationships, to accompany and have effective communication Expresses reality, contextualizes, critical reading, oral fluency. | 0.94 |
| Science and Creativeness | Idea generation, characters in science, discoveries, motivational work ability, achievement orientation | Interpret, create, teach | 0.92 |

As a third conception we have that teachers consider storytelling as a function of history in engineers. It serves as a tool for analysis of discoveries, biographies, contributions to innovation and scientific progress, as well as social progress. This conception shows us the student's ability in mathematical modeling from textual syntax and the execution of experiments. In the same way, the management of technology, the implementation of software, the application of analysis and graphical interpretation, emerge as methods of

effective learning. This conception considers that learning is the ability to reason, meditate and analyze, with which the student acquires the ability to structure his own idea in the different topics seen, and then communicate it. This conception focuses on abstraction and analysis, where storytelling reinforces their ability to communicate their practical experiences.

Likewise, another conception (fourth) was identified, where storytelling is an art with the capacity to stimulate the necessary skills to solve future problems, as well as the application of knowledge in the work environment. This conception focuses on providing tools for performance at the professional level; here, narrative is used to expose experiences to reinforce the assimilation of concepts. In this way, students relive and share their own experiences, to be compared with the appreciation of an expert.

In addition, the results yield important information such as that a small number of teachers had some problem to discern grammatically the philology of words and to include punctuation perfectly. On the other hand, 97% had no difficulty with punctuation. Next, it can be seen that 36% of the teachers had difficulty understanding expository and narrative texts. We see how the correlation is statistically significant between the variables of phonological awareness, writing and reading (Table 3); highlighting the low score of engineers in writing and phonological awareness.

Table 3. Correlation between phonological awareness and literacy

| Variable | Correlation | p-value |
|------------------|---------------------|---------|
| Level of writing | Pearson Correlation | 0.267 |
| | Next (bilateral) | 0.047 |
| Reading Level | Pearson Correlation | 0.277 |
| | Next (bilateral) | 0.041 |

The triangulation in the methodology shows that language in the sciences is reflected in the learning of information in a structured manner, in the dissertation of concepts in semantic, phonological, pragmatic and syntactic subcategories. Language is defined as the art of communicating through narration and stories, highlighting the ability to endow symbols with sense and meaning. It is also appreciated, the learning by means of the interaction of the students between cooperating in a direct way; improving at a cognitive level the abilities of reading, analysis, reflection, organization and segmentation of knowledge, ideation and creation; therefore, the storytelling takes as definition that of an art that allows to produce new knowledge from giving meaning to knowledge, achieving that the student can manifest and transmit this knowledge, enhancing their ability to produce texts, be more critical and in turn increase their ability to modify their own learning, seeking to increase their competences at social and language level; As well as, the attitude from the subcategories of socialization, functional application of knowledge, participation, interpretation, ability to maintain healthy relationships with peers, thanks to assertive communication, among others; as for the dimension as a function of the engineers' storytelling, with the category of communicative skills and subcategories such as interactivity, teaching, oral production understood as the ability to encourage assertive interaction among peers. Finally, the empathy dimension is tangibilized in the category of motivation and help; with subcategories such as, sharing, communication and accompaniment; defining the storytelling, as a center of emotional foundation and company for the student achieving personal and cognitive advancement.

Discussion

The teachers relate the stories to places that represent a symbolic meaning; similar to what happened with Seheni [22], therefore, storytelling is presented as a means that orders biographical communication [23]. In addition, it is reflected how teachers have conceptions of storytelling similar to those presented in schools of psychology, which state that the causes of conflict are the iteration of phenomena external to the individual; therefore, the conflict is produced by failures in communication (misinterpretation or

perception), neobehavioral frustration, the social learning model, game theory, among others. In the same way, it is not observed how close it is to the thesis of structuralism where conflict is assumed to be the product of social asymmetry; inequality in the distribution of means of power and distribution. Likewise, similar to those exposed by Krishna [24], it can be seen that some teachers associate the narrative with entertainment and humor; therefore, it manages to stimulate socialization and empathy among those involved. On the other hand, the results are opposite to what Gallo expressed Guzmán [25], referring to textual production, reading and narrative interpretation; thus, he considers that the objective of narrative is to centralize textual comprehension and production in the students with the support of their parents; arguing what Monsalve and Woodhouse [26] said, where they relate the narrative with the perception of emotions; postulating the idea that the engineer or engineering student should be accompanied in the proper management of their emotions, achieving an increase in positive results at the cognitive level, as stated by Vergel, Martinez and Isidro [27], where collaboration has a positive impact at the practical level.

Conclusions

The engineers' conception of storytelling as the art of telling stories stands out; being an important pedagogical tool in the development of skills, with an approach perspective; very assertive to evaluate scientific progress, to analyze the professional performance of engineers, collaborators and very important for its contribution to the development of innovation. It is worth highlighting the statistically significant correlation between the variables of phonological awareness, reading and writing.

As for the dimension of scientific productivity and creativity; with categories such as literary production, with subcategories such as critical reading and life stories; as well as the ability to create and modify their own learning, performance in creative environments; as for the categories of language, prosocial and attitude, with subcategories such as socialization, accompanying functionality, interpretation, participation, among others; defined as the skills necessary to establish excellent relationships with their peers, through assertive communication, accompaniment and maintenance of respect; as well as the ability of textual production and interpretation, as well as critical analysis; Likewise, the dimension of narrative as a function of the story in engineers and communication skills as categoria; with subcategories such as the ability to interact, oral production, teaching and social promotion effectively among their peers. As for the empathy dimension, it is reflected with the categories motivation and support, with subcategories such as communication, companionship and accompaniment of their peers, where the narrative serves as the axis of emotional, cognitive and personal development of the engineer with society.

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