DEVELOPMENT OF COMPETENCES IN NATURAL SCIENCES FROM THE INTEGRAL PROFESSIONAL TRAINING OF NATIONAL LEARNING SERVICES (SENA) IN COLOMBIA

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Abstract

Between 2017-2018 it was realized an investigation with the aim of improving the basic competences evaluated in the SABER PRO test at the National-Center-of-Hotels-Tourism-and-Food-Industries (CNHTyA).

Methodology. A descriptive investigation of a case study was carried out with 991 students, through a quantitative approach where a pedagogical strategy is designed and applied to develop basic skills in natural sciences through the analysis of parallel tests (two types of diagnostic tests) in natural sciences that were the antecedent for the design and application of learning guidelines, which framed the strategies used to strengthen basic competences in natural sciences of the MPFPI (Pedagogical Model of Integral Vocational Training) in the CNHTyA.

Result. Through the study there were a numerical increase in the development of all competencies (explanation of phenomena, comprehensive use of scientific knowledge, inquiry) by 40%, which was possible through the contextualization of the application of the guide when identifying the learning styles of apprentices. For the identification of learning styles within the training environment, something that the MPFPI (Pedagogical Model of the Integral Professional Training) did not contemplate, as the starting point to structure the learning guides to the training needs, the instrument of Alonso, Gallego & Honey has been used.

Conclusion. The strengthening of basic skills in Natural Sciences from the Pedagogical Model of Integral Vocational Training at the CNHTyA, has seen learning as a cyclical process in which the identification of learning styles promotes success in learning and the achievement of the objectives that are outlined as an instructor.

Keywords: case studies, hard intelligences, learning process, soft intelligences, skills development.

1 INTRODUCTION

Today's market confronts graduates with competitive work and high unemployment rates. The job interview allows to demonstrate the acquired knowledge and skills, differentiating from other candidates, this tool is a high value evaluation that allows to obtain ideas from the candidates, makes a prediction of their work (1). Therefore, higher education institutions are guarantors in the production of human talent to meet the demand and expectations of society, through the production of skills that must be adopted by students. As does Universiti Sains Malaysia, whose studies indicate that there is a lack of support in the level of soft skills development during school time, and these skills are supported in professional practice (2).

As mentioned by Fajar Hendarman & Hidajat Tjakraatmadja (4), in 1996 the Organization for Economic Cooperation and Development (OECD) stated that "knowledge is now recognized as the engine of productivity and economic growth, leading to a new focus on the role of information, technology and learning in economic performance "(p.36) .The workforce is determined by skills and competencies being two most important active components of society, being related to growth economic, productivity, individual income, education being the fundamental axis in the knowledge economy and it needs soft and hard skills, for problem solving, group learning, assertive communication, analytical skills among others.

Educational quality has been a strategic priority since the Universal Declaration of Human Rights (1948), which was evidenced in Colombia through Law 30 of 1992, Law 119 of 1994, Agreement 12 of 1985 and Agreement 00008 of 1997, the frameworks for the generation and execution of the pedagogical model of training of the integral professional SENA (MPFPI), which leads to generate
subjects capable of making a cognitive structural modifiability (4). The MPFPI requires a diagnosis of competencies as a starting point for knowledge and analysis of performance in order to facilitate the decision making of the instructor to generate cognitive and metacognitive strategies both in the methodological planning and the different types of evaluation that consider soft and hard competitions within the framework of the training program (5; 6; 7; 8).

Soft skills are described in terms of transferable skills, such as personality traits, objectives, projections, preferences and motivations, such as non-cognitive skills that promote the student to achieve in their learning social relationships that are important for human development and the workforce. These play an important development in the individual employability and the results obtained with the interaction of the labor market (9). In this case, the instructors are the ones who must undertake a preparation and successfully impart these skills, they play an important role in the construction of soft skills in the apprentice. But it must participate in a well-designed and organized educational system to cultivate human capital (10).

The design of an evaluation based on the explanation of the criteria, oriented to collaborative learning and continuous feedback, enables the improvement of those involved (11; 12) by the re-encounter between cognitivism (how the learner acquires and applies knowledge) and constructivism (new knowledge related to previous knowledge) (13), through the affective, cognitive and metacognitive levels of cognitive psychology (14) in evaluations by competences of a formative and contextualized nature (15).

The foregoing, makes it necessary to plan the staggering of the competences determining the competences of the program and its final level, the modality of evaluation. The teaching-learning method, the resources that must be acquired for the development of competencies, the organization of activities, as well as the trainee traineeship (14; 16), as a practice beyond a theoretical approach that it leads the apprentice to perceive, conceive and think about what surrounds him, in order to account for the overall organization of a system (17).

In this sense, authors such as Snyder (18), Millar & Parlett, (19) determined that the greatest influence on learning was not teaching, but an evaluation that underestimates the relationship of affective-cognitive-metacognitive levels, and found deficits in the knowledge and skills of sciences (20) that are visible in the university of this millennium that equates the evaluation with a directed qualification with little feedback (21), based almost exclusively on psychometric principles.

Taking as reference all the above, the study of Quintana (22) had as objective to improve the basic competences evaluated in the SABER PRO test in the CNHTyA, through parallel tests (two types of diagnostic tests) in natural sciences that were the antecedent for the design and application of learning guides, which framed the strategies used for the strengthening of basic competences in Natural Sciences from the MPFPI in the CNHTyA

2 METHODOLOGY

Between 2017-2018 Quintana (22) realized a descriptive investigation of case of study with a quantitative approach where a pedagogical strategy is designed and applied to develop basic skills in Natural-Sciences. The descriptive research is carried out with a quantitative approach based on the parameters of the SENA from pedagogical engineering (6;7;8) in order to strengthen basic skills in Natural Sciences in the CNHTyA, which required: - Diagnostic instrument design. - Application of the instrument. - Analysis of the information. - Determination of training needs by competences. - Plan the training to be developed. - Plan the learning route that will allow the installation of skills in the trainees (7).

The methodology used for the diagnosis consisted of taking the information of 991 trainees distributed in 51 records of all the CNHTyA coordinations following 7 steps:

1 Identification of the required competences: the basic competences in natural sciences are identified by the ICFES evaluated in the SABER PRO test of the level of training. This step established that the competences to be evaluated would be:

   o Explanation of phenomena. Build explanations that allow to establish the validity of an affirmation.

   o Comprehensive use of scientific knowledge. Understand and use concepts, theories and models of science in solving problems

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Inquiry. Identify variables, measure, organize and analyze results, as well as causality relationships that lead to new procedures for solving problems.

2 Definition of what, how, where and when the test was to be performed: schedules were organized to establish days of application of diagnostic tests to the students with the accompaniment of the instructors.

3 Definition of the type of instrument to be used: a questionnaire instrument with 30 multiple choice questions was carried out.

4 Design of the evaluation instrument. It had as reference the requirements of the evaluation instruments proposed by Ruiz-Bolívar (23), Flames (24) and Hernández-Sampieri et al., (25), corroborating:

- Objectivity (value judgment according to the rules clarified in the test).
- Type of instrument used. The written questionnaire technique of closed questions was used, creating evaluation indicators for the two elaborated tests.
- Validity (knowledge coherence stated in the standard).
- Reliability (application of two diagnostic tests).
- Representativeness (N applied to all students or greater than 70%).

5 Formulation of the evaluation criteria: questions were asked and a revision was made to the ICFES question banks related to the development of natural science competencies, which were organized in a database.

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Topic</th>
<th>Skill</th>
<th>Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>One</td>
<td>A</td>
<td>Evolution and transformation of Life</td>
<td>Explanation of Phenomena</td>
<td>The changes that Darwin proposes are based on natural selection</td>
</tr>
<tr>
<td>Two</td>
<td>B</td>
<td>Regulation systems</td>
<td>Comprehensive use of scientific knowledge</td>
<td>Neurotransmitters are biomolecules that transmit information from neurone to another neurone</td>
</tr>
<tr>
<td>Five</td>
<td>C</td>
<td>Genetics and biotechnology</td>
<td>Inquiry</td>
<td>All processes are carried out thanks to biotechnology</td>
</tr>
</tbody>
</table>

6 Validation of the diagnostic process. Validation of the instrument that consisted of the following steps:

- Validity of the content. (Trial of experts). The content of the test was based on the ICFES question bank. Likewise, its content was validated with the judgment of Spanish-speaking experts in the area of natural sciences with experience in the formulation of indicator instruments.
- Validity of the criterion. (Validity of the instrument). The instrument is validated by comparing it with external criteria such as standards or competences of the ICFES contemplated in its 2015 user manual, identifying predictive (future) and concurrent (present) criteria.
- Validity of the construct. The construction of the instrument presented references that support its construction, for it were taken as references courses taught by the SENA on issues related to human pedagogy and pedagogical engineering, the ICFES 2015 user manual which were fundamental for the development and analysis of the instruments applied.
- Reliability. The level of accuracy and consistency of the results obtained when applying the instrument was established through the identification of parallel measures (equivalent ways of measuring). This meant the design and simultaneous application of two competency tests in the groups.
- Viability. They contemplated the resources that were counted, those that were needed and the capacity that existed to obtain them.
- Externalities. Parameters that could affect the validity and reliability related to:
• Improvisation (ignorance of the variable and the sustenance of the theory on which it is based).
• Translation (contextualized).
• Inadequacy (lack of empathy of gender, age, occupational level).
• Conditions of the application (noise, time, public services).
• Mechanical aspects (precise instructions).

7 Design of learning guides. contemplated accessible didactic material, reusable, portable, from the knowledge-knowledge how the processing of information in a meaningful way, the know-how as the way to solve problems, and finally the know-how as the affectivity and the motivations, so that the apprentice build explanations, understand, identify, measure, organize and analyze results for the solution of problems, through hard or cognitive skills and soft or non-cognitive skills (26).

3 RESULTS
The analysis of the results (figure 1) exposes a low level in the competences in Natural Sciences since the average of the competition of greater result did NOT exceed 45% of 100%. Faced with the fact that some programs have strengthened these skills, it is because these careers see subjects related to science. In spite of the above, the low level in the CNHTyA was due to a lack of teaching of the natural sciences, as well as the methodologies used and the frequency with which their use is visible in the different areas.

![Figure 1. Comparative percentage result of all programs. Elaborated by Quintana (22).](image)

Based on the above, the strategy of combining soft and hard skills was generated (Figure 2) for the formation of an integral professional (27) that led to the development of the skills and attitudes of the trainees, under patterns of quality and productivity that serve to increase their levels of efficiency both of the project they perform at work, and of their ethical project of life (28). Identifying potentialities and conditions that may affect psychomotor training (orientation, precision control, reaction time, speed, manual dexterity, creative thinking) (29).

![Figure 2. Skills Classification. Own elaboration based on Prada and Rucci (30).](image)
The aforementioned evidenced the MPFP’s emptiness of not identifying the learning styles of the apprentices, as a starting point to strengthen the competences through the integration of cognitive, emotional, psychological and physical aspects, which influence the social being and therefore in their motivation (31) and academic performance (32), which led to prioritize the relationship of affective-cognitive-metacognitive levels in the FPI with real discussion spaces and contextualized activities (33), with questions that provide evidence on knowledge essential for apprentices to develop their skills and provide information about the environment where behaviors occur and their spontaneous behavior (34).

The learning styles were identified through the instrument of Alonso, Gallego & Honey (35), which is a metric of conceptual and linguistic component, which comprises four styles: active, reflective, theoretical and practical (36), which provided the possibility of recontextualizing the explanations to the socio-cultural reality of the group or the way such hard knowledge was related to the soft intelligence of each apprentice. What coincides with Papalia & Wendokos (37); Serrano (38); Flames (24); Molina & Martinez (39); Peña, Soto & Calderón (40) who place the socio-cultural and family factors as the most influential in coexistence because in these spaces there are reinforcing behaviors that can be positive or negative in relation to the behavior of people in certain situations (41)

The comparative analysis of the general results of the recognition of learning styles (active, reflective, theoretical and pragmatic) (35) for the strengthening of basic skills in natural sciences, tends to be framed in the pragmatic style (experimentation and application of ideas and concepts), which has made it necessary to generate explanations from the social, cultural, environmental, and economic reality of the apprentices, through the formulation of questions (prior knowledge) and observation (where behaviors occur) (22). In this sense, the teaching process requires the instructor to appropriate soft skills that are transmitted to the apprentice to apply them in the labor market (2).

This meant a curricular articulation of a reorientation of didactics, evaluation systems and pedagogical practices (16; 33; 42; 43), through appropriation, contextualization and reflection activities that would motivate applications of the sciences and their competences within the field specific discipline as well as interdisciplinary works that have as "center of the process the subject of formation" (SENA, 44, p.53), promoting "personalization, the development of solidarity, participation, organization and self-management" (SENA, 44, p 53), and the purpose of the professional training proposed in the FPI statute (1997) “the person trained will contribute in turn to the construction of a more developed and just society” (SENA, 44, p 15).

In this study, unlike that of Herrera & Zapata (45) in which the active style predominates, it is common that the predominant style is not absolute in the population, which shows that the styles are independent. In this way, the pedagogical strategy of generating new conceptual developments, ways of living (46) and acting in the world (47), made the evaluation processes carried out in the improvement of science competencies a coincident sub-process. that made visible the bias between the ways of evaluating in the classroom and what was applied by the State in external tests (48) such as SABER PRO. Despite this, there was a numerical increase in 40% of all the competencies that were evident in the competencies of the graduate profile of their careers (49) and in the combined knowledge of knowledge, procedures and attitudes in the practical stage (50).

4 CONCLUSIONS

The importance of SENA in the national education system lies in the relationship between academic offerings and business needs (51), converting SENA's educational coverage into a strategy to face the challenges of sustainability (environmental-social-economic) of the Nation. In this way, the diagnosis and improvement of competences in natural sciences from the MPFPI in the CNHTyA, widens the range of opportunities for apprentices who decide to homologate their degrees in universities and positions CNHTyA through the results of the SABER test. PRO.

Identify the needs of training through diagnostic tests of competences in science makes the MPFPI, holistic-systemic, articulator and cohesive, relevant, humanistic, flexible, promoter (innovation, creativity, self-management, research, adoption and practice of principles and ethical values), which strengthens interdisciplinarity, leading to the recognition and optimization of the economic, social and environmental components of sustainable development (52).

As Ibáñez (53) puts it, competency assessment must be concerned with the effectiveness of study plans, ensuring compliance and measurement of achievement linked to the profile of professional graduation. But recognizing the challenges in the improvement of science competencies from the
MPFPI en el CNHTyA, es necesario reconocer los estilos cognitivos de los aprendices, así como
tomar en cuenta la identidad misional del SENA (Ley 119 de 1994), los discursos
desahabilitantes (interior y exterior), el presupuesto nacional, la distinción entre universidad y educación terciaria,
la transición de énfasis laboral hacia el académico, así como el desafío de investigación en formación
práctica, que debe ser el punto de partida cuando se realiza el diseño curricular (ejecución, evaluación (aprendizaje, institucional) e implementación).

La estrategia de investigación para fortalecer las competencias científicas se enfocó en el
conocimiento a través de una metodología dirigida activamente que llevó al desarrollo de estrategias metodológicas para desarrollar
habilidades metacognitivas en aprendices competentes, quienes pueden actuar adecuadamente en un contexto
demostrando sus cualidades personales (conocimiento, saber hacer, capacidades, cultura, emociones) y los
recursos de redes (bases de datos, redes documentales) (54).

Integrar los niveles personal y social a las competencias de las ciencias de MPFPI en el
CNHTyA, no solo aumentó los resultados de la evaluación en 40%, sino que también hizo posible lo que Paez,
Cuervo, & Cruz (52) llamó la transformación del personal, social, ambiental y productivo
eventualidad, el aprendizaje en el foco de atención, por otros recursos (pencils, cards,
dibujos, videos, etc). De esta manera, lo que Le Boterf (55) definió como una situación que determina una
contextualización, se evidenció en el periodo productivo del aprendiz, donde la combinación
conocimiento del conocimiento, procedimiento y actitudes desarrolladas en el fortalecimiento de
las competencias enriqueció las analíticas, el conocimiento y la acción de sus funciones.

ACKNOWLEDGEMENT

Elaboración del VIVENCIAES grupo de investigación, resultado de una Tesis Doctoral en Estudios Sociales de la
Universidad Francisco José de Caldas, dirigida por el PhD Francisco Sierra Gutiérrez en la
línea de Potencia Política y Sujetos Colectivos. El artículo presenta el estudio de investigación “Fortalecimiento de
las Competencias Básicas en Ciencias Naturales desde el Modelo Pedagógico de Intervención Vocacional en
el Centro Nacional de Hostelería, Turismo y Industrias Alimentarias, (CNHTyA).

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