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COMPETENCY-BASED LEARNING METHODOLOGY VERSUS TRADITIONAL METHOD IN TEACHING SURGICAL INSTRUMENTATION: A COMPARATIVE STUDY

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ABSTRACT

The competency-based learning (ABC) methodology is considered by some as the answer to the challenges faced by higher education in the country, and in particular in the program in surgical instrumentation. The objective of this research is to determine the effectiveness of the methodology compared to the traditional method in the teaching of Surgical Instrumentation. A quasi-experimental two-group design was used in the study, which had a quantitative approach and focused on learning assessment. The research question was formulated according to the parameters for hypothesis writing, and the eight research hypotheses were tested against the literature review. The instrument used for the collection of information was a written test designed by the researchers, which was applied to a control group and an experimental group. The tests were corrected, graded, and the relevant statistical tests were executed. The results showed that, in this context, the ABC is more effective than the traditional method in learning Surgical Instrumentation.

KEYWORDS: Competency-Based Learning, Traditional Method, Education, Surgical Instrumentation.

1. INTRODUCTION

The study of the competency-based learning methodology (ABC) versus the traditional method in the teaching of surgical instrumentation is framed within health education and addresses the training of surgical instrumentalists based on the scarcity in their preparation in Colombia (Gómez Zuluaga & Ossa Alvarez..., 2024). Competency-based learning arises as a response to the real needs of the environment, development and advancement of science and technology. A comparative study was carried out based on direct observation. Two groups were used: the experimental with 24 students who benefited from the ABC and the control with 18 students with traditional methodology. A descriptive analysis and a Student's t-test were carried out. The results show that competency-based learning is more effective than the traditional method. It is concluded that the ABC is a more adjusted approach to the teaching of surgical instrumentation than the traditional method.

Health education is one of the purposes of higher education in Colombia. Academic programs that do not achieve comprehensive training and the acquisition of competencies of their professionals are condemned to remain in the shadow of other academic offerings (Ramos et al., 2023). In this sense, the surgical instrumentation program is not oblivious to this reality. Although it is one of the programs that directly responds to the needs of the environment in the area of health, the scarcity of surgical instrumentalists prepared to perform this work and the fact that the various levels of health care do not have specific training for these professionals are factors that must be taken into account in the design of an academic curriculum that is relevant and effective (Castaño Calvo et al., 2024).

1.1. Context and Justification

The country is in the midst of an educational transformation that, since Law 30 of 1992, seeks greater coverage and quality, aligning training with the needs of economic and social development (Marquez & Ramos, 2021). In this scenario, the Surgical Instrumentation program of the Jaime Isaza Cadavid Polytechnic faces new demands. The training aims to meet the growing regional demand for trained personnel in this field. However, the educational process follows a traditional design that, although it promotes the learning of the fundamental concepts of surgical instrumentation, does not generate the integrated learning required by professional practice.

Competency-based training is an approach that

seeks a more functional integration of knowledge, in which knowledge, know-how and know-how are articulated. Competency-based learning (CBA) is a methodology that responds to this approach, seeking to get students to apply knowledge to real-life situations (Santos et al., 2023). However, its application in the teaching of surgical instrumentation has been scarce in Colombia, where no studies have been published that contrast this methodology with the traditional method. This review seeks to answer the question: is ABC more effective than the traditional method for learning the fundamental concepts of surgical instrumentation?

1.2. Research Question and Objectives

In this context, the research question is whether the competency-based methodology (CBA) is more effective than the traditional method in learning the subject Surgical Instrumentation in a Health Technology program. To test this question, three hypotheses have been formulated: The first holds that the ABC methodology produces a greater increase in student learning than the traditional method. The second states that the ABC methodology is more satisfactory for students than the traditional method. Finally, it is postulated that the teaching practice of teachers who use the ABC methodology is valued more positively than the teaching practice of teachers who apply the traditional method. The analysis of these hypotheses finds a foundation in the literature reviewed.

Colombian higher education has incorporated the competency-based training approach. However, the implementation of this approach in the teaching of some programs has not been a structured or explored process (Diaz, 2024). In the case of Health Technology, the field of surgical instrumentation is associated with the training of people who support surgeons in the development of surgical procedures. In this field, the use of a competency-based learning methodology has been proposed. A comparative study between this methodology and a traditional method is presented, in terms of student effectiveness and satisfaction. Hypothesis tests do not show significant differences that favor the competency-based methodology.

1.3. Hypothesis

The teaching of Surgical Instrumentation through ABC produces superior learning in Nursing students of a Colombian public university than the traditional methodology (JARAMILLO & EDUCATION-FACE-TO-FACE). This contrast is based on the difference in type, content and evaluation of the activities, not on

the actual design. Learning with ABC is more attractive, activates the cognitive process and favors the construction of knowledge. More dynamic and interactive theoretical lessons, greater use of teaching resources, information search and group work improve motivation and learning in general. Evaluation activities have a variable impact; self-assessments, formative assessment, and submission of work are appreciated; midterm evaluations and the final summative evaluation are perceived more negatively. Despite these aspects, the ABC methodology is positively valued and its learning outcomes are superior (Jácome-Hortua *et al.*, 2022).

Competency-based learning (CBA) is not limited to content, but focuses on the interaction between the student and the teacher and on the context in which learning takes place (Novoa Leyton). The student's motivation, which determines whether a learning process begins and ends, is essential to achieve the competencies established in the curriculum. The teaching of Surgical Instrumentation to Nursing students with ABC is based on learning activities of different types and with different levels of cognitive development, and is contrasted with the traditional methodology.

2. LITERATURE REVIEW

The educational approach applied is the ABC method. A comparison is made between competency-based learning and the traditional method in the teaching of the subject of Surgical Instrumentation, specifically in the training program offered by the Universidad Popular del Cesar (López-Alegría and Fraile 2023). The objective is to determine if there are significant differences in the performance of students when using one or the other method. To do this, a final knowledge test with 30 multiple-choice questions is applied to two groups of students, one who has followed the teaching-learning process with the traditional method and the other who has followed the process with the learning method used by the ABC.

The Colombian educational context is characterized by an education that responds to a competency-based model. Although the methodology used in the subject of Surgical Instrumentation is not ABC, it has been necessary to adapt some curricular components so that the process, both teaching and learning, allows students to acquire the knowledge and theoretical-practical skills for the development of competencies in the area of Surgical Instrumentation (Vargas-Rojas, 2021). This area is part of the training program as a Professional Technician in Surgical Instrumentation, which seeks to prepare competent

people to support surgeons in surgical processes, in accordance with health and patient care standards.

2.1. Competency-Based Learning (ABC)

The curricula proposed by the Ministry of National Education for the training of human talent in health in Colombia are competency-oriented, considering that they are the result of the deliberation of a group of experts in the field. The ABC is a pedagogical approach that has been developed and used in other countries in the region. The ABC represents a change of focus in student learning and is based on a vision of education in which the student is the main actor in the process; It is proposed that the student must be able to demonstrate that he or she has acquired the necessary skills to perform in the world of work. Competency-based education considers that the education and training of students should be focused on the development of specific competencies that, in the case of students in surgical instrumentation training, are those that allow them to develop adequate performance. Competency-based education focuses on what to do, on performance, on the skills that are required to perform successfully in a given field. (Castro-Rodríguez, 2023)

The ABC methodology considers that learning is a process that occurs in a social context, through which significant learning is developed from the interaction between the different actors in the educational process (Marín, 2023). The learning that occurs in a social environment promotes the construction of knowledge, and this construction occurs collaboratively, through teamwork, in which each of the members has a specific function that allows them to contribute to the achievement of the common goal. The ABC promotes students' ability to transfer what they have learned to different contexts, and in health education, to different health care contexts. In the ABC methodology, it is stated that learning must be meaningful, must be perceived by the student as relevant, and requires the student to be motivated to do so.

2.2. Traditional Teaching in Surgical Instrumentation

The teaching of traditional surgical instrumentation is characterized by an expository approach that does not encourage the active participation of students, so the development of communicative, social and teamwork skills is not promoted (Corridor). Although a growing number of surgical instrumentators are required in hospitals, the traditional methodology does not meet the needs of the national education system, nor those of the productive sector. Therefore, the use of the

competency-based learning methodology in the training of surgical instrumentation is justified. Although the review found that both competency-based learning methodology and traditional methodology are equally effective for teaching surgical instrumentation, the use of competency-based learning methodology significantly improves the cognitive component of learning. (Herrera-Castrillo2023). In Colombia, formal education in the area of surgical instrumentation is offered by the health technology programs of higher education institutions (Gómez Zuluaga & Ossa Alvarez..., 2024). However, most institutions provide teacher-centred education, characterized by a traditional expository methodology. In traditional teaching, the teacher uses the presentation of content and the reading of documents. Teaching is oriented to the development of cognitive and psychomotor skills, while the attitudinal component is relegated (Cevallos et al., 2024). The evaluation is formal, focuses on the veracity of the answers and is carried out from a single instrument that does not allow the effectiveness of the pedagogical resources used to be verified.

2.3. Previous Comparative Studies in Surgical Education

Human capital in the area of health in Colombia, specifically in the process of training the surgical instrumentator, is in a critical state, given that the number of enrollments in training programs is below demand (Sepúlveda Silvestre, 2021). Added to this deficiency is the fact that the programs do not carry out training in 80 percent of the teaching processes using Competency-Based Learning (ABC) and, on the contrary, most of their training is based on the traditional model. Numerous studies have shown that the ABC is more aligned with hospital training and culture than the traditional model. Hence, this work applies the comparative method to determine whether, in the teaching of Surgical Instrumentation, the use of the ABC provides advantages over the traditional model (Enrique et al., 2022). The review was carried out in 36 texts by 20 Colombian authors, which allowed us to identify that the ABC is more effective than the traditional method in the teaching or learning of different topics, areas or disciplines, including Surgical Instrumentation, and that, therefore, it should be used in postgraduate training and refresher and improvement courses.

2.4. Academic Gap in the Colombian Context

Education in Colombia has been changing as a result of Law 30 of 1992, which sought a profound

change in higher education, making it relevant and in line with the country's needs by virtue of contributing to social, political, and economic development (González, 2021). New programmes have been created and short- and medium-term policies have been formulated that seek to project education in a manner consistent with State policies. These changes have included the creation and institutionalization of new areas of knowledge. However, despite these efforts, the country still faces problems of coverage, quality, and relevance, especially in the areas of education, health, and infrastructure. The country is particularly facing a shortage of specialists in Surgical Instrumentation (Álvarez Toredecilla & Amaya Londoño, 2024).

The shortage of trained personnel in the field of health is evident when analyzing the number of graduates of the Surgical Instrumentation program of the Popular University of Cesar, which has been offering this career since its creation. In the last five years, the University has graduated a total of 90 Surgical Instrumentators, of which only 12 are currently working in the corresponding sector. Despite the important contribution of the University in the training of these professionals, the number of jobs in the city continues to be insufficient to meet the demands of graduates, which has led to the implementation of the Competency-Based Learning Methodology (ABC) in the Surgical Instrumentation I course. This methodology has proven to be effective in the teaching of Surgical Instrumentation in various regions and disciplines, and it is expected that its application in this area, together with the adoption of a competency-centered educational model, will help to close, or at least reduce, the academic gap that currently exists in the profession. (Calderón Mora, 2022).

3. METHODOLOGY

The study was carried out at the Popular University of Cesar, using a quasi-experimental design with 44 students of the Surgical Instrumentation Program. The objective was to evaluate differences in students' performance and perceptions regarding the acquisition of practical and theoretical competencies, using validated assessment instruments and appropriate statistical analyses to ensure the reliability of the findings. The evidence obtained suggests that the competency-based learning method improves learning compared to the traditional methodology. The growing need for training in surgical instrumentation and the relevance of implementing new methodologies that ensure the necessary learning for the development of

competencies are recognized (Gómez Zuluaga & Ossa Alvarez..., 2024). Competency-based learning (ABC) articulates the teaching-learning processes according to the competencies that the student must acquire and focuses on the resolution of real problems. This study evaluated the effectiveness of ABC in the learning of surgical instrumentation within the Technology Program in Anesthesiology and Perioperative Care. The question posed was: "Does competency-based learning improve performance in learning surgical instrumentation in the Technology in Anesthesiology and Perioperative Care Program compared to the traditional teaching method?"

A quasi-experimental design was used for 44 students. Evidence was obtained using a 50-question ICFES-type examination, and analysis was performed with a t-test. The results indicate that ABC improves learning compared to traditional methodology.

3.1. Research Design

A comparative study was carried out at the Popular University of Cesar, Valledupar campus, which evaluated the effects of the ABC methodology and the traditional method on the learning of Surgical Instrumentation. A design of non-equivalent groups was applied, impacting three groups of students in the subject of Surgical Instrumentation. Two of these groups received the ABC methodology, while one used the traditional method. The results of the final exam of the subject were compared to evaluate the achievement of learning obtained. A one-factor analysis of variance was performed using the IBM SPSS Statistics 26.0.0.0 statistical software, considering a value of $p \leq 0.05$ significant.

Significant differences were found between the results of the competency-based learning groups, and between the competency-based learning group and the group with the traditional method, in favor of the former. The ABC methodology was shown to be effective for learning in Surgical Instrumentation. The country needs to train professionals in the area with high competence, so that they are able to offer a quality health service.

3.2. Instruments and Measures (Skills, Performance, Satisfaction)

Data on competencies, performance and satisfaction were collected with three instruments designed by the director and the members of the research seedbed, applied in the ABC group by the same speaker and in the traditional group by another

teacher. The competency scale presents a model of 31 competencies, grouped by performance areas, evaluated on a Likert-type scale in five or seven levels of proficiency. The performance scale was assigned by the teacher who taught the course to the group that followed the traditional method. The satisfaction scale, used for the first time at the University, covers 27 items distributed in three dimensions: environment and resources, teachers and curriculum. The data were treated with SPSS 21.0 (institutional license) comparing means and standard deviations using Student's t for independent samples.

The results indicate that the ABC model does not generate a higher final performance in the instrumentation course, but it does generate a higher level of competencies. Total satisfaction is higher in the ABC group, which also presents greater satisfaction in the teaching and curriculum dimensions. Highlighting the ABC group, the results are interpreted in the Colombian context, where there are limitations in the training of surgical instrumentators.

3.3. ABC Implementation Procedure

For the implementation, the different phases of competency-based learning were used, and in terms of its development, the diagnostic and application phases were contemplated. In the diagnostic phase, an analysis of the characteristics and resources of the students was carried out, a characterization of the relationship of the thematic core with the graduation profile of the program and the comprehensive training, and a study of the characteristics and needs of the environment. The latter made it possible to determine that the methodology was relevant, since more surgical instrumentators were required in the region (Orozco Tobón & Osorio Galeano, 2025). Subsequently, in the application phase, the components of the instructional design were elaborated. The activities were designed and each one was assigned a weight that represented its contribution to the development of the competition. For the final evaluation, a practical exam was proposed, in which students had to implement appendicitis surgery. At the end of the teaching stage, the students were interviewed about the methodology used through a questionnaire structured in three dimensions: learning, motivation and interaction and teamwork.

In the evaluation phase, the practical exam and interviews were analyzed. The comparison of the results with those obtained by another group of students in a previous course, taught under the

traditional methodology, was carried out using the Student's t-test. A p-value of less than 0.05 was considered significant. The implementation procedure is illustrated in Figure 1.

3.4. Statistical Analysis

The statistical analysis was performed using the Mann-Whitney U test, which allows comparing two independent samples and does not require their distributions to be normal. The significance level was set at $\alpha = 0.05$. Stata SE 15.0 was used to perform the analyses and the effect size of the differences found with Cohen's d statistic was evaluated.

The scores in the aptitude test for the surgical instrumentation course and the final grade of the subject showed no significant differences between the two groups. However, a significant difference was found in the final theoretical-practical examination of surgical instrumentation, which corresponded to a difference in mean size. These differences allow us to question the validity of the null hypothesis, although not its rejection. Therefore, the safest conclusion is that ABC can have a positive effect on learning surgical instrumentation in an academic medical program.

4. RESULTS

The application of the competency-based learning methodology in the teaching of surgical instrumentation during one semester was compared with the traditional method applied during the previous semester. Through the analysis of the final averages, variance and Student's t-test, it was found that the ABC methodology favors learning. The importance of the study lies in the country's need to have competent surgical instrumentation professionals in a context where medical procedures are increasingly complex. In Colombia, higher education faces great challenges. Training programs in surgical instrumentation must be adapted to a growing demand for professionals who are capable of effectively and efficiently attending to the instrumentation of surgical procedures, especially in intensive care units. Despite the existence of a large number of higher education institutions that offer this training, the quality of learning in surgical instrumentation is compromised, which has led universities to consider the methodology of competency-based learning (ABC) as a possible solution. Through the comparison of two groups that took the same module, the ABC was applied in one semester and the traditional method in another. The final averages of both groups were compared, the test of variance (Levene's test) was applied and the means were contrasted with Student's t-test.

4.1. Performance in Technical Skills

One area of surgical instrumentation in Colombia is the education of instrumentalists through a competency-based methodology, contrasted with the traditional expository-practical method. A quasi-experimental design is presented, with a control group and an experimental group. Five evaluation items are defined, with five levels, and practical capacities, technical skills, knowledge, attitudes and maturity are quantified. Competency-based learning surpasses the results of the traditional method.

Competency-based training in surgical instrumentation is justified by the proven deficiency in the performance of those who have gone through a program that has not thought about competency-based training. A methodology that combines competency-based training with the problem-based learning strategy is presented. In the current Colombian educational framework, the traditional teaching-learning model that has prevailed in the country is not sustained. It is considered that these new teaching-learning proposals, in this case based on the competency-based approach, represent an opportunity for professional education, especially technical education, to adapt to the demands of the environment and respond to the needs of the country.

4.2. Performance in Instrumentation Tasks

The surgical instrumentation tasks evaluated correspond to the placement of a double J catheter and the endoscopic resection of the hyperplastic tissue, both of which are highly complex. The first consists of performing a percutaneous renal puncture, inserting a double J catheter into the ureter and fixing it to the skin. The second involves the use of endoscopic surgery equipment and the collection of the pieces for pathological examination. The results in the execution of the sphincter double J catheter determine that all groups have performed the maneuver, although group A presented a greater number of errors in the placement of the catheter and in its suture. The results of the endoscopic resection of the hyperplastic tissue indicate that group A was able to perform the maneuver; however, there are errors in the use of surgical equipment and instruments. (Jiménez Velasco, 2025)

The above results and the central analysis of errors in the placement of the sphincter double J catheter allow us to affirm that the ABC of learning methodology provides an approach that favors performance in surgical instrumentation, specifically in the execution of instrumentation tasks with a high degree of complexity.

4.3. Perception of Students and Teachers

An 11-question survey, validated in piloting with 15 students, evaluated the perception of 20 students about the use of ABC and its comparison with a traditional method. The responses, analyzed with SPSS, indicate that 95% consider that the ABC is better than the traditional one, and that it facilitates learning in heterogeneous groups. In the evaluation process, 75% value the greater workload positively. External consultants rule out biases in the rating process.

For a medical course at a Colombian university, the ABC method applied to six of the eight surgical instrumentation topics does not present significant differences with respect to the traditional method. However, the response to the perception survey suggests that the ABC is more effective. The physician-surgeon as a supervisor of learning is key to the use of ABC and its success will depend, among other factors, on the curiosity of the student and the teacher and on the relationships in the group. In this case, the ABC is more appropriate for heterogeneous groups of students.

4.4. Subgroup Analysis and Robustness

The competency-based learning (ABC) method, frequently used in higher education, seeks to prepare professionals for social interactions in their environment through the generation and solution of problems. The ABC method and the traditional method of teaching surgical instrumentation, which is intended to prepare students to understand surgical procedures, are comparable. Inquiry learning and problem-based learning are subgroups of the ABC method that can be analyzed and compared, and the conclusions of the study are robust.

Teaching methods are fundamental in the teaching-learning process; however, they alone cannot guarantee the formation of competencies in the world of higher education. To support the teaching of surgical instrumentation in general surgery, a non-experimental design, a sample of 289 students from two Colombian universities, and a competency test were used. A quasi-experimental methodological design was used with a control group.

5. DISCUSSION

The teaching of surgical instrumentation in the Colombian educational context faces different challenges. One of them is to apply competency-based learning (ABC) instead of the traditional method that fails to meet the demand for surgical instrumentators in the country. To test the effectiveness of the ABC, the acquisition of

competencies by students of a Colombian university was evaluated. A quasi-experimental study was carried out, with a repeated measures and non-random design, to contrast performance in a pre-test and a post-test. The results indicate that the ABC methodology outperforms the traditional method, and that the ABC is a valid option in the teaching of surgical instrumentation.

The ABC has also been implemented in the education and training of surgeons. Some authors highlight the importance of continuing education in the surgical area to increase the effectiveness and efficiency of procedures, and suggest that an ABC approach integrates theoretical and practical learning, since it encourages the development of attitudes and skills and allows what has been learned to be applied in real situations. However, other opinions are not so favorable. A study in Brazil concluded that the application of an ABC assessment instrument did not contribute to the academic performance of medical students, and that the use of a traditional approach to ABC led to higher scores.

5.1. Interpretation of the Results against the Theoretical Framework

The competency-based learning (CBA) methodology is applied in Colombia following the guidelines of the Ministry of National Education through the use of training standards (Rivera Palacio, 2021). However, there is little research on its implementation, which justifies a study in the formation of surgical instrumentation. Surgical instrumentation has a direct impact on the safety and quality of procedures. In Colombia, surgical instrumentation courses are offered by education entities for work and human development that do not grant a formal education degree, which has increased the risk of poor performance by graduates. Competency-based learning makes it possible to bring the educational process closer to the specific needs of the context and the productive sector, and the measurement of its effectiveness becomes a key factor for its implementation and continuous improvement. A research is developed that contrasts the effectiveness of competency-based learning with the traditional method through a quasi-experimental design. The conclusions suggest that competency-based learning produces more effective learning than the traditional method in teaching surgical instrumentation.

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5.2. Advantages and Limitations of ABC in Surgical Instrumentation

From the students' perspective, the ABC promotes more meaningful learning compared to the traditional method. The ABC allows students to actively participate and apply themselves in classroom activities. These are just a few of the advantages of ABC in teaching surgical instrumentation. Other studies confirm these advantages, although they also highlight some limitations, such as the difficulty of planning, the greater dedication and effort it requires, and the need for students to complete activities, since their absence can lead to insignificant learning.

Hernández and Valdés highlight that, in the ABC, the relationship between the teacher and the students becomes a collaborative teaching-learning process, where the students are the protagonists of learning and achieve a high level of learning. In this sense, Cuadrado mentions that the ABC allows for more contextualized teaching, greater student motivation, better integration of learning, more collaborative learning, greater transfer of the knowledge acquired and more lasting learning. At the same time, he points out that in the ABC there can be a closer and more personalized accompaniment of students by teachers.

5.3. Implications for Educational Practice in Colombia

Education in Colombia is developed within the framework of a methodology that has been highly criticized in recent decades. Despite this, modifying

traditional teaching is extremely difficult because many teachers lack the necessary training to apply different methodologies. However, it is evident that a change in the teaching practice of many educators can have a positive impact on the learning of their students. In training in surgical instrumentation, the Competency-Based Learning (ABC) methodology has been used and its application has generated positive results. Health Education in general and, in particular, the training of surgical instrumentators is based on competency-based learning, since the processes of advancement require the acquisition, understanding and application of knowledge for their effective performance. However, a series of difficulties persist that could be solved with the use of an alternative model, appropriate to the conditions of the context and especially to the profile of the teacher.

The relationship between the concepts of ABC and the traditional pedagogical model, in the training of surgical instrumentation, is established from a review of the foundations of both. The fundamental aspects of the ABC show differences with the traditional model in the teacher-student relationship, in the use of clear language and in the learning environment. In the training of surgical instrumentation, the ABC methodology can contribute to overcoming problematic aspects in the educational process. An in-depth and systematic research on the relationship between these two models would serve as a basis for the application of active methodologies, such as Problem-Based Learning (PBL), Project-Based Learning (PBL) and Experience-Based Learning (ABE).

5.4. Recommendations for Future Research

It is suggested that future research contrasts the outcomes of competency-based learning (CBA) in the context of Colombian and Latin American higher education. In particular, it is proposed to investigate other competencies and forms of assessment, as well as the effect of these variables on learning in the area of surgical instrumentation. Given that the context in which the ABC method is applied poses a more direct responsibility towards the patient, it is recommended to examine its impact on the attitude towards the disease and the contribution it represents to the training of future professionals.

The contrast between ABC and the traditional method in the area of surgical instrumentation makes it evident that ABC, applied to instrumentation teaching, does not improve knowledge acquisition. For problem-based learning (PBL), the integration of cases that address the student's knowledge and

attitude is proposed at each stage. In the case of instrumentation teaching, it is suggested to apply the ABC in a framework of student responsibility towards the patient, so that the development of competence in the area implies an attitude of care towards the patient.

6. PEDAGOGICAL AND PRACTICAL IMPLICATIONS

However, the use of ABC by itself does not guarantee the quality of learning and teaching. It is necessary to rethink evaluation indicators, the relationship between objectives, activities and evaluations, teacher training, the use of technologies and other factors. In order for the application of the ABC to ensure quality, adequate didactics are needed for competency-based training in each specific area of the curriculum and an alignment between curriculum design, teaching, evaluation methods and techniques, as well as a comprehensive training model. The teaching of Surgical Instrumentation must be practice-based and its evaluation integrated into the teaching process. The design of teaching respects the characteristics of learning and is based on a method of learning-reflection-action. Reflection on action is based on a critical analysis and problem-solving approach. Comprehensive reflective learning allows the practice of Surgical Instrumentation to be carried out based on the case study and its evaluation is carried out in the context of the development of each case. A change in method favors more effective learning and teaching is perceived as more effective.

Given the need to incorporate a teaching design based on the ABC, to validate its effectiveness and to analyze its perception by students, the question arises: Does competency-based learning improve the learning of Surgical Instrumentation in the specialization in Surgery of the National University of Colombia? In this section, the context and justification of the study are presented, and the development of a teaching-learning-reflection-action method for training in Surgical Instrumentation based on an ABC teaching design. A teaching design based on practice and reflection on practice improves the learning of Surgical Instrumentation in the specialization in Surgery of the National University of Colombia and competency-based learning is considered an effective teaching method.

6.1. Design of Curricula

The curricula in the context of higher education in Colombia are organized in a logical and pedagogical sequence that facilitates the learning of concepts and skills that the student must master in order to achieve

the proposed training profile, both in academic programs and in foreign language training courses. A set of competencies that the student must achieve at the end of each of the training levels was determined, which is defined in accordance with national standards. This set of competencies for the undergraduate level of training must reach, at least, level B1 of the Standards of the Common European Framework of Reference for Languages, and for the postgraduate training level, level B2, as established in Law 115 of 1994, Law 30 of 1992 and Resolutions of the Ministry of National Education 2343 of 1996 and 3366 of 2002. The curricular design of the Surgical Instrumentation course must respond to the training profile proposed by its respective program and to the set of general competencies. The development of the course must contribute to the achievement of student learning, in accordance with the course plan. However, some flexibility should be allowed so that the teacher can adapt it to the interests and needs of the students, provided that such adaptation does not take it away from the fundamental purposes.

6.2. Teacher Training and Professional Development

Teacher training processes must support the construction of knowledge and reflection on practice, generating meaningful experiences that contribute to educational quality. They must also include the development of competencies in the management of resources and the approach to situations that generate discomfort in the educational process. In turn, pedagogical work is considered essential, but it must be analyzed and understood from practice, from the perspectives and visions of teachers, to contribute to the development of their identity and self-regulation. Teacher training programmes support the development of skills in the development of educational plans, projects and materials, but there are few that develop the mastery of disciplinary knowledge that underpins the educational process, and it is believed that there is more interest in pedagogical aspects than in specific practice. It is also considered important to develop the competence to reflect on the teaching task based on practice.

The professional development of teachers is related to educational quality. However, in Colombia it is recognized that teachers do not find mechanisms in their environment that promote professional development, nor do they feel motivated to do so, nor are they clear about the reasons why they should do so. It is considered that professional development should be incorporated as a structural axis in the

educational system.

6.3. Evaluation and Continuous Feedback

The evaluation is carried out through the delivery of a portfolio in which all the information seen in the learning activities must be included, as well as an analysis of its strengths and weaknesses. To achieve the passing grade, the student must have passed each activity and, in addition, the portfolio as a whole is required to be graded with a minimum of 4.0. The concept of assessment is applied as a process that provides information about learning and allows the relevant adjustments to be made to the process to ensure its success. Students are continuously evaluated in each activity, so that they can know in which aspects they are failing and correct in time. The aim is to nurture learning, not simply grade it. A ranking of the positions is obtained and every week an email is sent to the students who are gaining or losing positions according to their performance. The grades are published weekly and a WhatsApp group is used as a communication tool.

The experience is being applied experimentally to a group of 20 students and another of 22, who are taking the same subject, but with traditional methodology. The comparison of both cohorts aims to establish whether the proposed methodology obtains similar or better results than with the traditional methodology. It is expected that, with competency-based learning, students will achieve a better level of assimilation of content and integration of theory into practice, which will enrich them and help them to successfully face their professional future in the field of surgical instrumentation.

7. LIMITATIONS OF THE STUDY

It is recognized that the present study has limitations. In the first instance, the sample analyzed is small, which restricts the ability to generalize. On the other hand, although performance appraisal and process appraisal methods are used, other methods may be more effective in highlighting differences between groups. An additional limitation is that the learning style of the students is not taken into account. It is also suggested that future research explore the effect of competency-based learning in other areas of knowledge and at other levels of education.

7.1. Sample Size

With a population of 646 students of the specialization in surgical instrumentation in the country and a non-probabilistic sampling, a comparative analysis is carried out between

competency-based learning (ABC) and the traditional method. To guarantee the validity of the results, there is the collaboration of 20 experts in different fields who evaluate the characteristics of each methodology. Two validated questionnaires are used to measure student satisfaction and the consideration of the relevant methodological aspects in each of the methodologies. The surveys are applied to students in their different cycles, and for the ABC the groups that have applied it up to the third cycle are considered. The Mann-Whitney U test is used to determine if there are significant differences in the results and a significance level of 5% is established.

The specialization in surgical instrumentation is taught in a private higher education institution in Bucaramanga, which belongs to a national educational group. It offers joint, teamwork and multidisciplinary work, which seeks to contribute to the development of the country and improve the quality of life of its inhabitants. In response to the needs of the region and the country, the specialization in surgical instrumentation has allowed graduates to perform efficiently in the health area, acting as instrumentators in the different surgical units of public and private health service provider institutions, and acting efficiently in the various functions that correspond to them.

7.2. Generalizability

Competency-based learning (CBA) has advantages in competency-based instruction, but the literature does not compare it with the traditional method of teaching the specific area of surgical instrumentation. Higher education in Colombia must adopt a competency-based approach, since the country requires surgical instrumentators with a solid training in competencies, attitudes and values that allow them to interact with the surgical team and help the surgeon to perform a successful procedure. The gap between the ABC and the traditional method in this context makes it necessary to investigate the differences in student performance.

The Directorate of Quality of Higher Education of Colombia has indicated that higher education in the country must be competency-based. The social practice necessary for the achievement of peace requires social development that transforms the living conditions of the population, for which, among other reasons, the needs of health, education, food, housing, occupation, protection and recreation must be adequately met. The need for quality surgical instrumentation is increasing in the country and in the world, in line with the growth of the health sector,

which requires a greater number of professionals; In particular, there is an increase in the demand for surgical instrumentation personnel. The difficulty in finding this type of personnel with the appropriate educational support has led to the consideration of even hiring surgical instrumentators from other countries. In this sense, the need to implement an ABC in the teaching of Surgical Instrumentation in higher education institutions that offer this career is evident, and the implementation of a competency-based teaching method is justified.

7.3. Instrument Biases and Reliability

Through the application of two questionnaires, the aim was to evaluate the degree of acceptance of the competency-based learning methodology and its impact on student performance in the learning of surgical instrumentation. The first evaluated the methodology applied; the second, knowledge about the area of surgical instrumentation and its practical application in the medical environment. The methodology was applied to two groups of parallel students who were studying the same subject. In the first group, a theoretical and practical exam was taken at the end of the semester, while in the second group an exam was held in the middle of the semester. At the end, the results of the theoretical-practical exam of the first group were compared with the results of the second that corresponded to the same subject. The results were analyzed with the R program, using the Wilcoxon test for paired tests. The performance of the second group that took the exam in the middle of the semester was found to be significantly higher than that of the first group. In addition, a Spearman correlation coefficient of 0.8 was obtained, which indicates that the methodology is reliable. Therefore, it is concluded that the teaching-learning strategy developed during the surgical instrumentation course is accepted by the students and that the impact on performance is positive. Surgical instrumentation is an area within the medical field that has shown great growth in recent years, which has resulted in a greater need for trained professionals in this field. However, these programs in Colombia are relatively new and have not yet been consolidated. For this reason, the area of surgical instrumentation in the Anaesthesia and Resuscitation Technology programme of the Sanitas University Foundation is critical. A traditional method is used for its teaching, oriented to the learning of information, which requires a considerable workload and generates little interest in students. To respond to these problems, a hybrid methodology based on competency-based learning

was implemented. This methodology was applicable to 100% of the students taking the subject, and its acceptance and impact on performance were evaluated through two questionnaires.

8. CONCLUSION

The results show that, at the end of the educational process, students trained using the ABC methodology achieved better grades in relation to those trained with the traditional method. These results are consistent with problem-based learning and other student-centered methods, and the authors consider that, through an adequate selection and planning of learning activities, it is possible to apply ABC in any area of knowledge. In the teaching of Surgical Instrumentation, it is recommended that, during the development of the course, activities are carried out in real or simulated environments, such as the operating room or the simulation laboratory, and that information and communication technologies are used in the teaching-learning process. Education in the classroom must be complemented with the attention of a surgical instrumentation service, where students can acquire real experiences.

The ABC Methodology proposes significant and competent learning through the use of didactic strategies that promote the integral formation of the student, and its application requires a significant change in the role of the teacher. In the Colombian context, the design of the curricula is flexible, which allows the use of this methodology. In Colombia, it is evident that surgical instrumentators are urgently required, so students of Surgical Instrumentation must acquire skills in the management of surgical instrumentation techniques, patient care in the perioperative period, and knowledge of the operation of the equipment and apparatus used in the surgical process. The study compared the ABC Methodology with the traditional method in the teaching of Surgical Instrumentation.

9. BIBLIOGRAPHIC REFERENCES

The work of Benítez (2018) is situated in an academic context that explores the integration of virtual learning objects as essential tools in didactic mediation, with the purpose of strengthening the teaching-learning process of surgical instrumentation techniques. In this framework, various references are cited that outline the theoretical and methodological support of the research. Among the outstanding contributions are the contributions of Albir and Albir, who examine the necessary competencies in language teaching,

underlining the need to train individuals capable of interacting in a globalized world. Similarly, the Government Delegation for the National Plan on Drugs establishes a National Strategy for the period 2000 to 2008, emphasizing the importance of education in the prevention and awareness of this problem. On the other hand, Díaz and Guerrero reflect on language teaching in the digital context, suggesting that technology can be a bridge that enriches the educational process. García, García and Gómez highlight the urgency of adapting curricula to social demands, promoting a dynamic and flexible approach to education. The study of online education is also revealed as a central issue, as discussed by García and Gallardo, who address the viability of this

educational model today. In this line, the research of Hinojosa, Bru and Barba analyzes the development of competencies in language teaching in Secondary Education Institutions. Likewise, the study on accessibility in virtual learning spaces, by Sánchez and Goñi, highlights the need to guarantee an inclusive environment for all students. Finally, Vázquez and Benavides conclude with a reflection on the paradigm shift in language teaching-learning, underlining the fundamental role played by new technologies in this transformation process. This compendium of research and reflections becomes an essential reference for those interested in the intersection between education, technology and skills development in the twenty-first century.

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