Techno-pedagogical strategies of teachers in the process of teaching computer science in a public university

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Abstract

This study analyzes the techno-pedagogical strategies implemented by teachers in their components in the orientation of their thematic components. This is a quantitative research, exploratory and descriptive design with the observation of the variables and categories of analysis with an intentional or convenience sampling with a survey which was validated through a Cronbach analysis. The data were analyzed with the statistical software JASP. Teachers apply a series of pedagogical strategies that facilitate the use of technological tools in students. Their experience has a great influence on the management of these tools, strengthening the training or qualification of their students as a significant factor. This research makes it possible to advance the knowledge of pedagogical strategies that facilitate the use of ICT and to propose future recommendations on their application in the use of ICTs.

Keywords: Techno-pedagogical strategies, teaching processes, ICT.

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INTRODUCTION

Education and the formation of the individual are closely linked to the advances in information and communication technologies in the new knowledge society. When changes are made in the subjects, ICT must be taken into account for better training, as well as continuous improvement in the teaching-learning processes. The use of pedagogical strategies for the use of ICT can be based on the same use of technological tools. To improve their effectiveness in promoting teaching, it is necessary to design more useful learner classification functions and learning strategies based on Moso Teach and Rain (Oubibi *et al*., 2022). The slight advances in information and communication technologies - ICT, have been changing this knowledge society and in general the culture of the people because they are always looking for better teaching-learning processes. The educational community has been researching alternative teaching-learning processes of active methods to develop technical and transversal competencies (Neves *et al*., 2021). Consideration of the strategic role of technological innovation in the management and transmission of knowledge in no way excludes reflection on the relevance of the contents of training and even less on the meaning and purpose of such training, Zabalza (2000). The use of technology forces changes in traditional educational processes, which in many cases are centered on the teacher and the contents defined by him/her, to a process where ICTs are widely used.

To gain flexibility, comfort, self-learning, discipline, and efficiency, resulting in a better

academic level and leading to the use of ICTs to allow inclusion and the solution to the needs that students may present. ICTs assume an important role in all areas of society and the school as a place of inclusion must be able to meet the needs and overcome the difficulties of students, preparing them for the constant changes that technologies provide (Sampaio and Almeida, 2016). It can be inferred that the education sector is one in which many changes and advances have been presented, this has made educational institutions carry out large investments in technological equipment to obtain better educational processes that aim to facilitate the teaching-learning processes through technological knowledge, which implies that teachers are trained in the use of ICT.

Effective teaching depends on how teachers use ICT in their teaching, no study has focused in particular, on the technological pedagogical knowledge (TPK) of teachers. Sometimes these teachers are expected to teach a wide variety of subjects and, therefore, often do not have a deep knowledge of the content of each subject (Heitink *et al*., 2017). In the informational society, what determines the success or failure of individuals or organizations is the ability to select the most relevant information at any given time and to process it to apply it appropriately in each situation (Flecha *et al*., 2001).

In times of technological advancement and digital transformation in all spheres of life, the level of ICT competence is of great importance. Digital literacy is one of the key competencies of a modern young person (Bykova *et al*., 2020). As a chain, ICT has generated changes and evolutions in education, and changes at both social and business levels to be competitive in terms of information and communication technologies (ICT). The increasing introduction of ICT in the training context has changed classroom practice and the core of this change is the relationship between teacher and student (Roco and Barberá, 2020).

The changes produced after the irruption of digital Information and Communication Technologies (ICT), characterized by their simultaneity, instantaneousness, interactivity, asynchrony and ubiquity, have opened a new range of opportunities and demands in education (Flores *et al*., 2021). The relationship between subjects and the way of approaching them is so strong that it can be argued that both, subjects and didactic treatment strategies are inseparable (Camilloni, 1998: 186), from here it is clear that the teacher must think of pedagogical strategies that encourage his students and promote self-learning since the strategies are linked to the contents that the teacher wants to work on in his course.

In this new way of facing education, the use of pedagogical strategies allows the potential use of ICT in the mastery and exchange of information, facilitating the achievement of great learning and teaching experiences in educational models. This new reality requires a reconversion of traditional educational roles based on strategies that allow accessing and managing information through active and innovative methodologies marked by the predominance of the digital (Leiva *et al*., 2022). Theories have been used in traditional education to create models that facilitate the teacher to teach different thematic components, and to be able to help the student learn in the best way (Silveira, 2011). Otherwise, the traditional type of education has always been oriented to teaching, but without taking into account models or strategies that facilitate both teaching and learning. It is good to consider the following questions: What to teach, how to teach, and what and how to evaluate? It is possible to agree that:

> *A teaching model is a structured plan that can be used to shape a curriculum, to design teaching materials, and to guide classroom instruction...Since there is no single model capable of coping with all types and styles of learning, without limiting methods to a single model, however appealing it may be at first glance; Joyce and Weil (1985).*

The pedagogical strategy must be based on a method, but unlike a method, it is flexible and can take shape based on the goals to be achieved. In its application, the pedagogical strategy can make use of a series of techniques to achieve the objectives it pursues (Tardif, 2012). It can be indicated that the pedagogical strategy comes to make a planning system applicable to an articulated set of actions to reach a goal. Therefore, it cannot be said to be used when there is no goal towards which actions are oriented. To have pedagogical strategies for teaching is to facilitate the use of technologies that can be adapted, for example, to a virtual education

platform and also to a specific group of students with special characteristics defined in each academic period, and depending on the objectives to be achieved. Methods are very important in the process of planning, design, evaluation and systematization of orderly and coherent processes, which have a logical cumulative sequence and result in a qualitative transformation of the situation from which they started. For that reason they are very important in the educational process, because they show the way or the path to follow, allowing to chart a course in search of an objective, a goal, a purpose or an end (Torres and Girón, 2009).

Methodology

The paradigm was quantitative to analyze the strengths in the use of ICTs and their implication in the process of teaching computer science. With this, it is possible to design pedagogical strategies that allow the use of ICT. The methodological aspects considered in the development of the project are presented, from the type of research and the procedures.

The structure has four (4) phases: Phase 1) Exploratory exercise that allows exposing the target population of this research project (first semester teachers of the Business Administration program) to the purpose of the research project. Phase 2) Systematically collect elements that contribute to the fulfillment of the general objective, which is the design of the pedagogical strategy for the use of ICT, and so optimize the training process. Phase 3) Systematization of the information acquired in the field, through programs that facilitate the tabulation and analysis of the information with the capacity to analyze the textual data such as the transcriptions of the interviews, the written texts and the different notes obtained. Phase 4) Analysis of the information where it is considered to recognize the results found elements that make possible the proposal of adequate pedagogical strategies that optimize the use of ICT.

This design is exploratory and descriptive since it allowed to observe the variables and categories of analysis with which the research problem was observed and described. The research project started by establishing a theoretical framework from the pedagogical strategies for the use of ICT, taking into account all the technological resources available at the university. An exploratory and descriptive research design was used because the application of questionnaires was carried out to know how teachers apply ICT in the teaching of the computer science subject, without the researcher of the project influencing, but in the context of events of the practices of teachers of the university program. It is called exploratory because it is carried out on an unknown or little studied subject since in the literature search there are no guides, nor concrete pedagogical strategies, very superficial ideas on the subject could be found.

> *"Exploratory studies serve to increase familiarity with relatively unknown phenomena, to gain information about the possibility of conducting a more thorough investigation of a particular real-life context, to investigate problems of human behavior considered crucial by practitioners in a particular field, to identify promising concepts or variables, to establish priorities for further research, or to suggest verifiable statements (postulates)"* (Dankhe, 1989).

For the selection of the instrument to be used, the questionnaire is defined, taking into account that it is the most used instrument in research projects, because it allows the collection of information through questions, to which scores can be assigned in this way it can become more practical to achieve the objectives of this research project, as a strong point it allows the collection of data from primary sources. According to Hurtado (2000: 164): "The selection of data collection techniques and instruments implies determining by which means or procedures the researcher will obtain the necessary information to achieve the research objectives". Due to the above, the instrument to be used will be the questionnaire, which will be how the information or data provided by the teachers of the program will be collected, to later carry out the analysis that will allow contrasting the information obtained with the data collected with the use of other techniques.

The questionnaire design is characterized by contemplating two items: 1) The structure of the questionnaire seeks descriptive information provided by the teachers, regarding the way of transmitting knowledge in addition to the teacher's basic data. 2) The twelve (12) questions are contemplated concerning the choice of the

modality used in university teaching, student participation, training, contributions and application of what was taught in each of the units. The population or universe of study is the teachers of the Commercial Business Administration program of the evening session of the Universidad Colegio Mayor de Cundinamarca, Bogotá - Colombia. They guide contents in the first semester, being mainly the teachers of the subject of computer science, which is the thematic component of the study of the research project, who understand the institutional philosophy and of the program, know and wish to share the essence of being a commercial business administrator. And teachers of the same program related to the subjects of technology, of the Universidad Colegio Mayor de Cundinamarca, Bogotá - Colombia.

Purposive or convenience sampling to justify the rationale for this type of sampling and sample size, the following is provided to Arias (2004):

> *"It is a selection procedure that does not know the probability that the elements of the population have to integrate the sample, such as casual or accidental sampling, which is a procedure that allows to arbitrarily choose the elements without a pre-established judgment or criterion".*

Therefore, this type of sampling will be used since the members of the sample are the first semester teachers of the Commercial Business Administration program of the Universidad Colegio Mayor de Cundinamarca, who will have the same probability of being chosen independently of the others. The type of intentional or convenience sampling will be used since the members of the sample are teachers. The sample will be non-probabilistic, where the type of intentional or convenience sampling since the individuals of the population were selected directly and intentionally, that is to say, we will work with the program's teachers. As for the data collection technique, a questionnaire with semi-structured questions was used to analyze the academic spaces and their problems in real situations.

Results

Once the procedure that was carried out in the project was defined, where the scope of the research, type and sampling, data collection, tabulation and presentation of results were indicated, an analysis of the reliability of the data generated was performed using Cronbach's factor, an alpha ($\alpha = 0.86$) was obtained, above (0.80) which indicates that the instrument was reliable, the behaviors of absolute frequency, relative frequency were analyzed, four (4) types of frequencies were calculated: Absolute frequency (Fi) is the average of a predetermined sum and also consists of knowing which is the number of greater equivalence. The larger the sample size, the larger the absolute frequency; that is, the sum total of all the absolute frequencies should give the total of the sample studied (N), relative frequency (fi), is the quotient between the absolute frequency and the sample size (N). In other words:

$$f_i = \frac{n_i}{N} = \frac{n_i}{\sum_i n_i}$$

Cumulative absolute frequency (N_i), is the number of times n_i in the sample (N). Cumulative relative frequency (Fi), is the quotient between the cumulative absolute frequency (N) and the cumulative absolute frequency (N):

$$F_i = \frac{N_i}{N}$$

This resulted in the data shown in Table 1.

ANSWER	n_i	RELATIVE FREQUENCY fi	PERCENTAGE pi	Ni	ABSOLUTE FREQUENCY Fi	PERCENTAGE Pi
1	14	0.07	6.67%	14	0.07	6.67%
2	36	0.17	17.14%	50	0.24	23.81%
3	80	0.38	38.10%	130	0.62	61.90%
4	80	0.38	38.10%	210	1	100%
TOTAL	210	1	100%			

Table 1. Absolute and relative frequencies of tabulated data.

By applying the internal consistency method based on Cronbach's alpha, it was possible to estimate the reliability of the instrument, the internal consistency, in this way, has a range between zero and one. Therefore, it is inferred that the closer the alpha value is to (1), the greater the internal consistency of the items analyzed, as a result the project instrument applying Cronbach's alpha with the tabulated data was ($\alpha = 0.86$), which is between the interval of ($0.9 > \alpha \geq 0.8$), it is ratified that the instrument is reliable since the interval marks an internal consistency. In table No. 2, it can be seen that the median gives as a result four (4), which represents the value of the central position variable:

MEDIAN	STANDARD DEVIATION	VARIANCE	No. OF ELEMENTS
3.0	0.90180	0.81324	35

Table 2. Scale statistics.

To answer the research questions, Table 3 should be analyzed, questions that had a mean of less than three (3), where the mean of answers is closer to two (2), which is the tabulation of some times.

ITEM	VARIANCE	MEAN	MEDIAN
P3	0.472	1.8	2
P4	1.250	2.5	3
P5	0.917	2.5	3
P6	0.889	2.7	3
P7	1.222	2.7	3
P8	0.889	2.7	3
P10	0.917	2.5	3
P14	1.556	2.3	2
P15	0.222	2.7	3
P17	0.556	2.3	3
P19	0.556	2.7	3
P24	0.917	2.5	3
P30	0.472	2.8	3

Table 3. Critical mean of the questions of the instrument.

According to these results, the following is analyzed: Are the current pedagogical strategies for the use of information and communication technologies - ICT by teachers adequate? The current pedagogical strategies for the use of information and communication technologies - ICT, by teachers, are adequate, they have a course planning taking into account the other environments and the experience of pedagogical strategies, which are essential to increase the use of ICT by teachers. Similarly, 80% of teachers do not use ICTs to evaluate student learning to facilitate the curricular process by carrying out evaluations.

Among the shortcomings of current pedagogical practices is that the use of computer tools as a means of publishing materials through the Web, Blogs, Webquest, Virtual Classrooms, Wikipedia, among others, is critical since 33.33% of computer teachers never use it in their pedagogical practices; where the training provided by the University to teachers and the acquisition and updating of software and hardware that it carries out, produces improvements in curriculum management processes as indicated by the high percentage (83. 33%) of teachers who take advantage of the training and updates of the software acquired by the University.

CONCLUSIONS

It is essential to strengthen and optimize teaching processes, such as the use of specialized software or productivity tools to implement and optimize curricular management; or the use of ICTs to provide feedback on evaluation results, so that students can make the necessary adjustments, proposals and improvement agreements for their learning processes.

The implementation of pedagogical strategies for the use of information and communication technologies - ICTs, manages to optimize the teaching processes by university teachers where the information collected was used to determine the efficiency and effectiveness that the teacher can have in the teaching process of the subject with the use of ICTs.

In addition to the pertinent and effective use of the technological and digital educational resources used adequately and functionally of the electronic systems for the search and processing

of information as a means of communication with their students and obtaining didactic materials on the Internet as a complement to their courses and as a tool to program, manage, control and feedback the information of their course, maintaining the interest of the students.

For teachers, it is clear that the availability of ICT resources at the University facilitates the management of oriented courses and it is clear that the pedagogical strategies for the use of ICT according to the approach given at the University are useful to conduct the teaching-learning process.

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