

Methodological Learning Strategies Based on Disruptive Innovation in Research for Students of a Public University

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Abstract—The objective of the investigation was: To determine the effect of the application of the university investigation program to improve the investigation capacities in the students of cycle VIII, IX and X of the different faculties of the National University of San Martín-Tarapoto. From this perspective, it has been hypothesized that the application of a university research program produces significant effects in the improvement of research capacities in students of cycle VIII, IX and X of the various faculties of the National University of San Martín-Tarapoto. The explanatory study, of the experimental level, of the quasi-experimental design, has been carried out with a sample of 187 students from the various faculties of the UNSM-T. The comparison of the pre and post test scores, obtained from the students' responses, has allowed us to reject the null hypothesis and accept the alternative hypothesis, which shows that: The application of the university's research program significantly influences the improvement of research capacities, dimensions: Epistemological, methodological and transformational criticism of the students of the different faculties of the National University of San Martín-Tarapoto.

Index Terms—University research, research capabilities, epistemological, methodological and transformational criticism

I. INTRODUCTION

Methodological learning strategies based on disruptive innovation is a tool of great importance to develop investigative skills in undergraduate; since it seeks to work on the students with the basic skills that allow them to perform the occupational role that the labor market demands. Since university instigation is search, it is the creation and innovation of knowledge; it is the use of rigorous methods, a sense of critical peer judgment, in such a way that teachers, students and graduates

participate in research activities in the university or networks of research as well as national and international.

Research and teaching constitute a unit put into action; it is a requirement that raises the academic level in the university institution. In that perspective; however, UNSM-T is seriously affected in research and teaching, since there are deficiencies in development, consequently affecting the academic level. Reason why, it was necessary to apply a university research program that develops and strengthens investigative capacities.

The university research program was implemented with the objective of developing investigative capacities in the dimensions: epistemological, methodological and critical-transformational to improve research in undergraduate students. This is fundamental, because investigative capacities have to do with cognitive and intellectual processes leading to the construction of critical thinking skills and various research alternatives. Since it allows observing, discovering, consulting, interpreting and developing scientific knowledge.

Regarding the main method used in the investigation, it was the analytical method. In this perspective, the analysis focuses on the observation and examination of the investigative capacities of the students of the National University of San Martín -Tarapoto, with which it has been possible to: explain, make analogies and establish new proposals.

University research is considered today as a tool of great importance in the development of research capabilities, it seeks the generation of knowledge that involves not only the understanding of the world but also the understanding of man himself and his inextricable interrelation.

[1] Affirm that research has become a priority in the 21st century as a means of generating knowledge. In this way, research in education has been conceived as a viable path for educational entities that seek to improve teaching and, therefore, the teaching-learning process.

In this sense, it is also stated that research training has differences according to the case, the undergraduate or the postgraduate. According to [2] and [3], he declares "In undergraduate research training, the aim is to work on skills that often were not strengthened with basic and secondary education, helping the professional to have the basic skills that allow him to perform their occupational role in the labor market "

From this perspective, the university is a key instance that allows professors and students to contribute, through research, to the sustainable development of the society in which we operate and to be effectively energized in a process of constant reflection. In this regard [4] points out that reflexive is oriented to problem solving, efficient, and effective decision making.

Research at the National University of San Martín is seriously affected given that there are deficiencies in its academic development in the formulation of the research problem, instrument development, statistical processing; consequently, the preparation of the final report of the investigation; reason why it was necessary to apply a University Research Program that strengthens and develops investigative capacities in its dimensions: epistemological, methodological and transformational criticism.

University research. University research is considered "a process of seeking new knowledge, a process characterized by the creation of the act, by the innovation of ideas, by the rigorous methods used, by self-criticism and by the validation and critical judgment of peers" [5]. Along these same lines, [6] they understand formative research as that which seeks the generation of knowledge that involves not only the understanding of the world but also the understanding of man himself and his inextricable interrelation, in addition, it is necessary to say that through he somehow begins the development of an ideologically critical and autonomous research culture, which allows adherence to advances in knowledge.

In this context, the university is a research-oriented academic community; its work is focused on research. Research constitutes an essential and obligatory function of the university, which encourages and carries it out, responding through the production of knowledge and the development of technologies to the needs of society, with special emphasis on the national reality. Teachers, students and graduates participate in the research activity in their own institution or in national or international research networks, created by public or private university institutions. (University Law 30220, 2014, Art. 48 °).

University Research Program

It is defined as the generic strategy of academic research activities that seeks to put institutional research intentions into operation (well-founded research foci) through a set of complementary projects or activities aimed at achieving a common objective that tends to solve one or more problems or create opportunities in the fields of knowledge or social sectors.

In summary, a research program guides the strengths of the executing groups and organizes all the resources to optimize and achieve the research objectives. In this way,

it defines the strategies related to the identification of problems and research needs of the institution, the region, the company, the educational, social sectors and all those who have or seek a relationship with the academic processes and the projection of the university, facilitating the definition and implementation of policies in the areas or sectors object of the research program.

A Scientific Research Program, according to [7] "... is the Descriptive Unit of great scientific achievements, also considered as an Epistemological Analysis Unit consisting of a sequence of scientific theories with space-time continuity that relates its members, establishing modified versions according to a common initial plan. According to the PIC methodology, great scientific achievements are research programs that can be evaluated in terms of progressive and regressive transformations of a problem. The program can be defined by a succession of theories and hypotheses and it consists of methodological rules, some of which indicate the research routes to avoid and others the routes to follow (positive heuristics). A research program has three parts: i) a tenacious nucleus, ii) a negative heuristic and iii) a positive heuristic".

The university research program aims to develop investigative capacities, epistemological, methodological and critical transformational dimensions, with the purpose of improving research in students.

The university research program brings together all the scientific action processes aimed at providing advice to each student. Each student proposes by affinity to her advisor who should carry out the monitoring and accompaniment during the preparation of the project, the execution and application of the instruments and the preparation of the final report. In addition, scientific actions and processes are contemplated.

The most notable characteristics would be: a) Modeling: observing the situation; specify the purposes of the action; establish essential dimensions and indicators to carry out the action; anticipate actions and results, b) Obtain: locate; to select; evaluate; organize; collect information, c) Process: analyze; organize, identify key ideas; rework information, compare results, d) Communicate: analyze information; select the variant of the communication style according to the case; organize information; prepare the communication and e) Control: observe results; compare ends and results; establish essential conclusions; feedback on the process and results of the action.

Research and teaching must form a unit of action for the researcher, since this is the best way to provide the student with content that raises the academic level; This unit allows the teacher to reflect on her intellectual and scientific concerns while investigating and transferring some of those concerns and knowledge to a prepared audience; in this way, he manages to bring the student closer to the national reality, with the knowledge extracted from that reality and surpassing the mediocre and pragmatic level that is so characteristic of the teaching chair.

The positive attitude that the researcher must have towards research is an important element in teaching. The way in which teaching is carried out is decisive in the formation of the spirit of investigation. Although the university allows the flourishing of a mechanical education, of transmission of information, normative, not critical, although there are millions of pesos and equipment, research will not be possible as a work environment, there will be a yes to another researcher, but isolated, without multiplier effect. Teaching is needed to ask these questions: What? 'Why' 'For what? For whom? Produce receptive minds, but not conditioned or domesticated. When the university has this scheme, it will not only produce people eager to meet, but teachers will necessarily have the attitude necessary for research. How can this be achieved? A teacher interested in research who wants to pass it on to his students creates the favorable conditions for them to question what he and the books say, rather than teaching, he makes his students learn to learn. Recognizes a fact that few consider: the University does not give, nor can it give the student everything. What endures is the ability to learn alone. The university that teaches and does not make its students learn does not fulfill its function of forming, not deforming, to men.

Investigative Competences. From a historical perspective, the discourse of competencies comes from the field of studies on management and human capital, for [8], which gained great prominence in the postwar period, but which landed in the field of education more or less from the 1980s after the traditional education that took place at that time. On the other hand, the competence-based approach to education is functional to train people in the skills required by the labor market, which shows a close relationship between the educational and productive systems.

Understood in this way, investigative competences is a transversal component in the university curriculum, since it must allow the development and construction of cognitive and intellectual processes conducive to observing, discovering, consulting, interpreting scientific knowledge, developing thinking skills and identifying problems. research.

An example of the success of the discourse of skills in the field of education is the Bologna Plan, which forced to standardize European higher education and prepare young people for the labor market. The Tuning Project sought to standardize the principles of the Bologna Plan in Latin American universities. By sponsoring the quality policy in universities, the competencies approach emerges, which improves the quality of higher education, since it allows overcoming some of its traditional deficiencies: (a) emphasis on the transmission of knowledge; (b) little relevance of careers compared to context; (c) little collaborative work between teachers; (d) rigid and authorized evaluation systems; and (e) difficulty in approving studies; The current challenge is for the competency-based approach to enable universities to commit to (a) equity; (b) relevance; (c) dialogue; (d) daily work; and (e) orient education towards learning [9], [10].

The competence in education approach provides practical facilities for teachers and institutional systems to evaluate students, since it allows establishing a series of common or standard minimums that the latter are supposed to have and, as a checklist, establishes whether certain Competences are present through indicators that integrate the cognitive, the procedural and the attitudinal.

Investigative Capacities. The training and development of research capacities in the undergraduate constitute a topic addressed in various educational investigations in the international context. One of the fundamental tendencies of these studies has been the correlation between the terms development of capacities for research or development of research skills and that of training for research. The authors of [11] and [12] can be cited among the authors that address the term development of investigative capacities.

The investigative capacity seeks to verify if reality corresponds to the "permanent verification of the process and the results of the application of proposals that constitute scientific alternatives to solve reality problems, which allows evaluating their achievements and difficulties from scientific and ethical positions". [13].

Dimensions of investigative capacities

Epistemological dimension. This process considers the design of abstract systems with a sense of universality that, by imitating behavioral models of a reality, approaches the construction of knowledge.

It is the theoretical system in a must be of the being of the studied situation, the main indicator of the constructed knowledge. The possibility of generating knowledge about situations that are not directly observable is left open, that is, through logical arguments and reasoning, explanatory models can be structured in this regard. Knowledge results from combining the work of various teams in an interdisciplinary way, in such a way that they talk about research programs, because of the progress of the entire process. The respective researcher or team is free to design their theoretical structure that supports the knowledge that is being generated.

Methodological dimension. This dimension refers to the disposition and investigative capacity that the university student must have to design the research instruments. The methodology depends on the postulates that the researcher considers valid and proposes to put into practice (from what he considers the objective value of science and scientific knowledge), since it will be through methodological action how to collect, order and analyze reality. studied.

It can be said that there is no longer a perfect methodology, but often several interlocking or symbiotic relationships must be linked. In both the human and social sciences, the coexistence or alternation of various methodologies applied successively to the same object is common.

According to [14], these methodological capacities refer to the researcher's ability to manage the techniques that are used during the development of the investigation. They are the set of skills necessary to carry out, detect, demonstrate and put into practice the functions and

activities inherent to the research work with precision and efficiency. Through these competences, it is sought that the researcher has the ability to carry out a sequential order in the steps or stages of the research process: design, experimentation, if necessary, verification and, finally, the systematization of the results obtained.

Critical Transformational. For [15], they consider that the critical transformation capacity approach suggests a broader active and critical reflection from the ethical, personal, political and collective spheres on the implications of the acquisition and application of competences. Human capital-based discourses and practices "are instrumental and focus on what employers want from graduates, rather than what graduates want for themselves, or what educational traditions and theories consider desirable to learn"

It is the domain of the action that is deployed to solve research tasks in the educational, labor and adequate research fields with the resources of the methodology of science". In the work, it is considered that this concept is the one that has the greatest relationship with the undergraduate training process, since it shows the investigative capacities as a transversal axis within the substantive processes.

University research is a creative task that reproduces, generates, maintains and perfects scientific knowledge. One of the functions of the University is research itself, which links us to society.

II. METHODOLOGY

The main method used in research was the analytical method, that research method that consists of the dismemberment of a whole, decomposing it into its parts or elements to observe the causes, nature and effects. In this perspective, analysis is the observation and examination of a particular fact; in this case, the investigative capacities of the students of the various faculties of UNSM - T. It was necessary to know the nature of the phenomenon and the object that was being studied to understand its essence. This method allowed us to know more about the object of study, with which it has been possible: to explain, make analogies, better understand its behavior and establish new proposals.

Experimental design is a statistical technique that allows the causes of an effect to be identified and quantified within an experimental study. In an experimental design, one or more variables, linked to

causes, are deliberately manipulated to measure the effect they have on another variable of interest. In this configuration, the quasi-experimental design is used; in it, at least one independent variable is also deliberately manipulated to observe its effect and relationship with one or more dependent variables, only that they differ from the "pure" experiments in the degree of security or reliability that can be had in the initial equivalence of the groups. In this case, the design is with two groups, one experimental and the other control, with intact pre-post-test groups (one of them control).

Quasi-experimental, according to [16] quasi-experimental designs also deliberately manipulate at least one independent variable to observe its effect and relationship with one or more dependent variables, only that they differ from the "pure" experiments in the degree of security or reliability that is can have in the initial equivalence of the groups. In this case, the design is with two groups, one experimental and the other control, with pre-test and post-test and intact groups (one of them control). Likewise, consider that "population is the set of all cases that agree with a series of specifications. Populations must be clearly located around their characteristics of content, place and time." In this study, the population of students of cycles VIII, IX and X enrolled in the academic period, from the National University of San Mart ín, based in Tarapoto.

III. RESULTS AND DISCUSSION

Table I shows a highly significant statistical difference in investigative capacities ($Z_c = 145.01$ vs $Z_t = 1.96$). As indicated, the general hypothesis is accepted; that is to say, the effect of the university research program, in its stages: planning, doing, verifying and acting significantly influences to improve the investigative capacities of students of the VIII, IX and X cycle of the various faculties of the National University of San Mart ín - Tarapoto, in this sense [17] proposes the PHVA cycle "that considers a continuous improvement strategy that serves to: Improve processes, solve problems, implement new procedures and standardize processes. This knowledge production process is carried out mainly in Universities, so it differentiates two types of research that take place there: on the one hand, the research that aims to train professionals or researchers; and, on the other, that which has the declared intention of producing new knowledge or research.

TABLE I. RESULTS ACCORDING TO COMPARISONS OF CALCULATED Z AND TABULATED Z: GENERAL HYPOTHESIS TEST

Hipotesis	Measures Statistics	Value Z Tabulated	Value Z Calculated	Significance Level	Decision
$H_G: \mu_d = \mu_{Pre} - \mu_{Post} = 0$ $H_o: \mu_d \neq 0$	$\bar{d} = 44.3825$ $S_d = 4.1404$	$Z_t = 1.96$	$Z_c = 145.01$	$\alpha = 5\%$ $\alpha = 1\%$	Accept H_1

[18], states that in the field of research capacity development, new needs appear that lead to the development of alternatives with a view to solving global problems that concern the human being; These skills can

be configured in the course of the training process and lead to greater demands and faster responses

Table II shows a highly significant statistical difference in the epistemological dimension of the

variable investigative capacities ($Z_c = 181.59$ vs $Z_t = 1.96$). The same as it indicates, the acceptance of the alternative hypothesis (H1) where the application of a university research program produces highly significant effects on research capabilities, dimension; Epistemologically in the students of the VIII, IX and X cycle of the various faculties of the National University of San Martín - Tarapoto, this is corroborated by [19]

when he points out that: "theorizing the educational reality represents the search, application and socialization of the essential scientific knowledge to interpret and explain educational reality, as well as assuming personal scientific and ethical positions that allow you to project it in an enriched way ". Consequently, the use of concepts and categories to support and argue research problems.

TABLE II. RESULTS ACCORDING TO COMPARISONS OF CALCULATED Z AND TABULATED Z: GENERAL HYPOTHESIS TEST

Hipótesis	Measures Statistics	Value Z Tabulated	Value Z Calculated	Significance Level	Decision
$H_2: \mu_d = \mu_{Pre} - \mu_{Post} = 0$ $H_0: \mu_d \neq 0$	$\bar{d} = 19.9016$ $S_d = 1.4826$	$Z_t = 1.96$	$Z_c = 181.59$	$\alpha = 5\% \rightarrow$ $\alpha = 1\% \rightarrow$	Accept H1

TABLE III. RESULTS ACCORDING TO COMPARISONS OF CALCULATED Z AND Z TABULATED: SPECIFIC HYPOTHESIS TEST 2

Hipótesis	Measures Statistics	Value Z Tabulated	Value Z Calculated	Significance Level	Decision
$H_2: \mu_d = \mu_{Pre} - \mu_{Post} = 0$ $H_0: \mu_d \neq 0$	$\bar{d} = 18.7486$ $S_d = 1.0875$	$Z_t = 1.96$	$Z_c = 233.21$	$\alpha = 5\% \rightarrow$ $\alpha = 1\% \rightarrow$	Accept H2

TABLE IV. RESULTS ACCORDING TO COMPARISONS OF Z CALCULATED AND Z TABULATED: SPECIFIC HYPOTHESIS TEST 3

Hipótesis	Measures Statistics	Value Z Tabulated	Value Z Calculated	Significance Level	Decision
$H_3: \mu_d = \mu_{Pre} - \mu_{Post} = 0$ $H_0: \mu_d \neq 0$	$\bar{d} = 7.7705$ $S_d = 1.5335$	$Z_t = 1.96$	$Z_c = 68.55$	$\alpha = 5\% \rightarrow *$ $\alpha = 1\% \rightarrow **$	Accept H3

Table III shows a highly significant statistical difference in the methodological dimension of the variable investigative capacities ($Z_c = 233.21$ vs $Z_t = 1.96$). Likewise, it indicates that the alternative hypothesis (H2) is accepted, where the application of a university research program produces highly significant effects on research capabilities, dimension; methodological in the students of the VIII, IX and X cycle of the various faculties of the National University of San Martín - Tarapoto; which makes it possible to test and adapt a novel technique; a new technology, a work scheme, an ingenious procedure, etc., and based on the results, to specify and decide on the benefits of it [20], seeking that the researcher shows willingness and ability to build the instruments research; as well as, the expertise in its application.

Table IV shows a statistically significant difference in the critical transforming dimension of the variable investigative capacities ($Z_c = 68.55$ vs $Z_t = 1.96$). Therefore, the alternative hypothesis (H3) is accepted when the application of a university research program produces significant effects in the improvement of research capabilities, dimension; transformational critic in the students of the VIII, IX and X cycle of the various faculties of the National University of San Martín - Tarapoto. Supported in research on higher education from the perspective of capabilities, as requirements in the training of human resources at the present time.

IV. CONCLUSION

The application of methodological learning strategies and disruptive innovation has produced significant effects on research in students of public universities.

The analysis of the results of the previous test allowed the design of didactic proposals to insert students in the search for knowledge and scientific contributions, in its dimensions: epistemological, methodological and transformational criticism.

The comparison of calculated Z and tabulated Z, because calculated Z falls in the rejection region, has allowed strengthening the critical epistemological, methodological and transformational analysis in the students' research.

When comparing the calculated Z and the tabulated Z, when the calculated Z fell in the rejection region, it has been established that the effects produced by the application of methodological learning strategies and disruptive innovation have successfully influenced undergraduate research.

That research be a tool for change, sustainability and emphasis on the development of research capacities based on methodological learning strategies based on disruptive innovation in research for students of a public university.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Manuel Padilla and Ibis Lopez carried out the research and data collection: Baldo Olivares, Ana Leon and Mario Chauca worked on the analysis and methodology of the research. All authors contributed and had approved the final version.

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