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Artículos Científicos

Semillero de investigación: Estrategia educativa para promover la innovación tecnológica

Research Seedbed: Educational Strategy to Promote Technological Innovation

Camada de pesquisa: estratégia educacional para promover a inovação tecnológica

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Resumen

La propuesta de formación del semillero de investigación, tal y como se concibió gracias al apoyo del área académica del Instituto Tecnológico José Mario Molina Pasquel y Henríquez (ITJMMPH), Campus Puerto Vallarta, refleja el interés que se tiene en concretar proyectos de desarrollo tecnológico e innovación que no solo permitan al estudiante adentrarse en la investigación básica y aplicada, sino también incursionar, por medio de la transferencia tecnológica, en la posible comercialización de sus proyectos.

La metodología empleada es la de una investigación de acción participativa. Debido a que se busca que el estudiante desarrolle habilidades específicas para pensar de forma autónoma. Esto se expresa en dos aspectos: el primero, mediante el diseño y construcción de una propuesta de investigación individual o colectiva que propicie la participación activa, crítica, reflexiva y propositiva de todos los miembros del grupo; y el segundo, en la gestión y desarrollo de dicha propuesta. Se establecieron tres categorías de análisis: diseño del proyecto de investigación, desarrollo y seguimiento del proyecto.

En este artículo se proponen los mecanismos administrativos, académicos y elementos metodológicos mediante los cuales se fomenta la formación de investigadores, así como la práctica de la investigación extracurricular, tanto de alumnos como docentes, para la generación y desarrollo de proyectos tecnológicos y prototipos funcionales que formarán parte del patrimonio institucional

Palabras clave: enseñanza superior, ingeniería, innovación educativa, investigación y desarrollo, método.

Abstract

The research seedbed training proposal, as conceived thanks to the support of the academic area of the Instituto Tecnológico José Mario Molina Pasquel y Henriquez (ITJMMPH), Puerto Vallarta Campus, reflects the interest in concrete technological development projects and innovation that not only allows the student to enter into basic and applied research, but also to enter, through technological transfer, the possible commercialization of their projects.

The methodology used is that of a participatory action investigation. Because it is intended that the student develop specific skills to think autonomously. This is expressed in two aspects: the first, through the design and construction of an individual or collective research proposal that encourages the active, critical, reflexive and proactive participation of all group members; and the second, in the management and development of said proposal. Three categories of analysis were established: design of the research project, development and monitoring of the project.

This article proposes the administrative, academic mechanisms and methodological elements through which the training of researchers is encouraged, as well as the practice of extracurricular research, both for students and teachers, for the generation and development of technological projects and functional prototypes that will be part of the institutional heritage.

Keywords: higher education, engineering, educational innovation, research and development, method.

Resumo

A proposta de formação da sementeira de pesquisa, como concebida graças ao apoio da área acadêmica do Instituto Tecnológico José Mario Molina Pasquel e Henríquez (ITJMMPH), Campus de Puerto Vallarta, reflete o interesse em projetos concretos de desenvolvimento tecnológico e inovação que não só permite ao aluno entrar em pesquisa básica e aplicada, mas também, através da transferência tecnológica, ingressar na possível comercialização de seus projetos.

A metodologia utilizada é a de uma investigação de ação participativa. Porque se pretende que o aluno desenvolva habilidades específicas para pensar de forma autônoma. Isto se expressa em dois aspectos: o primeiro, através do desenho e construção de uma proposta de pesquisa individual ou coletiva que incentive a participação ativa, crítica, reflexiva e proativa de todos os membros do grupo; e o segundo, na gestão e desenvolvimento da referida proposta. Três categorias de análise foram estabelecidas: concepção do projeto de pesquisa, desenvolvimento e monitoramento do projeto.

Este artigo propõe os mecanismos administrativos e acadêmicos e os elementos metodológicos através dos quais a formação de pesquisadores é incentivada, bem como a prática de pesquisa extracurricular, tanto para alunos quanto para professores, para a geração e desenvolvimento de projetos tecnológicos e protótipos funcionais. fará parte do patrimônio institucional.

Palavras-chave: ensino superior, engenharia, inovação educacional, pesquisa e desenvolvimento, método.

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Introduction

One of the main interests of the Government of the state of Jalisco is to promote and encourage scientific research, innovation and technological development. Since it has been confirmed that these components of development have a direct impact on the index of business competitiveness and regional growth. The National Council of Science and Technology [Conacyt] (2015) notes, in its Jalisco Innovation Agenda, a document prepared with the support of 54 institutions, which has demonstrated that technology-based enterprises create virtuous circles: they generate high profit margins and They employ highly qualified staff with competitive salaries.

The interest in scientific research, innovation and technological development permeates the educational field; in the case of technological higher education it becomes even more imperative. It should be noted that the goal of the Jalisco Secretariat of Innovation, under the Jalisco Secretariat of Education, is to "create the conditions conducive to promoting, coordinating and contributing to regional development through innovation and educational, scientific and educational development. technological state "(Government of the State of Jalisco, 2015).

Applied research and technology transfer are visualized today as the advanced higher education. It is also worth mentioning that it is framed in a constructivist pedagogical model that aims for the student to appropriate learning and knowledge to be a facilitator in their work, in order to develop skills that allow them to solve diverse situations and become in a competent professional in all fields and areas of your environment.

For higher education it is extremely important to implement applied research processes, since this allows generating knowledge that impacts the social, economic and political environments, as well as enhances the intellectual development of each student through the approach of questions and concerns, in order to provide solutions to the problems of the social environment that surround the human being.

Research seedbeds have emerged as a response to the need to introduce students and young professionals, through a process of motivation, participation and continuous learning, to the

practice and methodology of scientific research. In addition, they seek to contribute to the integral training of current and future professionals through the approach to investigative knowledge as a strategy for developing thinking and solving problems.

The importance of applied research in education is based on the construction of knowledge of a technological and scientific society that seeks the development of new strategies that provide innovation. It is the task of a teamwork between teachers-students and students-students, where the learning of each other is sought, since each person is structuring their knowledge through research and the methodology that it must take to become in a specialized scientific type, supported worldwide and that generates large-scale changes and development.

The Organization of Ibero-American States for Education, Science and Culture [OEI] (2012) considers the following:

> Scientific and technological knowledge is one of the main riches of contemporary societies and an indispensable element to boost economic and social development. Science, technology and innovation have become necessary tools for the transformation of productive structures, the rational exploitation of natural resources, health care, food, education and other social requirements.
>
> (…) Institutional strengthening, the training of researchers and technologists, the creation of linking tools and the social dissemination of knowledge are central features of a science and technology program for the strengthening of social cohesion and citizenship, which can be adopted by the Latin American community (p. 5).

Without a doubt, the global trend points towards the development of new technologies. Hence the need for universities to focus their students on the creation, innovation and implementation of these developments.

Background

Molineros (2009) points out that the research seedbed movement in Colombia originated at the University of Antioquia in 1996 as an extracurricular strategy to promote research and as a reaction to the forms of impulse to this basic function of higher education, institutionalized by the

university itself and promoted by the Administrative Department of Science, Technology and Innovation (Colciencias). In 1997 the socialization processes of this new strategy began; In the case of the Universidad del Cauca, he was known by a group of his students who developed academic activities at the University of Antioquia.

The movement gradually developed in several of the country's universities, and resulted in a significant number of working groups that sought to provoke and convene spaces for the development of new skills that promoted research, complementing and transcending traditional learning models . In 2002, Colciencias included, within the framework of its promotion programs, a call for support to research seedbeds, especially aimed at regions with a lower degree of research capacity development.

Quintero, Munévar and Munévar (2008) recover the opinion of Dr. Norma Serrano, director of the Biomedical Research Center of the Autonomous University of Bucaramanga, who points out the following:

> The seedbeds appear as an auspicious space where students involved in the daily work of a researcher, who acts as a tutor, manage to jointly create learning communities around a research topic, the creation of projects, the development of the same, of the socialization of the results before the scientific community and, lastly, not for being the least important, of the search for economic resources to keep the research in force (p. 35).

For his part, García (2010) highlights a kind of fraternity arising from the proximity that represents the power of the seedlings to think of as communities of affection for knowledge, equity with knowledge and investigate what happens to them in the experience everyday, which does not consist in thinking anything, but in doing what depletes the definition of being, in short, a being that is thought.

Eduardo Rojas Pineda (2009), Vice Chancellor for Research at the University of Cauca, mentions how in this university the seedbeds configure a source of human talent that adopts their own and diverse strategies to encourage students' interest in research dynamics and that Therefore, from the principles and strategic objectives of the Research System of the University of Cauca, support for the seedbed movement has resulted in resources destined to strengthen their own interaction dynamics and with institutional research groups. It is conceived as an element of the

articulation of research with the formation processes, respecting the initial philosophy that gave rise to the birth and development of the movement in Colombian universities.

These universities have advanced in the attempt to institutionalize the organization of their students around the idea of seedbeds and have sought to encourage their interest in research activities and, in passing, give a response to the demands of the Ministry of National Education in relation to the characteristics of the investigation within the framework of the requirements for the qualified registration of training programs.

Bernardo Restrepo (2009), for his part, states the following:

> The seedlings have acted as the seed capital of research training through formative research, through the formation of research learning communities, through the deconstruction and reconstruction of the research method or methods, through the study of contextualized problems, through the Participation in networks that extend the scope of problems and their solutions and by strengthening the same human development of researchers trained in the metacognition process that allows self-regulation, to optimize them, the thought processes (p. 8).

Finally, Danilo Reinaldo Vivas Ramos (2009), rector of the Universidad del Cauca, believes that advances in science and technology day by day mark the world event; They are witnesses and part of an evolutionary society, which forces us to go beyond being aware and being users of them. That is why, without a doubt, research has now become the cross-cutting axis of all activity generated by the academy.

The seedbeds of researchers at the University of Caldas

In 1996, the Institutional Educational Project (PEI) of the University of Caldas was born. One of the essential axes of this university is the generation of high level knowledge. From the generation and appropriation of knowledge, it will train people, professionals and researchers useful to society. As for the strategies to achieve this, it is to encourage the formation of academic groups with the possibility of discussing and discussing problems and ideas that contribute to research work.

In this context, the seedbeds of researchers are a space to exercise freedom and creativity, criticism and the ability to be amazed, that is, the potentials and abilities that are repeatedly denied or obstructed in the educational system (Bonilla, cited in Botero , 2008).

According to the program directors and the objective of the curricula, research in the training of students and future professionals of the undergraduate programs is essential (Gartner, cited in Botero, 2008). For his part, Botero (2008) explains that the seedbeds of researchers at the university build a community of young researchers who not only contribute to training researchers, but also train professionals of higher quality, greater capacity for integration and interlocution, and of greater social commitment.

For Rivera, Nieto and Tangarife (1999) the greatest difficulties that arise in the dynamics of a group of this nature are related to the lack of criteria for the incorporation of students, the lack of incentives for collective work and the inflexibility of the plans study. Finally, returning to Botero (2008), the seedbeds should become a basis for the growth of their members, so that these groups not only take an interest in the discussion about science, but also contribute to the construction of citizenship and the integral formation of the person. The research seedbed proposal constitutes a strategy to boost research in the university and for students and professors to be protagonists of national development.

Research seedbeds in Chile

The emergence of research seedbeds in Chile dates from 2000 and takes official form in 2004 (Gallardo, 2014). Through these, it is observed how students grow and forge a life different from the formation of any student (Gallardo, 2014, p. 107).

Latin America

Gallardo (2014) points out that countries such as Chile, Peru, Ecuador, Mexico and Venezuela reviewed the way the research seedlings worked and adapted it to their research and academic environment. The Veracruzana University of Mexico, for example, has adopted the Colombian experience as a reference. Ecuador has participated as a guest in Colombian meetings and has developed its own experiences from which it already has consolidated groups that meet at events, just as young and child researchers do in Colombia.

Research Seed Networks

Gallardo (2014) explains that by articulating the seedbed as an initial constitutive group to an organization composed of institutional seedbed networks, it becomes part of a youth social framework for formative research, under which they become visible and operate. For its part, Escobar (2013) considers that research seedbeds contribute, in addition to what has already been mentioned, to the training of the student, especially in the development of skills to work in a team, and to address interdisciplinarity in knowledge. Scientific research is rigorous, and from future higher education institutions, future professionals must be inclined to such rigor. The seedbeds are a good means to obtain diagnoses of our reality, and proposals according to the needs of the environment, to transform and improve it.

Technological Mario Molina

The proposal made for the José Mario Molina Pasquel y Henríquez Technological Institute (ITJMMPH), Puerto Vallarta Campus, whose purpose is to implement as a didactic strategy a research hotbed in the Electromechanical Engineering career, differs with respect to the seedbeds of other universities of Latinamerica. The main difference lies in the fact that in groups of this nature already established in other universities, students are integrated into a research group already created and led by a professor. The research project they develop is already determined in advance.

The proposal made for the ITJMMPH was to implement a didactic strategy of a research hotbed in the Electromechanical Engineering career where the main idea of the project to develop comes from the students and where they, the students, invite one or more professors to join this initiative. Thus, the research groups are headed by a student and advised by teachers of the institution. In such a way that the leadership capacity for the monitoring and development of projects is promoted in young people, in addition to the objectives already stated and specific to the project.

From the above, the following research question arose: Will implementing a research seedbed lead to the development of technological innovation projects in the ITJMMPH?

Viability of the investigation

Magaña, Aguilar, Argüelles and Quijano (2015) They point to the fact that higher education is aware that its graduates will not engage in research as a main or essential activity. The majority of graduates will work in the areas of their discipline, these authors mention, so it is necessary that they have the training and ability to perform it from different work scenarios. Thus, research seedlings emerge as a response to the need to engage students and young professionals in a process of motivation, participation and continuous learning of the practice and methodology of scientific research; a dynamic that leads them to experience from theory, and where practice is the experimentation of that theory so fundamental in the formation of the engineering profile.

The possibility of implementing a research hotbed in the ITJMMPH is high. The academic administrative authorities reviewed the proposal and found it viable. There is the infrastructure and academic staff trained to start with this educational strategy.

Methodology

To carry out this research, a proposal was made for the creation of a research seedbed in the ITJMMPH Electromechanical Engineering degree. This proposal was submitted to the academic direction of this institution.

It is convenient to note that it is based on the premise that students, because of their youth, have innovative and creative ideas, and that sometimes teachers, because they are immersed in the rhythm of daily work, lose contact with what happens in the Changing world of technology. Today, the Internet and social networks play a very important role in communication and information: young people are immersed in that sea of information and knowledge and are therefore updated on what is happening in this technological context. so fluctuating

As mentioned above, the proposal presented here differs from traditional research seedbeds, in which students join a work team led by a professor-researcher. In those cases, the idea to develop part of the teacher or is assigned by the institute. In the proposal for the ITJMMPH, students generate an idea and invite teachers to join the work team.

Due to the type of research, this study meets the methodological conditions of a qualitative investigation. Because of its level, it is considered an exploratory type: it is a first approach to the situation that is considered problematic; for its purpose, it is applied, since it seeks to solve a

difficulty. Also, due to its temporal scope, it is synchronous, since it refers to a specific moment. Finally, it is experimental because a provoked situation will be observed.

The methodology of a participatory action research was used because in the research seedbed the student seeks to develop specific skills to think autonomously. This is expressed in two aspects: the first, through the design and construction of an individual or collective research proposal that encourages the active, critical, reflexive and proactive participation of all group members; and the second, in the management and development of said proposal.

The purpose of this research is to determine whether the creation of a research hotbed is viable as a strategy to promote innovation, development and technology transfer projects, as well as entrepreneurship within the ITJMMPH. The expected results are prototypes and technological systems. This study was carried out in the period of September 2016-August 2017.

Based on the analysis of the work of students and teachers belonging to the research seedbed, an attempt is made to establish an adequate and systematized process for the establishment and operation of the seedbed, in order to generate projects that become products or services. innovators that have a positive impact on the region. The information was collected through non-participant observation: a field diary, an electronic logbook and photographic memory for each project, as well as interviews and progress reports prepared by the same members of the research group.

Analysis structure

Three categories of analysis were established: design of the research project, development and monitoring of the project. The three components of the research methodology try to be a transformative principle to have a work model that promotes the training of students.

The sample

Hernández-Sampieri and Mendoza (2018) point out that to select a sample, the first step is to define our unit of analysis (people, organizations, newspapers, etc.). The "who will be measured" depends on clearly specifying the problem to be investigated and the objectives of the investigation. These actions will lead to the next step, which is to define a population.

Once we have defined what our unit of analysis will be, we proceed to delimit the population that will be studied and on which it is intended to generalize the results. When selecting the sample, the characteristics of the population must be defined.

For this case, a non-probabilistic sample was chosen, since it is a case study: those that are carried out on a unique, unique and unrepeatable reality, without necessarily meaning a single subject. Hernández-Sampieri and Mendoza (2018) consider that a case can be a subject, but also a certain group of subjects: a classroom, a program, a resource, a change, a center or institution, a family.

To choose the sample, the students of the 5th semester of the Electromechanical Engineering degree were considered as population: 67 in total, who were invited to participate in the research seedbed through a call published in the month September 2016.

So the sample is of voluntary participants. In this regard, Hernández-Sampieri and Mendoza (2018) define it as self-selected, since people propose themselves as participants in the study or actively respond to an invitation.

A total of nine teams (19 students) were registered to participate. A committee composed of the academic authorities of the institute and some invited teachers selected five projects; The selection was based mainly on the viability of the project presented. The teachers who participated in the projects did so at the invitation of the students.

Finally, the sample was made up of 12 students and 5 advisors, distributed in 5 work teams. Table 1 shows both the project to be developed and the distribution of students and advisors for each of the teams.

Tabla 1. Proyecto y distribución de los equipos

Proyecto	**Núm. de alumnos**	**Núm. de asesores**
Sistema automatizado de	2	1

riego, fertilización y plaguicida en tierras agrícolas		
Trip Cam 360°	2	1
Apprende	1	1
Invernadero automatizado	3	1
Refrigeración solar	4	1

Fuente: Elaboración propia

The projects must have at least one teacher advisor, a coordinating student and students who are listed as members and who must be active.

Advisor professor

He is a teacher interested in supporting students and carrying out the project. Responsible for accompanying and guiding students in their research projects and activities, and representing the seedbed in matters that the student-coordinator cannot assume.

Student Coordinator

He is responsible for the activities that derive from his role as coordinator of the group, such as the scheduling of the meetings, the planning of activities and everything else that is relevant for the seedbed to develop its activities.

Selection or construction of the information collection instrument (s)

For the collection of information, the seedbed projects are monitored and evaluated, and feedback is sought in the process of training and student performance. The following aspects were identified:

- Each student project coordinator must have a logbook (or diary) that details the activities

carried out in each work session. Due to the ease that the use of cell phones represents for students, it was agreed to keep a logbook electronically and a photographic memory of the work done.

- Each work team must present a semi-annual work plan. This should indicate the kind of activity to be carried out, the date, the objectives and the person who coordinates each specific activity.
- Monthly report on the activities carried out, which must be endorsed by the project coordinator.
- Semiannual review of the general academic achievements achieved by each of the students linked to the seed group.
    - The time spent in the seedbed must be a minimum of one semester.

Results

Gialdino (2006) considers that the methods used by qualitative researchers exemplify the common belief that they can provide a deeper understanding of the social phenomenon than could be achieved through quantitative data. The author also continues, the particular strength of qualitative research is her ability to focus on real practice in situ: the observation of how interactions are routinely performed.

For Gómez (2012), action research considers the problems from the point of view of those involved in them; It can only be valid through the open dialogue. And it considers as objectives of participatory action research, on the one hand, to produce knowledge and useful actions for a group of people; on the other, that people be empowered and trained through the process of building and using their own knowledge.

Since, as Álvarez-Gayou (2003) points out, qualitative research does not interest representation; An investigation can be valuable if it is carried out in a single case (case study), in a family or in any group of few people, although it is important to consider saturation. The above refers to the moment in which, during obtaining the information, it begins to be the same, repetitive or similar.

Presentation of proposal

The research seedbed project was submitted to the ITJMMPH academic authorities, who agreed to implement it as an institutional program; initially as a pilot in the Electromechanical Engineering career.

A schedule was made to develop this proposal from the 2016B semester, which begins in August. The call was written. Once the call was published, a total of nine teams (19 students) were registered to participate. A committee composed of the academic authorities of the institute and some invited teachers selected five projects, based mainly on the feasibility of the project presented.

Participating students, both those selected and those who were not, were informed of the decisions taken. The students invited some teacher to be part of their team. The assignments for teachers were delivered in the month of November.

Implementation and Development

Once the work teams were formed, the students began working on the development of their projects. They quickly chose their coordinator and established roles for each of the members. For the month of December they delivered their work plan corresponding to the January-August period of 2017.

Project Tracking

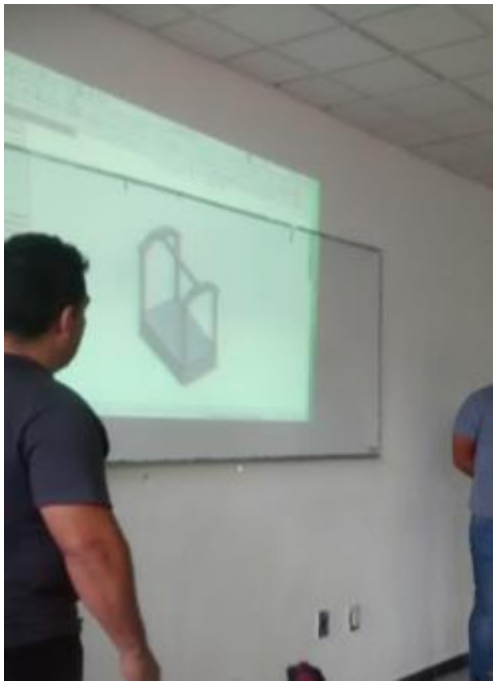
For the follow-up of collective work, feedback in the process of training and student performance was considered of utmost importance. The following aspects were identified:

- Each student project coordinator has a logbook (or diary) of the activities carried out in each work session.
- Semiannual review of the general academic achievements achieved by each of the students linked to the seed group.

The four research seedling projects were followed up during their development. Their progress was monitored. The performance of their work was observed, and their activity was recorded by means of a follow-up blog. Interviews were conducted with the participating students and work meetings. A photographic memory of the development of the projects was also made. Students look and feel excited and confident that their prototypes can be marketed.

In a work meeting the possibility of participating in a call to reduce resources was submitted to the coordinating students; But they were not interested. They considered their project to be valuable, and prefer to find other sources of financing or entrepreneurship programs.

Figura 1. Memoria fotográfica de uno de los proyectos



Fuente: Elaboración propia

A total of three work meetings were held to present progress with the academic-administrative authorities. Unfortunately, one of the five projects belonging to the seedbed did not succeed in changing the residence of the coordinating student.

The remaining four projects were successfully completed after two years of work: three prototypes were obtained. These projects have been inherited to a new generation of students, who will give them continuity and practical application in support of other projects carried out within the institution. In this way, students, teachers and the institution benefit. The latter because it has prototypes that can be used to practice through simulations and thus enrich the teaching-learning process. Regarding students, they generate significant learning because they transfer theoretical knowledge to real practices. In addition, the aforementioned prototypes may be subject to improvement and updating by new student research teams. It is worth mentioning that the benefit of this project is also for society, since engineers with real practices and therefore more qualified

graduates from the institution. Students, by acquiring these skills and competencies, generate greater confidence and are more likely to be inserted into the labor field more quickly.

Next, images of the prototypes developed so far in the research seedbed project are shown.

Figura 2. Trip Cam 360º, versión 1

Fuente: Elaboración propia

Figura 3. Etapa de pruebas del refrigerador solar

Fuente: Elaboración propia

Figura 4. Primera cosecha invernadero automatizado

Fuente: Elaboración propia

The proposal for the formation of the research hotbed, as conceived thanks to the support of the ITJMMPH academic area, reflects the interest in concrete technological development and innovation projects that not only allow the student to enter into basic and applied research , but also to enter, through technological transfer, the possible commercialization of your projects.

This experience, this research hotbed for the training of students has allowed the development of a work model that integrates, in a precise way, a long-term vision, administrative, academic aspects and methodological elements, all of which are relevant in the implementation of a strategy to encourage extracurricular research of students.

Discussion

The intention of this project is to train students in research techniques to achieve projects that culminate in a good or service that impacts society. For Murillo (cited in Vargas, 2009), applied research is called practical or empirical research because it seeks the application or use of the knowledge acquired while others are acquired. The use of knowledge and the results of research

that result in a rigorous, organized and systematic way of knowing reality. Applied research responds to the challenges that demand understanding the complex and changing social reality.

For Gacel (cited in Pedroza and Velázquez, 2013), Latin American universities, and particularly Mexican ones, are struggling to earn a place in the face of globalization, so one of their primary tasks at the moment is internationalization. From this orientation, higher education has shown interest in conducting research cooperation with various institutions in the international arena, primarily through their academic bodies, researchers and students, and in this way strengthen their knowledge-generating nature for the solution of Problems of human activity.

And for their part, Beraza and Rodríguez (2010) indicate that the innovation capacity of a country or a region is closely linked to its capacity to create and disseminate knowledge. In this context, the university has had to find more direct ways of bringing its academic knowledge closer to the market, which constitutes a radical change for universities to the extent that they have been induced to play an active role in the economic scene. As a consequence, in recent years, the mechanisms of knowledge transfer used by universities have evolved.

Due to the responsibility of universities and higher education institutions to contribute to the solution of the problems and needs of the social context in which they are immersed, there is a need to link research with projects that have a positive impact on the environment .

Hence the need for students, young engineering students, to be involved in research projects, since, for higher education, it is extremely important to implement applied research processes that allow generating knowledge that impacts social, economic, political environments , as in the intellectual development that is sought to create in each student through the presentation of questions and concerns, in order to provide solutions to the problems of the social environment that surround the human being.

Research seedbeds have emerged as a response to the need to introduce students and young professionals to the practice and methodology of scientific research; In other words, they seek to contribute to the integral formation of current and future professionals through the approach to investigative knowledge as a strategy for developing thinking and solving problems.

Conclusions

The research seedling project emerged as a proposal within the ITJMMPH with the intention of promoting technological development projects. It seeks to respond to the need to introduce students and young professionals, as already mentioned, to the practice and methodology of scientific research. It is a way of contributing to the integral formation of current and future professionals.

The general objective of creating and implementing a research hotbed during the 2016-2017 school year with the students and teachers interested in the ITJMMPH Electromechanical Engineering career was then raised. The above with the purpose of carrying out projects that promote scientific research, innovation and technological development. The seedbed began its work in January 2017 and concluded in December 2018. The students of that generation graduated in January 2019. They left three prototypes for the institute, which will continue to be developed by another new generation

It can be concluded that the creation of the research hotbed gave the expected results, that the students and teachers participating in this initiative, fulfilled the commitments made and that, perhaps most importantly, the students were managers of their own knowledge, of their learning.

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