VISUAL REVIEW | Vol. 16, No. 1, 2024 | ISSN 2695-9631
International Visual Culture Review / Revista Internacional de Cultura Visual
https://doi.org/10.62161/revvisual.v17.5181

INTERNET OF THINGS AND CULTURE OF INNOVATION IN PUBLIC UNIVERSITY STUDENTS

BERNARDO CLÍMACO HERMITAÑO-ATENCIO[1], MARTIN WILLIAM ORTIZ-VERGARA[1], GRIMALDO WILFREDO BULEJE-AGÜERO[1], JUAN MANUEL TORRES-CALIXTRO[1], VIDAL CRISTIAN GARCÍA-ROJAS[1]
[1]Enrique Guzmán y Valle National University of Education, Perú

KEYWORDS

Internet of Things
Culture of Innovation
Collaborative Learning
Sustainable Development

ABSTRACT

The global economic downturn, the challenges posed by climate change, escalating poverty rates, dwindling water and food supplies, and health issues, among others, continue to affect the world's population. In response to these crises, the promotion of innovation has become imperative, particularly within university education. This research, using a quantitative approach with a pre-experimental design, aims to determine the influence of the development of an Internet of Things (IoT) module on the culture of innovation among students at the National University of Education (UNE). Data were collected from 62 students enrolled in the Telecommunications and Computer Science programme. The results show that the implementation of the IoT course significantly influences the values, behaviours, climate, resources, processes and outcomes related to the innovation culture.

Received: 01/29/2024
Accepted: 02/12/2024

1. Introduction

The global economic crisis, the problems caused by climate change, the increase in poverty, the decrease in water and food resources, health problems, among others, are affecting the world's population; global growth is slowing down abruptly; this crisis is accelerating the increase in extreme weather events such as droughts, melting glaciers, sea level rise, landslides and hurricanes, evidence of the growing urgency to address the challenges of climate change. (Letelier and Cáceres, 2023, p.35). The impacts of climate shocks relate to the availability of water for critical ecosystems, affecting biodiversity as well as plant growth (Cadilhac et al. (Cadilhac et al., 2017, p.173).

In addition, the Sustainable Development Goals (SDGs) are a set of 17 global goals adopted by the United Nations (UN). These goals aim to address key global challenges and improve the quality of people's lives, protect the planet and promote prosperity, while promoting universal peace and ensuring access to justice. (López-Carrión and Martí-Sánchez, 2024, p.82) In this sense, students' academic activities should be linked to their familiarity with the Sustainable Development Goals in order to provide them with a deeper understanding of the world around them and to empower them to be informed and engaged citizens committed to building a sustainable future.

Regarding innovation, it is one of the underdeveloped areas in Latin America, and this is what is happening in our territory. To thrive in the SDGs, we need two dynamics: the commitment of all actors and the full development of innovation in all sectors. (Sanz-Hernández and Martínez Alfaro, 2020, p.23). People, educational or business organisations, must always improve, and when there are changes or improvements, it is a sign that they are innovating; measuring innovation makes it possible to determine the extent to which organisations are nominally innovative. (Cordero-Guzmán et al., 2022, p.144) Given the need to improve innovation, one of the main ways is through the use of technology, through the Internet of Things (IoT).

It is also essential to foster an environment that values creativity, continuous learning and experimentation in order to promote a culture of innovation. First, inspirational leadership: leaders need to encourage and support innovation by setting an example of openness to new ideas and approaches; there is no doubt that innovation requires extra effort associated with novelty and the dissemination of successful experiences. (Núñez et al., 2022, p.2). Encouraging diversity in the team is also crucial, as different perspectives and skills promote the generation of innovative ideas; students' teamwork creates an overriding need to reach consensus on their conclusions and solutions, which strengthens their communication and collaboration skills. This process not only encourages reflection and active questioning, but also significantly strengthens their scientific and critical thinking. (Fernández & Checa-Romero, 2023, p.630).

In terms of IoT, in recent years, due to their widespread acceptance, Internet of Things (IoT) systems have become ubiquitous, transforming many aspects of the lives of millions of people. (Alzahrani, 2023, p.155). The Internet of Things (IoT) is a network of various sensing devices that provide services according to application integration (Mohamed et al., 2020, p.280) The Internet of Things (IoT) is the mechanism that enables the connection of common objects in the physical environment to the Internet network (Redhat, 2023). (Redhat, 2023) IoT is the mechanism that enables the connection of common objects in the physical environment to the Internet (Redhat, 2023), i.e. With expertise in the collection of things or objects that connect to the global network and share data with each other, objects can be connected through wires, fibre optic or wireless technologies, cellular, satellite, Wi-Fi, Lora, Bluetooth or others; furthermore, IoT encompasses a range of technologies including sensors, security mechanisms, alarm systems, unmanned aerial vehicles, automated machines, home appliances, smart grids, office machines and additional devices (Srir et al., 2023). (Srhir et al., 2023, p.900).

Also, the 3 fundamental aspects of IoT are: connect everything, connect everywhere and connect anytime. (Badach, 2020) When referring to anything, it means that the most common objects that exist in the home will be able to be used, managed in a transparent way, according to standards and certifications, and validated in their performance and operation. (Ulloa-Vásquez et al., 2022, p.219). By connecting any location, the whole set of objects that are part of our daily environment can generate and exchange data, without the need for human intervention in the process, through the management of electronic devices (Extremera et al., 2022, p.219). (Extremera et al., 2022, p.2). When referring to any time, when the system is running, it is possible to connect at any time to control or obtain a result; IoT allows such a connection without human intervention, it can collect information from all kinds of events, in real time. (Rodríguez-Gómez, 2022, p.244).

Furthermore, developing educational projects that integrate IoT and the SDGs can foster critical thinking, problem solving and social awareness in students, while addressing real-world issues in a practical way. Fostering environmental awareness in students is crucial to inspiring future generations of environmental leaders and responsible citizens and helps to cultivate sustainable attitudes and behaviours that can last throughout students' lives.

The Internet of Things (IoT) also plays a crucial role in the culture of innovation, opening new frontiers of connectivity and data collection. By connecting devices and collecting data in real time, the IoT provides a rich foundation for creativity, revealing patterns, trends and behaviours. This connectivity also drives efficiency through automation, freeing up resources for more creative approaches and creating opportunities for the development of new customised products and services; entrepreneurs should initiate new projects based on innovation, as creativity is a precursor variable for innovation. (Tapia and Pico, 2023, p. 1538).

Also, an IoT scenario in a university campus consists of applications that create an intelligent environment, these spaces allow access to services with less effort and time, the intelligent system should interact with the environment around it. (Muñoz et al., 2023, p.2). In addition, the IoT is transforming industries by facilitating innovative business models and improving the user experience by personalising solutions. At the urban level, the implementation of IoT is leading to smart cities, marking a fundamental shift in the way we address urban challenges. Ultimately, IoT not only improves operational efficiency, but also drives an innovative mindset by challenging established norms and encouraging more agile and creative approaches to problem solving.

In this context, based on the aforementioned data, there is an urgent need to propose an improved culture of innovation, adapted to the new challenges that education requires, and to encourage students in public universities to generate innovative proposals in line with the SDGs through IoT activities.

2. Methodology

2.1. Design

The pre-experimental design could be used because the work was carried out exclusively with an experimental group and without a control group, a pre-test and a post-test were developed (Tafur and Izaguirre, 2014, p.204). (Tafur and Izaguirre, 2014, p.204) and during the pre-experimental phase, the use of Internet of Things modules was taken into account. The independent variable, the use of Internet of Things modules, was manipulated and then the results were analysed for the dependent variable, innovation culture.

2.2. Participants

The research was developed with the use of an intentional non-probabilistic sample, therefore the inclusion criterion was to work with students of the 4th and 6th cycle, of the study programmes Electronics and Informatics and Telecommunications and Informatics, based on the following arguments: the students correspond to the same professional school, share the same subjects and teachers, do not know the Internet of Things concepts and their relationship with attitudes towards innovation; students of the cycle lower than 4th and higher than 6th were excluded. Therefore, after applying the above criteria, 62 students from the Academic Department of Electronics and Telematics of the National University of Education were taken into account.

2.3. Instruments

The survey was used as a technique, the attitude scale was adapted from the methodology developed by (Rao and Weintraub, 2014), it was constructed to find out the state of the innovation culture of companies in Spain. As for the content validity, it was evaluated using the technique of expert judgement, the data provided by the judges were processed using the validity scale of the instrument. The result value was 0.87, from which the data was considered as a very good level. For the reliability of the instrument, a pilot test was carried out with the participation of 10 students whose characteristics were similar to the sample, taking into account the same study programmes; with the test data, the Cronbach's Alpha coefficient was applied and the result obtained was 0.73, this value obtained confirmed that the instrument was very reliable for its application.

The content of the instrument consisted of 36 items, distributed according to its dimensions, as follows:

- Dimension values: 1,2,3,4,5,6.
- Dimension behaviours: 7,8,9,10,11,12.
- Climate dimension: 13,14,15,16,17,18.
- Resources dimension: 19,20,21,22,22,23,24.
- Processes dimension: 25,26,27,28,29,30
- Dimension results: 31,32,33,34,35,36.

Similarly, each item was scored on an ordinal scale from 1 to 3, with the response options as follows 1 = No, 2 = Sometimes and 3 = Yes.

2.4. Procedure

The contents shown in Table 1 were developed in an academic cycle of 16 weeks, taking into account 2 weeks for evaluations (weeks 9 and 16), the topics developed were distributed in 14 weeks; the first 8 weeks were prioritised to the learning of theoretical contents (2 hours) and the practical part the lesser part of the time (1 hour); the following weeks, from week 9 to week 16, the distribution of time was minimal for the theoretical part (1 hour) and the greater part of the time for the practical part (2 hours).

Similarly, from week 6, the teams analysed projects, elements or components, as well as the appropriate budget, since each team had to finance its project itself; in week 9, the teams started to implement the project, with the project already defined on the basis of the known stages; at the end of each session, the teams reported on their progress and problems, and had to meet more than once a week to find solutions to the problems that had arisen.

Table 1. Activities carried out during an academic cycle.

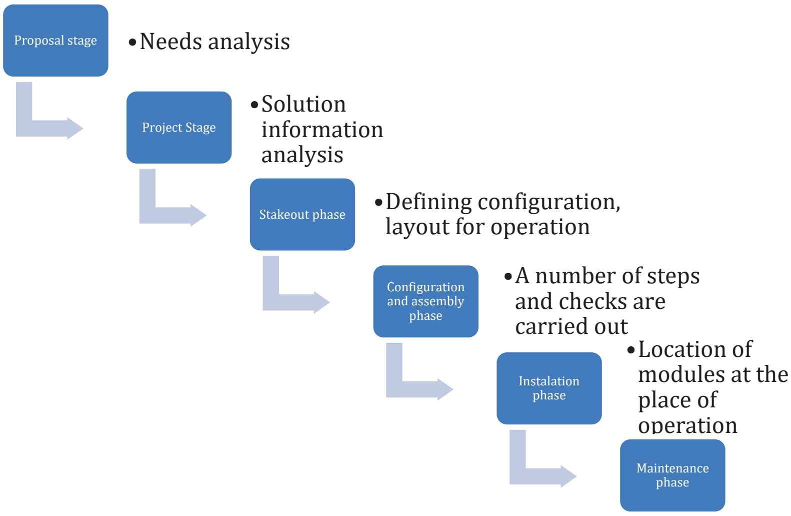
N°	Contents	Practical activity	Expected learning	Time
1	Internet of Things Fundamentals		Describes and identifies the fundamentals and basic concepts of the Internet of Things.	3 H.
2	Telemetry and telecontrol • Telemetry • Telecontrol		Identifies the basic telemetry and control concepts and operations	3 H.
3	Meaningful data • Processes and services • Problems, improvements, providing information. • Developing new services	• Team building • Proposal for teams	Ability to identify processes, problems and improvements to manage information.	3 H.
4	IoT application areas. • Smart Cities • Smart Campus	• Introduction of team members	To be able to clearly define what Smart Cities, Smart Campuses are and to understand the basic principles behind them.	3 H.
5	Sensors • Types of sensors • Sensor networks	• Analysis of the problem to be solved	Includes the use and operation of sensors.	3 H.

N°	Contents	• Practical activity	Expected learning	Time
6	Actuators • States of an actuator • Types of actuators	• Review of problem oriented IoT projects	Includes the use and operation of actuators.	3 H.
7	Servers for IoT • Types • Operation	• Preliminary project proposal	Gain an understanding of the types of servers used in IoT...	3 H.
8	Cloud services and platforms • Server platforms	• Final project proposal	Identifies cloud platforms for IoT services.	3 H.
9	Phases in implementing a system. • Proposal • Project phase	• Problem analysis. • Define projects for installations and equipment	Identifies and develops the proposal and development phases of an IoT project.	3 H.
10	Phases in implementing a system. • Stakeout phase • Configuration and assembly phase	• Review of elements for correct operation of the system • Tests and operational checks	Identifies and develops the stakeout and configuration phase of an IoT project.	3 H.
11	Phases in implementing a system. • Installation phase • Maintenance phase	• Assembly of modules • Learning about the maintenance process	Identifies and develops the installation and maintenance phase of an IoT project.	3 H.
12	Presentation of progress 1 of group project • Prototypes • Progress	• Assembly of a project on a protoboard with mobile elements.	Present the progress of a prototype as a proposal for a group project.	3 H.
13	Progress presentation 2 of group project • Prototypes • Progress • Correction of errors	• Project assembly with elements fixed on a structure.	Present the progress of a prototype as a proposal for a group project.	3 H.
14	Presentation and exhibition of the project as a final product • Exhibition • Publication	• Demonstration of system operation.	Demonstrate and explain the project as a final product.	3 H.

Source: Authors, 2023.

Likewise, as a working strategy, the development of the research was based on the phases for the implementation of an IoT system proposed by the Telefónica Foundation in a virtual course openly run by its digital training programme called Conecta Empleo; it is not enough to establish connections with other people, it is now imperative to understand how the objects around us can connect to the Internet and provide us with utilities. (Fundación Telefónica, 2020).

Figure 1: Phases for implementing an IoT system.



Source: Adapted from (Fundación Telefónica, 2020).

In the proposal phase, the students, in teams already formed with the support of the teacher, analysed in a general way the need for implementation according to the problem to be developed; another brainstorming session should be held to define the tasks for each cause; with the aim of contributing to the academic field, the integration of teaching-learning, social skills and teamwork is considered as an essential competence for the training of future professionals in the field of information. (López-Hernández et al., 2023, p.46).

Similarly, in the project phase, the working teams carried out an exhaustive analysis of the information about the installations and equipment of the system to be developed; when the team has reached an adequate level of scientific knowledge about its idea, a meeting with an expert in the field is organised. During the different meetings, the ideas are evaluated in detail with the participation of the different working teams. (Freiberg-Hoffmann et al., 2021, p.3).

On the other hand, in the stakeout phase, each team carries out a coverage analysis and detailed planning to determine the configuration, layout, installation method, appearance and number of devices needed to ensure the correct functioning of the system; the capacity developed by the students enabled them to approach the problems in a consistent manner, obtaining results that turned their experience into a constructive process in formative research. (Perico-Granados et al., 2022, p.14).

In the configuration and assembly phase, the students also took into account all the installation details specified in the project. A series of tests and checks are carried out for the proper functioning of the IoT system; the configuration of the applications leads to the identification and creation of business value, allowing the execution of advanced analytics and the detection and response to events of numerous IoT devices. (Albarrán, 2023) (Albarrán, 2023); considering that in the absence of specialised laboratories with a set of sophisticated sensors, an inexpensive computational mechanism has been designed and implemented to capture and monitor the data obtained by the sensors (Mendez et al., 2023). (Mendez et al., 2022, p.3).

In the installation phase, as it is an educational institution, the IoT system was assembled into modules so that they could be moved around the university environment. Although the prototype was initially implemented in a mock-up, the model is adaptable and can be extended for application in homes as well as in different environments such as buildings, educational institutions and small businesses. This would allow real-time monitoring, automation and control of electronic devices in an effective manner. (Mendoza and Marín, 2020, p.14).

In the maintenance phase, after the presentation and exposition of the works, the teams, according to their organisation, defined the fixed installation in the designated place and then developed the maintenance process there. It was suggested to the students to carry out a periodic maintenance; the company or organisation presents a loss of money because of the excess of hours in corrective maintenance, the implementation for a good maintenance with standardisation tools, the planning of maintenance projects, the increase of the production line, the reduction of the time of execution of corrective maintenance. (Condo-Palomino et al., 2022, p.2).

The projects carried out were based on the use of ESP32 microcontrollers, as they have wireless modules that allow them to connect to the network and the Internet; ESP32 and ESP8266 devices offer the possibility of being used via the Internet, from any location and on any type of device. This makes it possible to create virtual applications for microcontroller laboratories, allowing flexible and remote access to the functionalities of these devices. (Pereira et al., 2022, p.53). As a result of the work carried out by the IoT-oriented students, the following were highlighted: 1. Water control and monitoring, 2. Temperature and humidity control system in laboratories, 3.

2.5. Data collection

For the data collection, in order to ensure a bias in the acquisition of information, the questionnaire was printed on adhesive sheets and presented to the students to be filled in. The material contained 36 items distributed in its dimensions such as: values, behaviours, climate, resources, processes and results. The questionnaire was administered before and after the use of the IoT modules; as a pre-test, the instrument was administered at the beginning of the 2023-II academic year (September) and as a post-test, the instrument was administered a few days before the end of the 2023-II academic year (December).

2.6. Ethical considerations

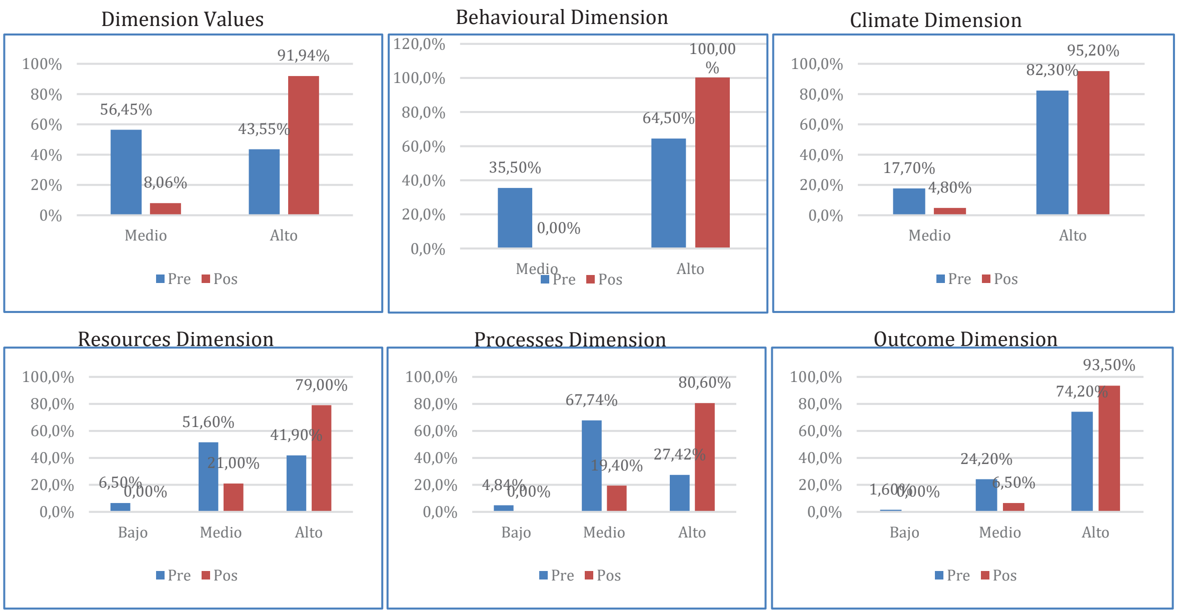
In order to comply with ethical principles during the study process, the students were informed so that they could participate in the study, informed consent was obtained from the students, and privacy was guaranteed in the handling of the information obtained, taking into account anonymity and confidentiality; it is important to consider that a research process cannot be developed when values and human rights are affected. (Tafur and Izaguirre, 2014, p.126).

3. Results

As this was a pre-experimental design study, the statistical analysis was carried out in two stages: the first part consisted of a descriptive analysis and the second part consisted of an inferential analysis.

Figure 2 shows the results of the descriptive analysis corresponding to the pre-test and post-test, the figure is made up of 6 blocks with information on each dimension, in each dimension shows the representative bars according to the levels: low, medium and high, both from the information obtained before and after the experiment.

Figure 2. Innovation culture descriptive analysis



Source: Authors, 2023

As for the analysis obtained from the results, in this part the data of the dependent variable to be analysed was the culture of innovation and it was developed for each dimension:

In the dimension of values, according to Figure 1, there is a decrease in the percentage of students in the medium level from 56.45% in the pre-test to 8.06% in the post-test. As for the high level, there is a significant improvement where it increases from 43.55% in the pre-test to 91.94% in the post-test, which means that after using the IoT modules, the students have better entrepreneurial initiatives, are more creative and show that they want to continue learning. (Ortega-Hoyos et al., 2019, p.96), which shows that entrepreneurial competences lead participants to take ownership of their ideas and trust in their abilities. It is imperative that the new generations do not remain passive in the face of the challenges of modernity and today's world. They must strengthen and emphasise their values, recognising that education is an essential component present in all cultures. (Llamas et al., 2020, p.170).

Also in the behavioural dimension, there is a decrease in the percentage of students in the medium level, from 35.5% in the pre-test to 0.00% in the post-test. As for the high level, a significant improvement is shown, where it increases from 64.50% in the pre-test to 100% in the post-test; this shows that after the application of the IoT modules, students present forward-looking ideas, promote a mentality of continuous improvement and are able to accept challenges, in line with Alvarez-Melgarejo et al. (2024), who indicate that the ability to generate process innovation is closely linked to adaptability, especially through technological innovation; for learning to be meaningful, it is essential that students have an active role and personal interest in the subject. This is achieved by giving students control over their learning, basing a large part of their activities on laboratories or projects related to a topic that motivates them. (Ortega-Hoyos et al., 2019, p.95).

Similarly, for the climate dimension, there is a decrease in the percentage of students at the medium level, from 17.70% in the pre-test to 4.80% in the post-test. As for the high level, there is a significant improvement where it increases from 82.30% in the pre-test to 95.20% in the post-test; this means that after applying the IoT modules, the students promote the development of skills, support the autonomy of thinking, also motivate their peers to take up challenges, which is in line with what is stated by López Quiroga, (2019, p.119)(2019, p.119), where he mentions that society must develop in a culture that is able to face the challenges of a rapidly evolving society in an agile way; given that universities are responsible for promoting the development of the competences of knowing, knowing how to do and being/coexisting for future professionals in their academic, working and productive environments, social skills play an essential role in this process. (Mendivil et al., 2023, p.144).

With regard to the resources dimension, there is a decrease in the percentage of students at the low level from 6.50% in the pre-test to 0.00% in the post-test, as for the medium level a decrease from 51.60% in the pre-test to 21.00% in the post-test. As for the high level shows a significant improvement where it increases from 41.90% in the pre-test to 79.00% in the post-test; that is, after the application of the IoT modules, students promote research, innovation, are considered a key element for development, taking into account the values and the organisational unit, this coincides with what Idrovo-Carlier et al, (2023), who states that the technological strategy that an organisation chooses directly affects human resources practices, since the achievement of strategic objectives depends to a large extent on the behaviour of employees. The alignment between technology policy and HR practices is critical to achieving the desired results.

On the other hand, regarding the process dimension, there is a decrease in the percentage of students at the low level, from 4.84% in the pre-test to 0.00% in the post-test, as for the medium level, a decrease from 67.74% in the pre-test to 19.40% in the post-test. As for the high level, a significant improvement is shown, where it increases from 27.42% in the pre-test to 80.60% in the post-test; that is, after the application of the IoT modules, students meet and evaluate ideas, propose development stages and prioritise projects or the development of prototypes; in the same line coincides with Pozo-Enciso et al, (2023, p.34), who state that the university has a positive organisational culture, characterised by a solid set of institutional beliefs and values that have evolved over time and have been effectively transmitted to its members. This cultural cohesion has contributed to the achievement of important goals, highlighting the importance of an environment conducive to success within the institution. To cultivate a strong culture of innovation, it is necessary to implement innovation processes organised around teams that promote interdisciplinary collaboration. (Souto, 2015).

Similarly, in terms of the results dimension, there is a decrease in the percentage of students at the low level, from 1.60% in the pre-test to 0.00% in the post-test, as for the medium level, a decrease from

24.20% in the pre-test to 6.50% in the post-test. As for the high level, a significant improvement is shown, where it increases from 74.20% in the pre-test to 93.50% in the post-test; that is, after applying the IoT modules, students evaluate their performance and that of their peers, verify their skills and show their level of satisfaction. The data are consistent with (Ortega-Hoyos et al., 2019, p.84), who obtained favourable results at the end of his study, where in the city of Clemencia 64.5% and in the city of Maria Baja 78.5% of their students showed passing grades. In all the projects, the students were continuously engaged and showed a willingness to tackle problems as they arose. This commitment continued until the successful completion of the research, with a constant attitude of ensuring that the relevant actions were carried out at all times. (Perico-Granados et al., 2022, p.18).

Table 2: Results from general and specific hypothesis testing

	HG	HE1	HE2	HE3	HE4	HE5	HE6
Z	-6,755[b]	-5,608[b]	-5,576[b]	-4,052[b]	-5,895[b]	-6,206[b]	-6,131[b]
Sig.	0,000	0,000	0,000	0,000	0,000	0,000	0,000

Source: Authors, 2023

Regarding the results of the general hypothesis test presented in Table 2, with a significance value of 0.000, which is less than 0.05, the tested or alternative hypothesis was accepted. This indicates that the development of IoT modules enhances the level of innovation culture among students at the National University of Education. In line with this, Peñaloza (2005) suggests that education involves processes of humanization, socialization, and cultural development. Additionally, Arosa et al. (2022, p.801) assert that educational or business organisations should constantly strive for improvement. Colther et al, (2020, p.131) (2020, p.131) states that the university should develop links with companies that facilitate the diffusion of innovation; culture should influence the process of knowledge management as it is a collective process. (Rodríguez-Ponce et al., 2022, p.273).

Concerning the specific hypotheses related to the improvement of the dimensions: values, behaviours, climate, resources, processes and results, the data in Table 2 show that the significance values obtained are less than 0.05, the data show that for all the dimensions mentioned, the alternative hypotheses were accepted, and the null hypotheses were rejected, i.e. The development of Internet of Things modules has enabled a significant improvement in each of the dimensions of innovation culture; innovation is a key driver of economic growth as it increases productivity through new or improved processes, technologies and business models; innovation can create additional revenue streams through differentiated products and services that meet unmet needs; innovation will be critical to increasing the overall efficiency and thus productivity of any sector (Halim et al., 2016), 2021, p.9).

Consequently, working on projects related to the Internet of Things leads to learning and handling various information technology tools; having information technology knowledge is not only related to technical skills, but also to attitudes. Possessing knowledge in the use of technologies positively influences attitudes towards their implementation and use, ensuring effective use and obtaining the expected benefits. (Rico-Bautista et al., 2021, p.67). Innovation is not an easy process; on the contrary, it requires willingness, knowledge, motivation, time and attitude towards change. In this context, students hold a positive perception of their interactions with the teacher in the classroom and regard the teacher's attributes as innovative (Núñez et al., 2022, p.12).

4. Conclusion

From the analysis and discussion of the results, it has been concluded that the development of the IoT modules improves the level of innovation culture of students at the National University of Education. The results show that the application of the Internet of Things course has a significant impact on the values, behaviours, climate, resources, processes and results of the culture of innovation; in this sense, changing attitudes involves actions aimed at changing the willingness to believe or think about an object, seeking to generate more positive feelings and build favourable emotional associations. (Aparicio and Bazán, 2006, p.18). Research training is an essential pillar of the country's science, technology and innovation environment. Universities need to integrate "smart" technologies to exploit their capabilities and transform their processes. This will allow them to adopt new organisational models and adapt effectively to the emerging concept of smart universities (Rico-Bautista et al., 2021, p.73).

Likewise, values, behaviours, climate and results are the dimensions with the greatest positive effect after the application of the IoT modules; in the values dimension, there was a great improvement in entrepreneurship, creativity and learning; for the behaviours dimension, there was a better performance in impulses, commitment and ease of influence and adaptation; In the climate dimension, there was an improvement in collaboration, trust and ease of taking responsibility and making decisions; in the same vein, the results dimension showed a significant improvement in the development of talents, where they were able to organise the knowledge acquired and integrate it efficiently into their projects.

On the other hand, resources and processes are the dimensions that had a small positive effect compared to the others; as far as the resources dimension is concerned, the integration of students with different personalities, the work system, time, money and space for the development of the project are considered to have had a negative effect on an optimal improvement; Likewise, in the processes dimension, the selection and integration of ideas, the concretisation of the agreements for the elaboration of the prototype and the progress of the development of the project were not the most efficient, given that the students, according to their education and way of life, presented different opinions and showed small inconveniences to reach an agreement, others lacked sufficient time to dedicate themselves to the project due to their work or the distance where they lived, they had difficulties to integrate themselves to the group progress, added the inconveniences in some way affected the good development of the project in the mentioned dimension.

Higher education institutions should regularly seek suggestions from their students to apply technology related to the Internet of Things in their practical work and innovation projects in order to encourage its application in solving problems in various areas, as it contributes significantly to developing competences in future professionals, preparing them to integrate more effectively into the labour market. (Palacios-Moya et al., 2021, p.100)..

It is advisable for students to consider the issue of environmental protection when designing their IoT projects, as it is directly linked to people's environmental awareness. Education in this area is very important, as it will contribute significantly to understanding the importance of preserving our environment and promoting sustainable practices; education in content related to environmental protection allows students to relate to environmental awareness. (Ochoa et al., 2023, p.8).

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