Towards the Construction of a Smart City Model in Bogotá

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Abstract

This article presents the results of four research projects carried out by the group Smart Cities of the RUMBO Network. The research was developed in response to the integration of technologies with the well-being of citizens, focusing on the city of Bogota. The systematization of shopkeepers allowed to identify in this first phase the main needs of shopkeepers and establish the way they control inventories, relationships with customers and the environment, through software that they access from their smartphones. Industrial Safety Training System Based on Virtual and Augmented Reality advanced in the design of a prototype made in 3D to train operators on industrial safety and machinery handling, through activities focused on the use of PPE for operators. The digital training proposal that strengthens the teaching and learning exercise in teachers and impacts the Impacts the Students' Skills Development analyzed the needs of teachers in digital skills, based on national standards and a pedagogical approach for challenges applied to teachers, solving environmental problems and generating multimedia content. Finally, the Proposal to promote Smart Tourism from Artificial Intelligence allowed to identify the critical success factors of sustainable tourism in a smart city. The results showed the importance of including technology in planning, identification of new patterns and dynamics, innovation in processes, infrastructure, accessibility, training, and design of cleaner and more efficient systems.

Keywords

Smart Cities, Artificial Intelligence, Virtual, Augmented Reality, Digital Training, Smart Tourism

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1. Introduction

In Colombia, universities have a permanent interest in contributing from their areas of knowledge and research to the construction of a better nation. That was the main reason why the smart cities research group was created within the Metropolitan University Network of Bogota -RUMBO-. The group is a space in which independent initiatives are approached and articulated to promote the growth of the region, with the participation of all possible actors, including members of the universities. This group acts as an open platform for future actors on the subject of smart and sustainable cities. The universities associated with RUMBO, aware of the contributions that the academic life can make in their environment, have considered it important to understand how technology contributes to improving the quality of life in cities. In this way, they have decided to integrate and develop projects that have an impact on the environment, through the group's knowledge and research process.

This paper presents the progress made on the development of real projects within this smart cities' initiative of RUMBO. All projects are focused on the construction of solutions to existing problems in Bogota, and are integrated with the idea of improving the quality of life of the city's inhabitants. Each section that follows addresses a different project, as follows: section 2 presents the project for the Systematization of Shopkeepers for an important neighborhood in the city; section 3 proposes an industrial safety training system based on virtual and augmented reality; section 4 presents a Proposal for digital training that strengthens the teaching and learning exercise in teachers and impacts the development of skills in students; and finally, section 5 presents an analysis of the viability of smart tourism in Bogota and proposes the implementation of artificial intelligence in a second phase

2. Systematization of shopkeepers

2.1. Introduction

In 2012, the project *Barrio Digital* was started at the Minuto de Dios University Corporation in Bogota, cataloged in 2014 as the best application in Colombia by Computerworld [1, p. 29]. Today it is carried out by the Unit of Engineers without Borders of the Uniminuto Social Innovation Science Park (PCIS). An IEEE article on the importance of stimulating research projects that promote impact in university environments encouraged the this project [2]. It was thought of in the closest environment, which is the Minuto de Dios neighborhood, linked to the history of the University as shown by the Faculty of Architecture of the Universidad de los Andes in one of its publications [3]. This project has been linked within the theme of Smart Cities as a response to the integration of technologies with the well-being of citizens.

2.2. Identity of neighborhood stores in Colombia

The neighborhoods are groups of properties that group families and that over the years have institutionalized the presence of these small businesses that sell multiple products for unitary consumption and that comply with the social service of offering products demanded by families. In general, they are managed by the head of a family who dedicates his life to running his

business. Grupo-Bit says that about 65% of the food that Colombians buy is bought in these types of stores, which amount to about 500,000 throughout the national territory [4].

The stores are businesses recognized by the community and the recurring access of the citizens creates a very close relationship with the shopkeeper. They are attended by people from social strata 2 and 3, such social strata in Colombia determines the characteristics of social and economic type, whose level of study is generally low. These businesses do not have technological processes and must be managed manually.

2.3. Technology in the Stores

The project is being carried out with the company *Servinformación*, which has developed applications for these small businesses with high social content and software located in the cloud and used from a smartphone. We work with students of social sciences, preparing them in the management of technologies, but especially in the personal and psychological management of people reluctant to change.

2.4. The Process

Over time, a functioning model was created that consists of several stages: formation of the group of internship students, preferably multidisciplinary; direction of professors in charge of the practices; training of students in technologies and software; training of students in the store concept, its operation and the psychology of shopkeepers; accompaniment by a professional advisor from the company that owns the software solutions; brigades led by an older person with managerial roles within the university, in which the shopkeepers are told what the project is about and their approval is sought to later receive the visit of the students; proper management of relationships with the shopkeeper to break his mistrust and get him to agree to enter the project. Once the trust of the shopkeepers has been achieved, the team begins to train them individually, creating trust brigades to trace the routes of the students.

2.5. The Type of Stores

The type of stores follows various typologies for which we present only a few, in this case in Bogota.

2.5.1. Vegetable store

In addition to the sale of common products, some stores emphasize fruits and vegetables by displaying their products on sidewalks, without intervening in pedestrian traffic. This type of product requires permanent mobility due to its characteristics, requiring agility from the shopkeeper in handling the renewal of its products. This is one of the aspects where technology can help.

2.5.2. Small supermarket corporations

This type of small business operates with mechanisms similar to large supermarkets, where people organize their purchases by walking inside the product stand. Administratively, this

type of business requires traditional inventory management, control of expiration dates, a billing mechanism based on what buyers choose in their shopping baskets and surveillance systems to guarantee the security of the business.

2.5.3. As part of the family home

Many stores are created as part family homes, using an area that faces the street to put the business. Money management is confused with the family's requirements, which prevents business growth and proper planning for growth and innovation. The project seeks that shopkeepers find, with the use of technology, a way to better manage their business and even have more time for their family.

2.5.4. Facing the Street

The stores open facing the street, serving traditional neighbors and pedestrians. In this "landscape" of the cities, the store is like an oasis within the hustle and bustle, where a walker can take a break for having a coffee or snack, which makes time pleasant. Almost all stores are sheltered under the same type of service for the city, so technology would make them part of a Smart Cities project.

2.6. Georeferencing of stores

In this project the stores are georeferenced and the real address is accompanied by the coordinates of the place to be able to capture their position on maps and use aspects such as heat maps to represent social aspects or other types of characterizations that give us information about the stores. In addition, as the stores are distributed in various parts of the neighborhoods and the project requires tours, it is very important to develop routes for the different monitoring brigades.

2.6.1. Google maps and route tracings

This map technology is also used to make social cartography where it is not only about the representation of location, but also about storing social information. Likewise, these technologies allow routes to be traced as shown in figure 1:

One of the reasons why the "Trust Brigades" have been created is that shopkeepers are, in general, distrustful and, therefore, the job of the brigade members consists of following the route set out to visit the new shopkeepers, inviting them to enter the project. It is required to have the backing of a credible institution because this is not a commercial project and the shopkeepers will not have to pay for the service, this is a social service, but the barriers of mistrust must be broken.

The interest of the company accompanying the project is to create networks of shopkeepers, not to receive money for the service. The networks they create will be the basis of sustainability because they can work with suppliers and make the project sustainable over time.

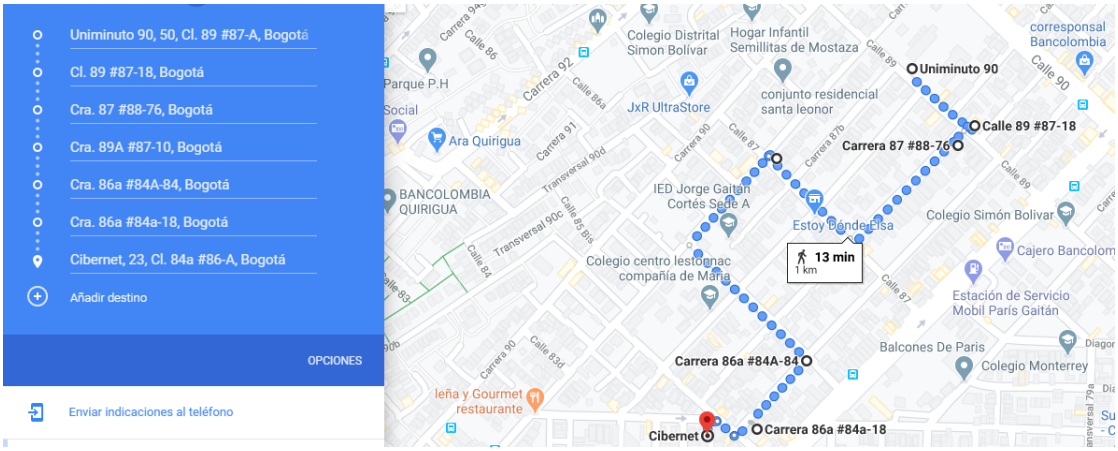

Figure 1: Route tracing. Source: Servinformación

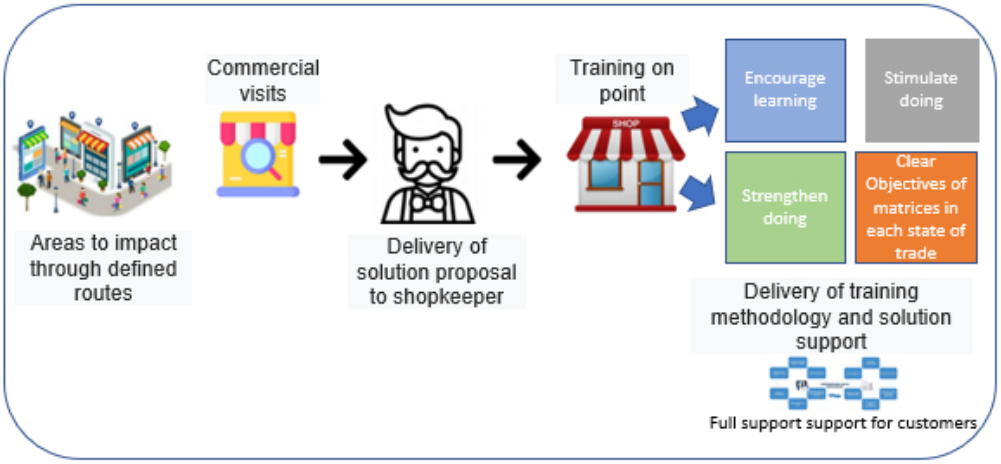

Figure 2: Diagram of the process of attracting commercial points: stores. Source: Servinformación

2.6.2. Satellite Views

This aspect is being worked on by monitoring the satellites of the European Union project called Copernicus [5]. In this particular case, its use is due to the need to go georeferencing the groups of stores that have been linked to the project, since the time will come when the number of stores will be large and their geographical positions will need to be projected on city maps.

Figure 3: Satellite georeferencing of stores. Source: Copernicus

Figure 4: Order process.

2.7. The Technologies

The technology used is called **Tiendosqui**, owned by *Servinformación*, using a basic version, it is based on the use of cell phones with internet to access cloud applications that allow the grocer to receive orders connecting new customers, increasing home sales and making an adequate collection and grouping of products to fulfill orders, including addresses. **Tiendosqui** offers communication between shopkeepers and customers, showing relevant data on consumption, products, prices, and movements, allowing the creation of sales and consumption patterns. Users will be able to ask one or more shopkeepers simultaneously under a process that carries the following sequence:

2.8. Start of the Project

The work team is made up of students of social sciences, a professor in charge of monitoring the academic and labor process of the students, the Servinformación advisor and a PCIS official who coordinates the operation. From there the process begins with a training of the students, followed by the registration of the stores. The next phase consists of loading the products into the inventory and billing system, which in order to operate requires the training of shopkeepers in the use of the system.

3. Industrial Safety Training System Based on Virtual and Augmented Reality

Within the framework of the projects that have been executed to adopt the guidelines of Digital Cities, the Faculty of Engineering of UNIMINUTO, in the line of education, has designed ICT implementation strategies at the service of the Minuto de Dios neighborhood community in Bogota (Colombia), based on emerging technologies such as augmented reality, 3D modeling and Virtual reality. This document describes the creation of an industrial security training system, based on virtual and augmented reality. Initially, the research projects that gave rise to the training system will be announced, then the implemented 3D modeling methods and the technical aspects used in the creation of the virtual environment will be explained, using the Unity 3D software. Finally, the learning activities incorporated into the simulator will be described.

3.1. Background

3.1.1. Barrio Digital (Digital Neighborhood)

Between 2012 and 2014, the Barrio Digital project was carried out, which consisted of the 3D modeling of 100% of the properties that make up the Minuto de Dios neighborhood in the city of Bogota. The project was developed within the "Modela tu Mundo de Google Earth" (Spanish for "Model your Google Earth World") program that sought the implementation of digital tools to model and georeferenced buildings, in order to later publish them in the 3D buildings layer of Google Earth [6].In the modeling, Sketchup Make and Blender, photo editing software, virtual hard drives, and websites were used and more than 1000 first semester students participated.

3.1.2. Finished projects

The Minuto de Dios Digital District consolidated the macro project called Smart Ecosystem, with the dimensions of Culture, Environment, Education, Transportation, Safety and Health. From the Education line, new projects were created focused on strengthening the work with the educational community of the Minuto de Dios neighborhood and the entities that are part of UNIMINUTO; Among the most outstanding projects are: Minuto de Dios neighborhood virtual tour, Minuto de Dios virtual university tour, Rafael García Herreros Museum augmented reality and the immersive tours Agroparque Sabio Mutis and Museum of Contemporary Art.

3.2. Framework

The development of the training system was carried out based on current legislation on occupational health and safety. Taking into account the wide existing regulations in the area, reference is made to Act 1562 of 2012, Decree 1072 of 2015 and Resolution 0312 of 2019, which define the General System of Safety and Health at Work, which present different related articles with the importance of promotion and prevention activities and establish the minimum standards of the industrial safety training system [7].

3.2.1. Modeling Techniques

In order to improve the presentation and quality of 3D elements, techniques such as *CGS (Constructive Solid Geometry)* were applied, where according to [8] polygonal figures are used and structures, dimensions, volumes, and materials prevail. The modeling from curves is based on the drawing of profiles, to which a revolution procedure is applied to create the desired object and the method of photogrammetry or use of maps, in which according to [9] a image is associated to a material to increase its realism, adding color to the model and other characteristics such as roughness or relief, without modifying the geometry.

3.2.2. 3D modeling of the TCR Tornometal SAS industry

The first phase to create the Industrial Safety Training System was based on the collection of information from the company TCR Tornometal, during this process the dimensions of the factory, the objects present in the environment and the machinery manipulated by the operators were identified. Using the 3D Sketchup modeling software, the ground plan was designed, the building guides and divisions were established for the creation of walls, windows, stairs, and levels of the building, using the techniques described above.

TCR Tornometal, specialized in the manufacture of automotive spare parts, has in its facilities welding equipment, lathes and grinding wheels, machinery used for the production of different car body parts, these objects were designed in 3D together with other elements of the factory such as : fire extinguishers, shelves, cans, billboards, notices, bars, tools and furniture. Figure 5 presents the 3D modeling process of the TCR Tornometal factory, the machinery, and objects in the environment.

3.3. Technology description

The virtual training system developed has advanced features that offer the user a sensation of immersion with great realism and presentation of quality content, which can be accessed in a multisensory way, to build knowledge in the context where what they learn will be applied , increasing the level of learning [10]. Access to the system is achieved with Microsoft's Oculus Rift viewers, which allow immersion in the company TCR Tornometal SAS, where the user can interact with different objects and industrial processes thanks to the incorporation of physics, animation application, gravity, and collisions.

The virtual environment is complemented with the implementation of augmented reality, which is available to the user to access new content that allows them to enhance the learning

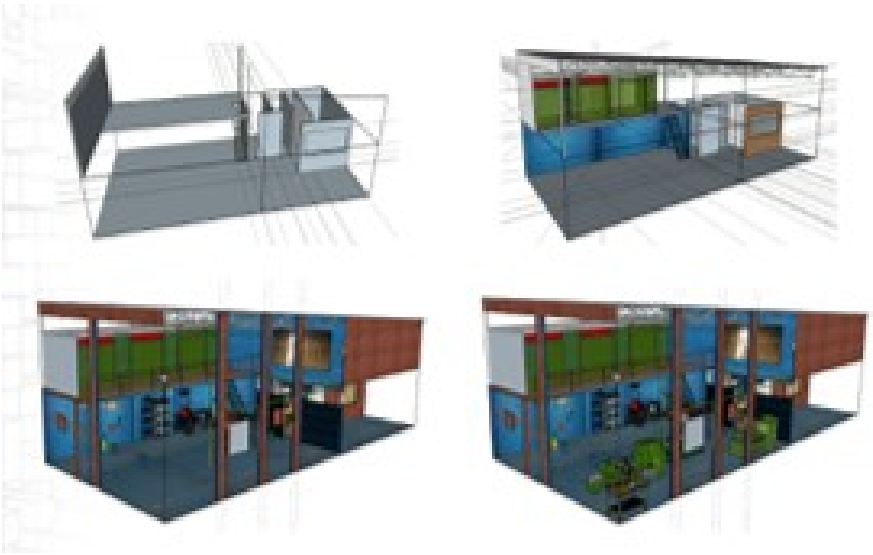

Figure 5: 3D model manufactures TCR Tornometal.

process that they have developed in immersion. The academic activities that were integrated in the training system are the use of personal protection elements (PPE) and eye protection in the sharpening processes of metal cutting elements.

3.3.1. Development in Unity

The second phase of the creation of the Industrial Safety Training System was based on the incorporation of 3D models to Unity. This tool, considered one of the best video game development engines today, allows the development of games for various platforms, such as: PC, Mobile, Video game consoles, Televisions, Augmented Reality, Virtual Reality and Web [11].

3.3.2. Management of Images

The 3D model of the factory was imported into Unity in .FBX format. This extension includes the meshes, vertices, edges and images used in the design of the model. Once the factory is inserted into the Unity scene, a process of assigning materials or setting the Shader to each 3D object is performed. Shaders are used to simulate real world objects, such as glass, plastic, metal, stones, among others, and their properties can be adjusted from the parameters of the materials inspector [12].

3.3.3. Avatar Model - Scene Settings

The industrial safety training system has the design of an avatar that performs the different training activities in the virtual environment, then the phases for the creation and configuration of the main character are described: Design of the 3D model, creation of the system

Figure 6: Training activities.

bones, character rig settings, animations and scripts to control movement. The factory avatar and 3D models feature physics, collision, and particle components to achieve interaction and manipulation of the elements of the training system.

3.4. Training activities

The System is under development and currently two topics have been incorporated in which training is given to workers within the virtual environment. When the avatar enters the facilities of TCR Tornometal SAS, it passes through an area of augmented reality in which it is taught about the importance of using PPE and indicates that it should look for the overalls, boots and helmet, and then wear them.

Later on, when he meets its first challenge, it gains entry to the plant and if it walks through the tool sharpening section, augmented reality again tells him to put on his safety goggles, to be able to work with the grinder and thus avoid work-related accidents, as you could be injured or even have sight damage. Figure 6 shows the avatar participating in activities designed for the training of workers in the metalworking sector.

4. Digital Training Proposal that Strengthens the Teaching and Learning Exercise in Teachers and Impacts the Students' Skills Development

This research proposal arises from the need to strengthen digital skills in people who, depending on their generational context, develop with little or great ability. A clear example of this are the so-called "millennials", considered as "digital natives", to whom we celebrate their affinity and development in using digital tools in their environment, but they do not demonstrate a pertinent and effective use in managing them, in educational or work contexts. Due to the above and, as an active part of the academic community, the continuous improvement of academic processes and the performance of students for the management of digital and technological tools are sought, which favor innovative processes in their disciplines [14]. The project proposed in its first phase, a quantitative method that began with the information collection,

through a measurement instrument, built and validated by experts, composed of the Prendes model five dimensions (2018).

The analysis of the data collected made it possible to diagnose the usage level for the information and communication technologies in the academic field, by the teachers in the Engineering and Basic Sciences Faculty, as well as the Faculty of Health. The instrument was applied to a sample of 174 teachers, 51.72% women and the remaining men, with 81% response to the call for completing the sample. The results were analyzed using a factor analysis in which of the four factors, three are reliable, according to the Cronbachn Alpha statistic, considering the factor analysis, the three reliable factors will be used: ICT Use and Social Impact, ICT Design, Management, and Evaluation, and ICT Analysis and Integration in Training, with the aim of carrying out a triangulation process to be associated with the ICT competences model created by the MEN (2013), chosen as the fundamental basis to issue the proposal aimed at solving the evidenced problem. Both models classify their skills into five large groups, which have very similar aspects in their characterization.

4.1. Project Methodology

The ICT skills model, created by the Ministry of National Education (MEN, for its Spanish acronym), proposes 3 levels of training: explorer, integrator, and innovator; and five skill: technological, communicative, pedagogical, investigative and management, (2013), which allow, in a comprehensive way, to train teachers in acquiring important digital skills for their development in the classroom and as a model to be followed by students in different backgrounds [13].

The main objective is to propose with these results a digital training plan that strengthens digital skills in teachers with an impact on students, considering the digital training standards from the MEN, implemented through an approach based in challenges, which allows, based on a need or problem, to propose solutions by involving digital tools that arise from the situation's analysis and allow them to confront their reality and present their proposal for solving the challenge.

4.2. Data Analysis

The digital training plan is based on the analysis of the data collected through the instrument described above, which showed, among its most important results, the following: of the 174 respondents, 134 teachers are at the Integrator level, which it means that teachers know the tools, use them but do not complement them or lead them to combine them with projects inside and outside the classroom; which corresponds to 77% of the sample. Out of the sample remaining, 12% are at the Explorer level, in this case they are teachers who know some tools but do not involve them in the academic field and 11% are classified at the Innovator level, where they integrate and add value to the projects inside and outside the classroom. Regarding the classification by skills according to the MEN, the pedagogical skill stands out with values of 69.5% for integrator level, 19.5% corresponds to explorer one, and 10.9% to innovator. The above indicates that teachers implement tools in their class but they need to be integrated in a more timely manner into other contexts to take advantage of the teaching and learning processes,

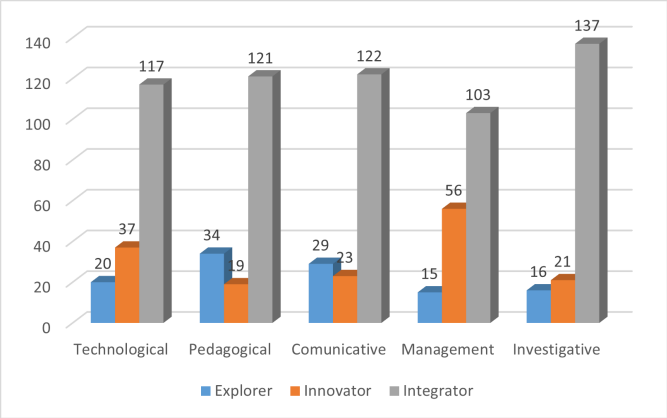

Figure 7: Classification by Skills.

especially in the help provided by this skill for the communication and socialization of disciplinary contents. The latter, followed by the technological skill with 67,2% in the integrator level, 21,3% for the innovator level, and 11,5% for explorer. Considering that there is a need to strengthen the use of tools and to acknowledge and practice them in daily academic and work life, there is evidence of a lack of continuous training in emerging technologies. Later, in terms of investigative skill, 78.7% corresponds to integrator level, 12.1% corresponds to innovator level and 9.2% to explorer; it is necessary to strengthen the management of tools that facilitate research processes, especially data analysis at both quantitative and qualitative levels. Continuing with the communicative skill, 70.1% corresponds to the integrator level, 16.7% to explorer, and 13.2% to innovator; the recognition of synchronous and asynchronous communication channels is evidenced, but it is necessary to make the most out of interaction, as well as the construction of collective knowledge generated within these spaces. Finally, there is the social skill with 59.2% for the integrator level, 32.25% for the innovator level, and 8.6% for explorer; working in this skill generates a great challenge: promoting good practices in social networks.

Additionally, the figure 7 shows that there is knowledge in ICT, but that they are not being put into practice; or, if they are used, it is not gotten the most out of them. Neither there is evidence of their integration with classroom, communicative or research projects, which is the purpose in the innovator level that according to the percentages is the lowest. This concludes that there is a great fallacy regarding both digital natives or immigrants, who are in constant interaction with digital applications or tools and that does not make them digitally competent. Teacher training on this subject is necessary in order to strengthen the assertive use of ICT.

4.3. Program Development

Currently, the project is in phase II, corresponding to the construction and development of modules for the digital training program, starting with the explorer module. Each of the levels consists of five skill, each of which has a four weeks term, in which the study material must be

used and, based on this, pose a challenge to develop and expose during the module's last week, resulting in the learning skill proposed at the beginning of the module. All the of the program development is carried out in the Moodle platform, virtually, taking advantage of its benefits, making use of communication tools as a space to develop both activities and evaluation. The course design was arranged in the form of video games, consisting in a smart city where the user can navigate and access spaces (buildings, banks, supermarkets, parks) as long as the scope of achievement is validated for each of the module's levels, advancing in complexity for acquiring each competence.

5. Proposal to Promote Smart Tourism based on Artificial Intelligence

10.4% of the global GDP is represented by tourism. This generates more than 319 million jobs worldwide [15].Tourism activities and their impact on the global economy have increased in the last decade [16]], and Colombia has not been the exception. Bogota is the most important destination in the country for tourism, receiving 1.1 times the sum of visitors received by the next four most important destinations in Colombia [17]. The tourist offer is wide, but not enough to make Bogota a smart destination. It is necessary to incorporate innovative alternatives that guarantee sustainability and accessibility through advanced technologies, thus impacting the visitor experience and the residents' quality of life. Smart Tourism contributes to the sustainable growth of cities and economic reactivation [18]. For its part, technology plays a fundamental role in tourism planning, reducing costs, anticipating possible crises in the sector, and identifying and determining aspects in carrying out activities [19]. In this context, the need arises to issue a proposal that allows converting traditional tourism into smart tourism based on the use of Artificial Intelligence. This research is carried out in two phases: the first corresponds to the identification and critical analysis of the conditions that determine the success of sustainable tourism processes; the second one corresponds to designing tools that allow a response from technology to the identified conditions, contributing to the concept of sustainable tourism. The results of phase 1 are presented below. Phase 2 is currently in the design stage.

5.1. Methodology

This first phase was done in four stages. In the first stage, a review and critical analysis of the literature was carried out, including scientific texts, regulations, and standards. In the second one, with the help of a multidisciplinary group of experts, the results obtained in the critical analysis were ranked using the Delphi method. Finally, with the results obtained from the critical analysis and the hierarchy developed by the experts, the determining aspects in the sustainable development of tourism activity in a smart city are established, so that in a second phase, they are addressed from the artificial intelligence. In the questionnaires used during the development of the Delphi method, the Likert scale was incorporated, which has been widely used in previous tourism and sustainability studies [20].

5.2. Experts Hierarchy

In order to prioritize the results obtained in the critical analysis, a group of experts is invited to participate in this second stage of the research.

5.2.1. Method

The experts are part of the following four groups: representatives of the government and the political sectors, tourism entrepreneurs, academics and researchers, directors of foundations and NGOs. The groups were selected based on their interference in the decision-making processes. 32 experts, 8 from each group, received the invitation to participate in the research via email. Three weeks later, 26 of them submitted their responses. After analyzing the results, a second questionnaire was sent to the 26 experts who had answered the first one; however, only 22 of them sent their second round of answers.

5.2.2. First phase

The information related to the study is communicated to the experts: objectives, method, type of questionnaire, term, and potential usefulness of the results. The questionnaire is sent to the 32 initially selected experts, with three open questions corresponding to the three areas established after analyzing the literature, regulations, and standards. The experts are consulted on the critical aspects that must be considered in each of the areas, specifying that they must include only the three that they consider most relevant in each case. 26 experts fill out the questionnaire, their answers are grouped and analyzed. A total of 78 responses are obtained per category, which could be repeated a maximum of 26 times. At the conclusion of the analysis, the second questionnaire is prepared and sent.

5.2.3. Second Phase

The second questionnaire is sent to the 26 experts who answered the previous one, including the responses from the first phase. The experts are asked to answer the questions designed based on the Likert scale, according to the three categories. In the analysis of results, the answers of all the experts are taken as equivalent, without weighing them according to the group to which they belong, their experience or any particular attribute. The results are presented in Figures 8, 9 and 10.

5.2.4. Final Report

The study concludes in the second phase due to the degree of consensus reached among the experts. Regarding the ecological component, they coincide in the importance of managing solid waste, polluting emissions, and wastewater, as well as the balance in ecosystems. On the other hand, the use of technology to identify behavior patterns in tourists and residents is pointed out by experts as a determining aspect in the sociocultural component, as well as the preservation of historical and cultural heritage, as well as social inclusion and gender equity.

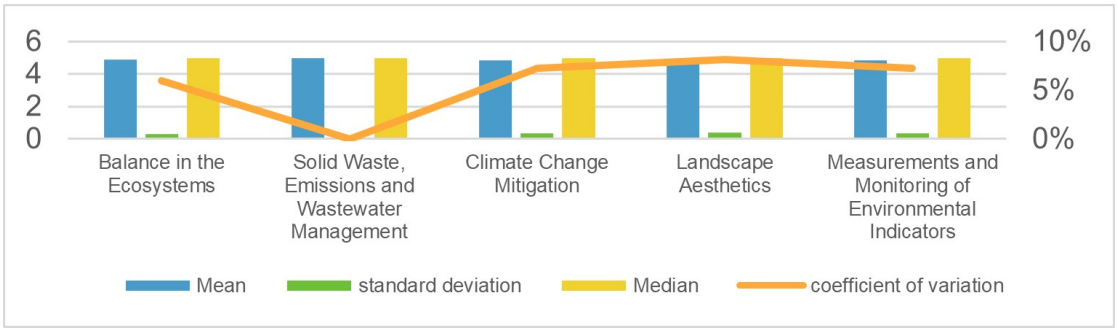

Figure 8: Results of the Likert scale on the Ecological Component

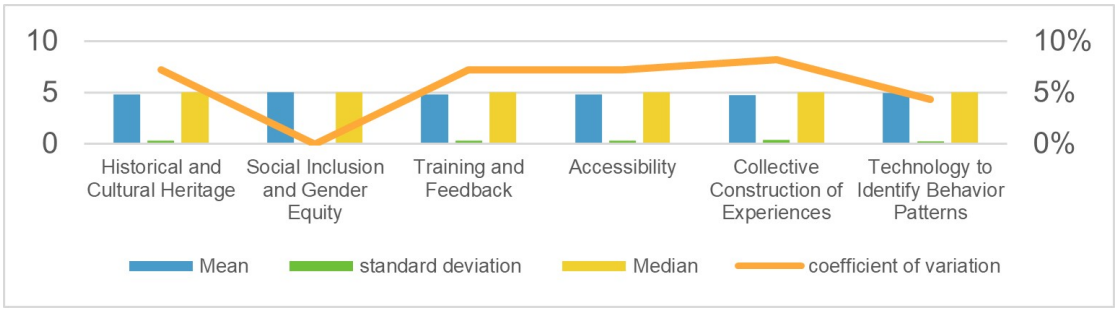

Figure 9: Results of the Likert scale on the Sociocultural Component

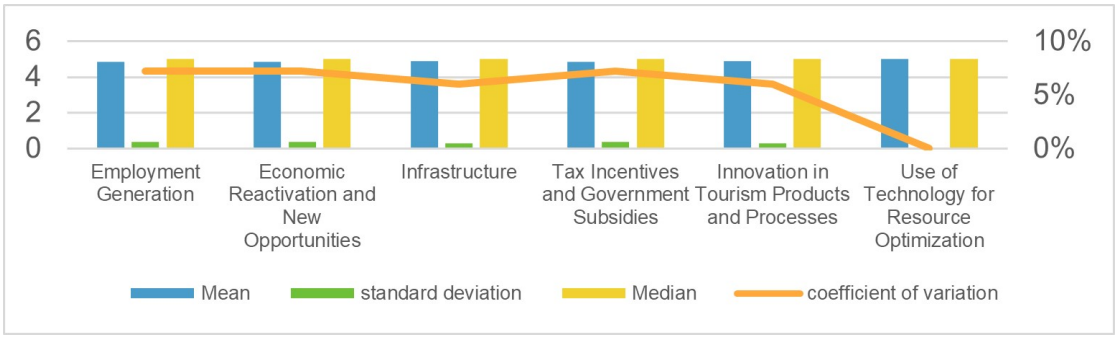

Figure 10: Results of the Likert scale on the Economic Component

Finally, they agree that innovation in tourism processes and products, along with infrastructure, are determining factors in the sustainability of tourism in a smart city and highlight the importance of the using technology for optimizing resources.

5.3. Discussion

In the first phase of the research, the identified critical factors on which the success of sustainable tourism in a smart city rests have been identified, grouping them into three components: ecological, socio-cultural, and economic. The results show the importance of including technology in smart tourism planning, in order to keep identified the new dynamics in the behavior of both visitors and residents. Technology is also targeted as a tool to promote innovation in tourism processes and products, not only from infrastructure and accessibility, but also from the formation and training of communities in tourism services and the feedback of these processes that allows continuous improvement and guarantee its permanence in time. One of the factors that most worries experts in the tourism activity development is the waste management. We cannot speak of smart tourism as long as their management is not adequate. Without a doubt, technology here would also play an essential role, on the one hand, in the design of cleaner and more efficient systems and processes, and on the other, in interactive training so that there is an appropriation of these new schemes by both residents and visitors.

6. Conclusions and Future Work

The Shopkeepers Systematization project allows inclusion by facilitating the most vulnerable sectors to face challenges such as the arrival of large competitors in the neighborhoods and the decrease in the competition capacity of neighborhood stores. The platform offers a POS system with a design in which usability allows it to be used with great efficiency by people without technological training. The project Industrial Safety Training System Based on Virtual and Augmented Reality is based on an immersive environment, developed to train operators in the metalworking sector, allowing them to manipulate machine tools and carry out learning processes with a high level of realism, eliminating risk conditions without the need to invest large amounts of money in inputs, which are present in traditional training systems. The project "Proposal of Digital Training that Strengthens the Teaching and Learning Exercise in Teachers and Impacts the Development of Skills in Students" is an alternative solution to the problem found, through data collection, in the Areandina university community, in the faculties of Health and Engineering and Basic Sciences, which as a representative sample indicates the need to strengthen, in a comprehensive manner, the ICT use in multidisciplinary contexts, through gamification and problem solving, based on formulating challenges. The project "Proposal to Promote Smart Tourism from Artificial Intelligence" is a contribution to the construction of a Smart Tourism model in Colombian cities that allows identifying the critical aspects of tourism activity, while, in a second phase, addressing them from artificial intelligence. The project seeks, through smart tourism, to contribute to the sustainable growth of cities and their economic reactivation. As a future work we can highlight the approach of the institutions belonging to RUMBO towards a sustainable and intelligent city, thus promoting projects that articulate the academy, the state, the industry, and the community focused on the citizen to solve problems in different areas such as: mobility, environment, education, tourism, among others. These projects will also seek to be developed in small cities in Colombia, taking advantage of the advice provided by experts from the EYR project of RedCLARA and GÉANT, which was awarded to the Rumbo Smart Cities group, allowing the assimilation of the projects'

results from large cities in the world and replicate them in Colombia.

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