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# AUGMENTED REALITY AS A TRAINING RESOURCE IN THE MILITARY FORCES A POLICE CASE - GENERAL SANTANDER CADET SCHOOL

# REALIDAD AUMENTADA COMO RECURSO DE FORMACIÓN EN LAS FUERZAS MILITARES CASO POLICIAL - ESCUELA DE CADETES GENERAL SANTANDER

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**Abstract:** The Colombian National Police, in its institutional educational project, enhances police knowledge and training, with tools to face the different challenges of citizens in terms of coexistence and citizen security, analyzing the possibility of implementing augmented reality scenarios in the development of the institutional curriculum at ECSAN, with innovative, dynamic and cutting-edge learning methodologies, allowing an approach from virtuality to facilitate the learning of police regulations, procedures and activities, under this context the methodological route of bibliographic review of background was outlined, followed by the design of the augmented reality prototype, execution of the application and evaluation of its effectiveness through statistical analysis, contributing to the approach and experience of the police service.

**Keywords:** Augmented reality, education, classroom methodology, curriculum development, virtuality.

**Resumen:** La Policía Nacional de Colombia en su proyecto educativo institucional, potencia el conocimiento y la formación policial, con herramientas para afrontar los diferentes retos de la ciudadanía en materia de convivencia y seguridad ciudadana, analizando la posibilidad de implementar escenarios de realidad aumentada en el desarrollo del currículo institucional en la ECSAN, con metodologías de aprendizaje innovadoras, dinámicas y a la vanguardia, permitiendo un acercamiento desde la virtualidad para facilitarel aprendizaje de la normatividad, procedimientos y actividades policiales, bajo este contexto se trazó la ruta metodológica de revisión bibliográfica de antecedentes, seguido

del diseño del prototipo de realidad aumentada, ejecución de la aplicación y evaluación de la efectividad del mismo mediante análisis estadísticos, contribuyendo al acercamiento y experiencia del servicio de policía.

**Palabras claves:** Realidad aumentada, educación, metodología de aula, desarrollo curricular, virtualidad.

## 1. INTRODUCTION

According to Ruiz (2011) Augmented Reality (AR) stands out in the digital world as a technological, attractive, and pedagogical resource. It offers enhanced experiences and interaction within the educational space and is aimed at replacing traditional methods. With AR, both students and teachers can break paradigms and improve their perception and actions through a simulator that brings reality closer to their learning process, offering meaningful experiences of creativity and the proper use of technology in teaching methods.

Augmented reality is also gaining ground in military fields, where it serves as a tool to perceive elements in the environment, within a volume of space and time, and project them into a future status. This is particularly valuable given the challenges of entering unknown terrains, poor reception, weak signals, and geographical problems. Therefore, this tool contributes to the successful development of operations. Saarelainen y Jormakka (2010).

In the Americas, the Defense Advanced Research Projects Agency (DARPA) considers augmented reality as a project that impacts technology development and successfully supports military operations Livingston (2002).

To advance and innovate within military and police personnel, several projects focused on digital and augmented reality systems have been created, addressing challenges in situational awareness. One such proposal is a framework called “Augmented Reality for Identifying Military Targets,” which aims to enable soldiers, military personnel, or defense professionals to perceive environmental elements that represent a combat threat on the battlefield. This is based on communication tools and technological control mechanisms Saarelainen y Jormakka (2010).

Regarding AR in military training, the EYEKON-USA Project stands out. This is a support system that involves installing intelligent agents on computers so that military personnel can visualize targets, weapons, environmental threats, dangers, and study situational awareness to achieve effective responses in military operations. Hicks et al., (2003).

On the other hand, the RAIOM project (AR for Identifying Military Objects) is presented under the supervision of CITEDEF (Scientific and Technical Research Institute for Defense). This project is significant as it focuses on facial recognition, detection and identification of objects, and identification of individuals. Its purpose is to collect data and contribute to research. This application is autonomous, as it is directly controlled from patrols and Command and Control centers through various technological means Ardito (2017).

In Orlando, Florida, the Battlefield Augmented Reality System (BARS) project was implemented by the Naval Research Laboratory (NRL). It involves connecting command centers to multiple mobile users to assist and support military operations in urban areas. Additionally, it allows personnel to be connected to a common database and join various channels to access graphics Livingston et al., (2002).

In the United States, two projects were developed. The entity Tanagram Partners was selected in 2019 by the Defense Advanced Research Projects Agency (DARPA) to develop a digital system to be used in military fields during complex environments, helping uniformed personnel perceive and project a course of action that enhances performance and the achievement of tactical objectives Juhnke et al., (2010).

On the other hand, the Urban Leader Tactical Response Project (ULTRA-Vis) involves integrating tracking systems for vision, position, and orientation with a see-through holographic screen. This allows soldiers to engage in military operations, visualizing all elements such as motorcycles, vehicles, aircraft, local locations, and

dangers when visibility is compromised. (Broad Agency Announcement, 2008).

At the national level, there is the CRV - Virtual Reality Center (Military University of Nueva Granada, Colombia), which aims to create an impact on the development of technology in the academic and scientific fields through the use of virtual reality. It seeks to provide the defense sector with scientific projects and promote educational strategies, (Centro de realidad virtual Universidad Militar Nueva Granada, 2022.).

In 2020, the ECSAN - General Francisco de Paula Santander Police Cadet School, proposed an Innovative Pedagogical Strategy for Approaching Police Cases for Future Police Officers in Colombia. In this research, field instruments in the form of surveys were applied to a total of 114 students as a finite random sample from a universe of 900 students. The result was the idea of strengthening the simulation centers at ECSAN, with 77.2% of respondents supporting it, and increasing practical hours within the academic curriculum, with 70.2% of respondents in favor. Ureña (2020).

Once the information from the background and the problem question, which is to identify "How does the implementation of augmented reality scenarios contribute to the training process of future officers at ECSAN?" has been analyzed, the main categories are established, including augmented reality, digital competencies, and training. Additionally, the subcategories of the project related to the opportunity for training, pedagogical strategy, competency development, technological resources, innovation, knowledge acquisition, training models, and implementation curriculum path are identified.

According to the analysis of surveys conducted at the University of Córdoba on technological tools to improve student learning, it was found that Augmented Reality is considered an important tool in the classrooms of higher education students in the Primary Education degree program. AR is seen as a means to develop content and playful activities for interaction between teachers and students (Andréu y García, (1996).
It is considered that the challenge for training centers, in this context, lies in rethinking formative processes oriented with new technologies and fewer traditional exercises, in order to enhance meaningful learning using didactic tools Mendieta et al., (2016).

In this context, the potential of implementing augmented reality scenarios within the training processes of students at ECSAN was analyzed, and specific objectives were developed, such as: identifying the key elements of AR as a pedagogical strategy for practical learning in police training from a theoretical perspective, determining the impact of AR as a pedagogical strategy on knowledge acquisition by ECSAN students, and proposing a path for the implementation of AR in different subjects within the ECSAN curriculum. This would allow for the continuation of such training models in various police training schools in Colombia.

## 2. THEORETICAL FRAMEWORK

For the development of the theoretical framework, the central topics were derived from the categories and subcategories, which were obtained through information consulted from databases and analyzed in the documentary triangulation, with the aim of finding responses and background that would lead to establishing and analyzing the potential of implementing augmented reality scenarios within the training processes of students at ECSAN. The research categories identified for the purposes of this study are:

*Table 1. Analysis Categories Identified in the Research*

| Categorías | Subcategorías | Definición conceptual | Definición |
|---|---|---|---|
| Realidad Aumentada | • Oportunidades para la formación<br>• Estrategia pedagógica<br>• Desarrollo de competencias | La RA en la pedagogía ayuda a para comprender diferentes estilos de aprendizaje, de una forma interactiva y didáctica. Cabero et al., (2017) | Adquisición de nue formas de aprendizaj los estudiantes policía de la Esc General Santander. |
| Recurso Tecnológico | • Recurso tecnológico<br>• Innovación | A través del recurso tecnológico de RA, el estudiante observará las nuevas tendencias y tecnologías educativas en ambientes propicios para la adquisición de conocimientos. Díaz (2016) | Nuevas herramienta metodologías permitan a los Cad comprender didácticamente temáticas polici antes de enfrentarse la realidad del proc policial. |
| Formación Policial | • Adquisición de conocimientos<br>• Modelos de formación<br>• Ruta de implementación/ currículo. | Este instrumento de RA, es utilizado en diferentes campos militares, como medio de formación, entrenamiento y preparación operaciones militares. (Lancheros y Jaimes, 2015). | Desarrollo procedimientos efectivos que garanti la actuación policial el marco de convivencia ciudada |

Note: The table shows the categories, subcategories, and conceptual definitions resulting from the analysis in the databases to guide the research.

### 2.1. Augmented reality

The use of this tool is a methodological opportunity for learning in the training process. It has a significant influence on education, as it develops a range of applications in training centers that significantly impact interaction, self-learning, knowledge appropriation, topic analysis, and comprehension. This type of tool has so many advantages that, when compared to traditional curricula and methodologies, it stands on a larger scale, being easy to handle and useful on mobile devices. This allows for greater satisfaction among students due to the ability to train, educate, and interact from anywhere—whether at school or in outdoor or indoor fields. Jamali (2015).

Augmented Reality (AR) is defined as a tool used to integrate physical objects with virtual objects. Its origins date back to the 1960s, with projects like "Sensorama" and the "Head-mounted Display," which are devices resembling a helmet, where images created by a computer are displayed on a "screen" placed over the retina of the eyes using a virtual retina HMD monitor. Augmented Reality is designed for any device that includes features like cameras, screens, and object detection software. (Arroyo y Vázquez, 2011).

AR significantly enhances thinking and understanding of applied subjects and contributes to the effectiveness and development of each project, resulting in improvements in interest in topics, mastery of subjects, attitude, and confidence. (Petersen y Stricker, 2015).

### 2.2. Pedagogical Strategy and Digital Competencies

According to Rodríguez (2010), pedagogy is understood as a compilation of educational knowledge in any of its dimensions. It is a clear and theoretical construction based on tools for an appropriate curriculum. Likewise, pedagogy is a discipline that must be combined with theories and student practices to avoid falling into the monotony of traditional classes.

Pedagogy should consider the didactic approach, leaving behind routine, habits, and various forms of ambiguous interaction, while promoting the appropriate application of the proper use of new technologies De la Rosa (2002).

Regarding traditional methodology, it is understood and promoted through the relationship between student and teacher to address topics and stimulate student interest. However, it is seen as lacking in relation to active methodologies, as the limited interaction and connectivity with technology influences the topics and their application Del Vas (2010).

In many publications, new methodologies are proposed as an important tool in the context of teaching. For instance, contemporary methods emphasize direct participation between the teacher and the student, based on the use of didactic elements that deepen the lessons. However, the rise of technology leads to the evolution of new software for pedagogical support, and the use of Augmented Reality emerges as a strategy to improve, adapt, and provide feasible information to contribute, control, and ensure comprehensive curricula. Hernández (2002).

Pedagogy leads to the generation of a dialogue between the school, the teacher, the student, and the citizen, creating a revolution in the communication among these actors, highlighting a shift in socio-educational paradigms. It is necessary to bring dynamic participation into the training process, as well as knowledge and guarantee of human rights from each of our professional roles. These actions are only learned through lived experiences, and sometimes incorrect actions, which is why it is important to bring these contexts into training processes through the use of new technologies. (Chacon, 2022).

### 2.3. Police training

Simulation and virtual reality systems facilitate learning and serve as a didactic element that contributes to improving military outcomes and performance compared to traditional curricula. Muente (2019).
As an added value, the National Police of Colombia would serve as a reference for the evolution of new learning methodologies by incorporating a learning methodology tool that fully engages students visually, mentally, and even physically. This aids in the internalization of knowledge, digital competencies, educational approach paradigms, and meaningful interaction, all of which are a necessity and reality in today's education. This is done within a relevant context, with proper and responsible use in training processes for life (Fernández et al., 2018).

## 3. METHODS

A search for the most important theses was conducted in databases, public tools, institutional, and academic platforms such as Redalyc, Scielo, Google Scholar, Policía Nacional, DINAE repository, and Scopus. These were related to the categories of this document, such as augmented reality, digital competencies, and police training. This search resulted in a dataset in Excel format, collecting information in a documentary matrix. The classification of information was supported by 46 documents, including journals, articles, and books in English and Spanish. These documents were previously coded and analyzed through word combination and an interactive word tree designed using MAXQDA Analytics Pro 2020. (See documentary matrix Annex A).

A frequency analysis was conducted on 31 documents and the main elements contributing to the effective development of the application as a pedagogical tool. The analysis found that the term "augmented reality" appeared 1037 times in the texts, corresponding to 67.39%, followed by the terms "technological resources" and "higher education," which appeared 169 times in 19 documents, representing 41.30%. Lastly, "military projects" appeared in 31 documents, with a frequency in 3 documents, corresponding to 6.52% (See frequency and correlation matrix Annex B).

Regarding data triangulation, the following key elements of augmented reality were identified in Figure 1 as a pedagogical strategy for practical learning in police training from a theoretical perspective.


*Fig. 1. Key Elements of Augmented Reality.*

Note. The figure displays the word cloud highlighting the term self-regulated learning as the most frequent, followed by learning environment and enhanced technology, based on the word cloud analysis conducted using the MAXQDA program.

According to the categories of this research, namely augmented reality, technological resources, and police training, a textual analysis was conducted. This analysis involved frequency relationships, a combination of keywords, and an interactive tree that enabled the identification of key elements of augmented reality in the training context. The results indicated that self-regulated learning, learning environments, and the use of technologies promote learning within the framework of police training. Digital tools were identified as elements that enhance citizen interactions and underscore the importance of keeping teacher training processes at the forefront. Additionally, the need to implement methodologies that connect police officers to their professional practice during the training process, rather than solely at the end as a final practice, was observed. Finally, the positive influence of incorporating augmented reality into training environments for Colombia's security forces was established.

Self-regulated learning enables students in police training to exercise control over their own thoughts and easily internalize the topics presented. It also helps resolve most doubts independently, fostering autonomy among police trainees. A second element is the learning environment, as cadets at the General Santander School can interact in various settings that showcase content relevant to police practice in an innovative way. This approach brings them closer to their future roles by utilizing augmented reality and other technology-assisted training techniques.

A third element focuses on augmented reality as a new technology that enhances the teaching-learning process. It facilitates access to new technologies and the development of digital skills. A fourth element, enhanced learning, employs augmented reality as a tool that introduces innovative, less traditional educational and didactic methods.

Another critical element is pedagogical practice, where future officers gain hands-on experience with police procedures before facing real-world scenarios related to prevention, coexistence, and public safety. Finally, augmented reality is pivotal in the training processes of Colombia's security forces, strengthening the preparation of future public servants. These individuals acquire better management skills for the tasks they will perform in their professional lives, supported by innovative technologies that enable simulation processes and realistic training. This approach allows them to develop strategic, operational, and educational activities while minimizing errors that, in real-world situations, often have irreversible consequences.

Determining the Impact of Augmented Reality as a Pedagogical Strategy on Knowledge Acquisition by ECSAN Students

To determine whether future police officers acquire greater knowledge through pedagogical strategies such as the use of AR, a prototype of Augmented Reality (AR) was developed during this objective. The prototype simulated a behavior contrary to coexistence as stipulated in numeral 3, article 111 of Law 1801/2016. The selection criteria relied on statistical data from the National Registry of Corrective Measures (RNMC), which indicated that between 2017 and 2021 in Bogotá, 5,485 citations were issued, and 174 pedagogical courses were implemented as corrective measures.

Consequently, the design and implementation of the AR app prototype commenced, divided into two phases: the Artistic Phase and the Technical Phase.


*Fig. 2. Image taken from the Augmented Reality app*

Note. The image shows the proposed scenario in the CNSCC augmented reality prototype, execution code, and visualization of the prototype app on the home screen of a mobile phone. Source: Own creation, augmented reality prototype app (2021).

During the artistic phase, Adobe Photoshop was used to illustrate the different characters and other art assets necessary to carry out the animation. Once the assets were finished, they were exported for use in the technical phase.

In the technical phase, the application was developed using the Unity3D game engine and the Vuforia Augmented Reality library. The art assets were imported, and the animation was developed with background narration, using the representative image that Vuforia detects in the real world and places virtual elements on top, as shown in Figure 2.

Once the behavior contrary to social coexistence was designed in the AR prototype, an educational exercise was conducted with students about to graduate as Masters in Coexistence and Citizen Security (chosen sample), as shown in Figure 3. The exercise consisted of explaining the same topic (Article 111, Law 1801 of 2016) using different teaching methodologies. Initially, traditional teaching was used with a printed code of Law 1801 of 2016. During the explanation, it was observed that the students were attentive but did not provide opinions or ask questions. The second methodology introduced was through a video and PowerPoint slides. More movement and interest from the students were evident regarding the information. Finally, the topic was explained using the AR app prototype. According to the observed reactions, the impact was positive, as the students showed interaction, dynamism, empathy, amazement, concentration, and smiles. Furthermore, their interest in the Augmented Reality content was clear, with comments such as "The project is very good," "innovative," and "great," which coincided with the responses from the survey participants in the data collection tool.

*Fig. 3. Protocol for Application of the Augmented Reality Prototype App*

Note: The image shows the scenario where the teaching methodologies activity was carried out, including the traditional methodology using visual media and applying the CNSCC augmented reality prototype.

## 4. ANALYSIS BY CATEGORIES, BACKGROUND, AND KEY ELEMENTS OF AUGMENTED REALITY.

According to the information obtained from the data collection instrument, the results generated by the forms were downloaded in Excel format and the information was organized by categories. Similarly, the data were coded using a convention table to replace qualitative variables with quantitative ones, so they could be included in SPSS (software used for data processing). Subsequently, a bivariate correlation was performed using Spearman's Rho. Additionally, based on the data obtained according to the categories and key elements, a heat map was generated indicating the relationship between uncorrelated variables and perfectly correlated

variables, in order to assess the impact of AR in the training processes at ECSAN. (See tabulation and coding matrix in Annex F, data entry in SPSS in Annex G, and frequency and correlation results in Annex H and heat map in Annex I).

Regarding the data collection instrument in the form of a survey, of the total number of respondents, 68.3% correspond to the selected sample of 28 students from the second section of the Antonio Nariño Company, 19.5% equates to 08 teachers who teach courses related to police planning and service in the Master's Program in Coexistence and Citizen Security, and 12.2% represents 05 commanders and uniformed officers. In terms of age, 61% are between 20 to 30 years old, 29.3% are between 31 to 40 years old, 7.3% are between 41 to 50 years old, and 2.4% are between 51 to 60 years old. Additionally, 58.5% identify as female and 41.5% as male.

Regarding the Augmented Reality category, as shown in Figure 4, 87.8% rated the experience in the AR prototype simulator as "very high," and 12.2% rated it as high. However, 61% were unfamiliar with the technological tool, and it was noted that extensive computer knowledge is required. Concerning the key elements of augmented reality, 63.4% fully agree that the use of AR promotes self-regulated learning in students, and 68.3% fully agree that AR environments facilitate learning and knowledge acquisition. Furthermore, 70.7% fully agree and consider it feasible to use the tool as an educational medium to explain different subjects and topics in the educational curriculum provided by ECSAN.

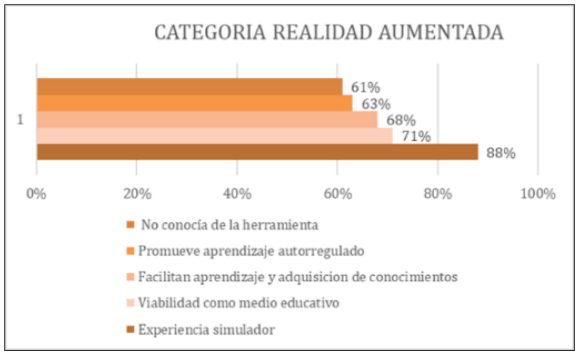


*Fig. 4. Category: Augmented Reality*

Note: Data taken from the main results of the Augmented Reality category, gathered from the Google Forms survey data collection instrument, related to the teaching methodologies activity.

Continuing with the analysis in the category of digital competencies and according to what is shown in Figure 5, 78% of the respondents are unaware if future officers have access to technological and simulation tools during their training. However, 68.3% fully agree that using tools like AR will allow students to develop greater digital competencies, such as data analysis and information systematization. Additionally, 68.3% believe it will enable students to acquire greater skills for using platforms and exchanging digital information, while 65.9% think that such learning and teaching environments enhance decision-making skills for both students and teachers. As a result, in the category of police training, 70.7% believe that future Lieutenants will be able to better internalize police activities if technological tools are implemented during the training process, thus aiding the appropriation of knowledge and regulations related to police work in an interactive manner.

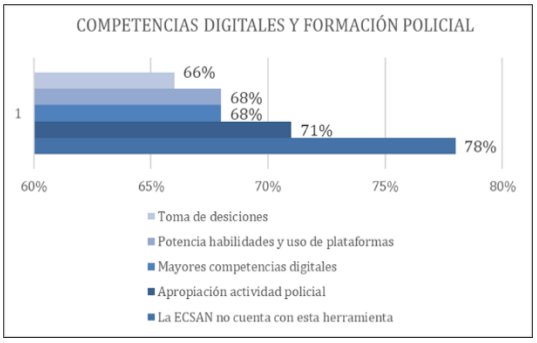


*Fig. 5. Category: Digital Competencies and Police Training*

Note: Information taken from the main results of the digital competencies and police training category, obtained from the Google Forms survey data collection instrument, related to the teaching methodologies activity.

**Correlaciones**

| RHO DE SPEARMAN<br>Categorías realidad aumentada, competencias digitales y formación policial | | ¿Los ambientes de Realidad Aumentada facilitan el aprendizaje y adquisición de conocimientos por parte de los estudiantes? | ¿Considera que a través del uso de Realidad Aumentada el estudiante promueve el aprendizaje autorregulado? |
|---|---|---|---|
| ¿Los ambientes de Realidad Aumentada facilitan el aprendizaje y adquisición de conocimientos por parte de los estudiantes? | Correlación de Pearson | 1 | ,975** |
| | Sig. (bilateral) | | ,000 |
| | N | 41 | 41 |
| ¿Considera que a través del uso de Realidad Aumentada el estudiante promueve el aprendizaje autorregulado? | Correlación de Pearson | ,975** | 1 |
| | Sig. (bilateral) | ,000 | |
| | N | 41 | 41 |

**. La correlación es significativa en el nivel 0,01 (bilateral).

*Fig. 6 Analysis of Spearman's Rho correlation using the SPSS statistical software.*

Note: Spearman's Rho correlation analysis according to the categories and based on the results of the analysis in the SPSS statistical program.

Once the data generated in the background, frequency, and bivariate correlation analysis using

Spearman's Rho for the categories and key elements were analyzed, it was established that the technological tool of Augmented Reality (AR) has a positive impact, with a significant correlation of .975** and a bilateral significance (Sig.) of .000 in the variables of AR environments, knowledge acquisition, and self-regulated learning, as shown in image 6. This is confirmed by the theory of (Cabero Almenara et al., 2017) which indicates that AR helps in pedagogy by enabling an interactive and didactic understanding of different learning styles through the integration of virtual and physical elements.

In the category of digital competencies, a correlation coefficient of .900** and a bilateral significance (Sig.) of .000 were found for the variable of using platforms and digital information exchange, as well as comprehension of police-related topics. As Díaz (2016) mentions, through the AR technological tool, students can observe new trends and educational technologies in environments conducive to knowledge acquisition.

Regarding the category of police training, the correlation coefficient is .848**, corresponding to the implementation of AR scenarios in different subjects and topics within the educational curriculum provided by ECSAN. This allows future lieutenants to better grasp police activities, as confirmed by Lancheros & Jaimes (2015), who state that the AR tool is used in various military fields as a training and instructional medium.

In this context, Augmented Reality is considered a learning method in the training process of future students because it enhances pedagogical processes, is innovative, and will allow students to acquire greater skills in using platforms and exchanging digital information, while also interactively internalizing the norms related to police work.

Proposing an Implementation Route for Augmented Reality in Different Subjects of the ECSAN Curriculum, to Continue Integrating These Pedagogical Models in Police Training Schools in Colombia.

Considering the analysis of the first and second objectives of this research, key elements of Augmented Reality as a pedagogical strategy for practical learning in police training have been identified from a theoretical perspective, as well as the impact of AR as a pedagogical strategy in the acquisition of knowledge by ECSAN students.

In this context, the learning environments, digital competencies, and self-regulated learning provided by Augmented Reality as a technological resource contribute to the acquisition of knowledge in an interactive manner. In this case, it brings police students closer to gaining procedural experiences before interacting with the public during their training process.

In relation to the above and according to the results where a significant Spearman correlation of 0.895** was observed between the variables "Using the Augmented Reality tool in different subjects and topics established in the educational curriculum provided by ECSAN, from the creation of learning scenarios in the context of police service and the realities they must face, in order to establish actions that minimize personal or citizen risks through models like those that can be created with Augmented Reality, as they allow greater decision-making skills for both students and teachers," it is proposed, as shown in Tables 2 and 3, that the technological resource be implemented as a didactic learning tool in the following subjects, programs, and police training schools in Colombia.

*Table 2: Proposal for the Application of the Prototype in ECSAN Curriculum Subjects*

| Campo de Formación | Asignatura | Contexto/Temática |
|---|---|---|
| Disciplinar | • Sistema Táctico Básico Policial<br>• Tiro | • Apropiar y aplicar Técnicas de Defensa Personal y Control Policial T.D.C, Tácticas de Intervención en Procedimiento de Policía T.I.P, establecidas en la guía 3EC-GU-0001" Guía práctica SITAB"<br>• Prácticas y posiciones de tiro |
| Fundamentación | • Fundamentación Jurídica<br>• Derecho Constitucional<br>• Derecho Administrativo<br>• Derecho penal y de Procedimiento penal<br>• Derecho Disciplinario<br>• Derecho Penal Militar<br>• Derecho de Policía<br>• Investigación Criminal y actuaciones de Policía Judicial.<br>• Procedimientos para el servicio de Policía Urbano y Rural<br>• Servicio de Policía Aplicada | Recrear comportamientos contrarios a la convivencia y conductas delictivas establecidas en las siguientes normas.<br>• Constitución política de Colombia de 2001<br>• Código penal Ley 599 del 24 de julio de 2000.<br>• Código procedimiento penal Ley 906 del 31 de agosto de 2004.<br>• Código penal militar ley 1407 del 17 de agosto de 2010.<br>• Código disciplinario único, faltas leves, graves y gravísimas.<br>• Procedimientos de Investigación Judicial. |

Note: Analysis of the Implementation of the Augmented Reality Prototype in Different Subjects of the Master's Programs in Coexistence and Public Security, Police Service Specialization, and Police Administration.

## 5. CONCLUSIONS

From the qualitative analysis of this research, it is established that augmented reality is a tool that promotes self-regulated learning for ECSAN students because it enables the students to be self-effective. Additionally, it is a technological resource that fosters alternative learning environments, different from traditional teaching methods, as it encourages the use of new technologies, the generation of new knowledge, the interaction of stakeholders, and exposure to real-life scenarios that future officers will face through virtual simulators. It also allows dynamic explanations and understanding of various topics and subjects provided by the educational curriculum in police schools nationwide.

Ninety percent of students acknowledge that the simulator facilitates their learning process and aids in the effective internalization of police knowledge applicable to their future profession. It contributes to the enhancement of digital competencies such as data analysis, information systematization, and skills for using platforms and digital information exchange. Moreover, 71% of future Sub Lieutenants mention that they will be able to better assimilate police regulations and practices in a different, dynamic, and engaging way for the learner.

According to the study conducted, it is inferred that the implementation of augmented reality prototypes and simulation tools in the training school for future officers and police officers in Colombia is necessary in order to strengthen the competencies of the academic curriculum.
As an additional component, the possibility of generating inter-institutional relationships in the training contexts is established, with institutions such as the army, which have a strong track record in the application of such technologies. Not only do they have the equipment, but also the experience in designing virtual scenarios, making this an opportunity to develop joint training and interaction projects aimed at enhancing the skills development of students from both institutions

As a result of this research, a proposed implementation roadmap is presented to the Escuela General Santander, aimed at improving the quality of education in various subjects, topics, and programs such as the Master's in Coexistence and Citizen Security, Police Service Specialization, Police Administration, and the Professional Technical Program in Police Service (training schools nationwide).

Educational models and the need to bring reality closer to classroom contexts are essential, leading to the necessity for institutions, educators, and students to advance toward new technologies such as 4G and 5G, as proposed here, or even further, to what is known as multiverse or pluriversal educational models. These models facilitate the creation of real 3D worlds where students can engage with and interact with various realities.

Educational transformations, following the pandemic, have driven the use and development of new technologies for training processes. Hybrid systems are becoming increasingly relevant, and the academic freedom granted by Law 30 for universities provides an opportunity to offer more varied and meaningful didactic strategies in the development of educational content. Augmented Reality (AR), as shown in this research, is a very good option but not the only one. It can be complemented with virtual classrooms where content related to reality in the Metaverse can be developed, which can be used synchronously or asynchronously, allowing students to review or recreate new realities and strengthen their learning.

The demands of transforming traditional classrooms into augmented reality classrooms present a challenge, not only in terms of mindset but also in infrastructure and the development of new skills for teachers. For example, educators must be trained in handling more advanced information systems with programs and software that require them to further professionalize in order to experiment with new tools, propose, and develop more creative, daring, and innovative lesson plans for their students, with the goal of making them more meaningful and real.

The roles between students and teachers will be affected, as students will need to take on a more autonomous and proactive role. Their interest and desire to participate, interact, and renew the contexts generated on augmented reality platforms will facilitate and enhance their formative and meaningful learning processes. On the other hand, the teacher's role will shift to that of a facilitator, providing not only documentary resources but also contextual and regulatory elements to help students engage with the realities they will face in their professional lives, such as managing citizen coexistence and security. As we can see, dynamics and roles will change significantly, so evaluation processes should adapt to these new concepts, placing significant value on the student's interest and active involvement in their learning.


*Fig. 7. Design and implementation of the institutional curriculum in phases*

Note. Proposal for the Application of an Augmented Reality Prototype in Programs, Fields of Study, Subjects, and Topics Developed at ECSAN.

Likewise, the object of study of this project mentions that institutional content topics, such as police procedures and current regulations, often become a tedious process. However, during the development of the objectives and data collection instruments, it was found that through the use of simulators and technological tools, future police officers more easily internalize institutional procedures, making it a valuable tool for application in disciplinary training and foundational fields.

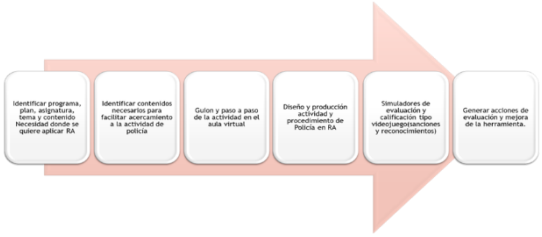


*Fig. 8. Implementation route*

Note. Information on the Step-by-Step Process for Implementing the Augmented Reality Prototype in Programs, Fields of Study, Subjects, and Topics Developed at ECSAN.

It is important to clarify that the construction and design require resources for hiring experts in design, technological media, platforms, and licenses for the operation of apps and software.

Additionally, it is necessary to consult with officers and non-commissioned officers about their lived experiences, particularly those that occur most frequently in the field, in order to recreate them. This will enable students to perform actions in AR that not only allow them to make mistakes but also to succeed in police actions.

Over time, this type of methodology not only facilitates training but also provides tools that help the police establish a better and more accurate connection with citizens.

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