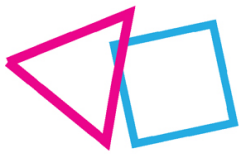


Deliverable Report

# D5.5 Pilot Studies Monitoring and Evaluation Results



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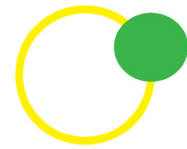
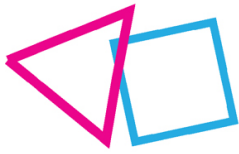


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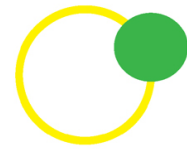
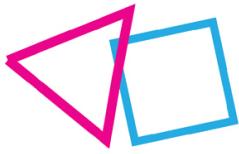
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# TABLE OF CONTENTS

- Document information and contributors ..... 2
- Document History ..... 2
- List of Abbreviations ..... 4
- Executive Summary ..... 5
- 1. Introduction ..... 6
  - 1.1 Project Overview ..... 6
  - 1.2 Purpose of the Deliverable ..... 6
  - 1.3 Scope and Objectives ..... 7
- 2. Methodology ..... 8
  - 2.1 Overview of the Pilot Study Design ..... 8
  - 2.2 Data Collection Methods ..... 9
    - 2.2.1 First Phase of Validations ..... 9
    - 2.2.2 Second Phase of Validations ..... 9
    - 2.2.3 Methodology for Questionnaire Analysis ..... 10
  - 2.3 Participants and Stakeholders ..... 11
  - 2.4 Ethical Considerations ..... 13
- 3. RAYUELA Pilot Studies ..... 14
  - 3.1 Phase 1 – Initial Prototype ..... 14
  - 3.2 Phase 2 – Enhanced Game ..... 14
  - 3.3 Phase 3 – Final Product ..... 15
  - 3.4 Conclusions from all Pilot Phases and Places ..... 15
  - 3.5 Photos from various pilots ..... 16
- 4. Perception of RAYUELA Stakeholders ..... 20
  - 4.1 Law Enforcement Agencies (LEAs) and Other Security Bodies ..... 20
  - 4.2 Policy Makers and Regulatory Bodies at National and EU Levels ..... 20
  - 4.3 RAYUELA's Supervised Testing Groups ..... 21
  - 4.4 Children and Young Adults ..... 21
  - 4.5 Family Environment and Friends ..... 21
  - 4.6 Teachers and Educational Environment ..... 22
  - 4.7 Privacy, Ethics, and Social Innovation Experts ..... 22
  - 4.8 Game Developers, Gamification, AI, and Data Modeling Experts ..... 22
  - 4.9 Anthropology, Criminology, Psychology, and Sociology Experts ..... 23

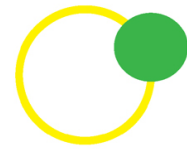
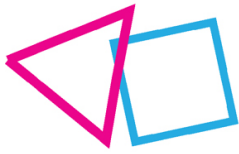


4.10 RAYUELA's International Advisory Board ..... 23

5. Conclusions..... 24

## List of Abbreviations

Abbreviation	Description
EA	ELLINOGERMANIKI AGOGI
EU	European Union
ICAI	Escuela Técnica Superior de Ingeniería
PC	Personal Computer
UCLL	UC LIMBURG



# Executive Summary

The "Pilot Studies Monitoring and Evaluation Results" deliverable provides a comprehensive analysis of the pilot studies conducted in various phases across multiple countries. It focuses on the continuous monitoring and supervision of the pilot studies, aiming to assess the effectiveness and impact of the RAYUELA solutions, particularly with emphasis on the serious game component. The report outlines the conclusions and achievements drawn from the evaluations, including data recorded, usability, user experience (UX), and the knowledge perception of stakeholders involved. This report includes five (5) main Sections.

**Section 1 "Introduction"** introduces the "Pilot Studies Monitoring and Evaluation Results" deliverable and provides an overview of the entire report.

**Section 2 "Methodology"** explains the design and approach used in conducting the pilot studies. It details the data collection methods employed, the profile of participants and stakeholders involved, and addresses any ethical considerations considered during the studies.

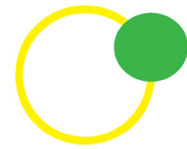
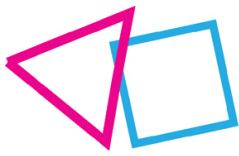
**Section 3 "RAYUELA Pilot Studies"** presents the results and analysis of the pilot studies conducted in the three Phases of the project pilots:

- Phase 1 across Greece, Spain, and Belgium. It highlights the key findings and conclusions drawn from each individual pilot study
- Phase 2, involving Greece, Spain, and Belgium. It compares and contrasts the results with those of Phase 1, identifying any significant trends or changes.
- Phase 3, involving Greece, Spain, Belgium, Estonia, and the UK as the main partner country. It analyses the data gathered and discusses the implications of these results on the RAYUELA solutions.

The analysis also includes the pilot studies conducted in additional countries during Phase 3, namely France, Croatia, Italy, Serbia, Czechia, Hungary, Netherlands, and Portugal. It provides a comprehensive overview of the evaluations' outcomes in these countries.

**Section 4 "Knowledge Perception of Stakeholders"** presents the results of perception surveys conducted to gauge the knowledge and understanding of RAYUELA solutions. It discusses how stakeholders perceive the educational impact of the project.

**Section 5 "Conclusions"** summarizes the key findings and takeaways from the pilot studies and evaluations. It highlights the lessons learned throughout the project and offers recommendations for further development and implementation.



# 1. Introduction

## 1.1 Project Overview

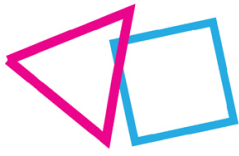
The RAYUELA project developed novel methodologies that allowed for a better understanding of the factors affecting online behavior related to cyber criminality, successfully contributing to a deeper comprehension of these critical aspects. It was also concerned with discovering and promoting the potential of young talents (students) in the fields of cybersecurity and technological research, effectively nurturing and showcasing the capabilities of budding experts.

The project proposed has managed to achieve these goals by designing a serious game with interactive and interwoven storylines on cybercrime that both enhanced players' knowledge of the issue of cybercrime and offered insights into tendencies to suffer or commit such crimes by particular profiles, in a non-invasive, safe, and ethical manner. The game followed a common script as the main plot, stacking increasing levels of complexity for each storyline considered. Overcoming each level depended on the player's decision-making capabilities: acting in ways that "rescued" their in-game avatar from facing typical risk situations that can often be found online, ultimately equipping participants with practical skills to navigate the digital landscape.

Thus, the RAYUELA project has provided Law Enforcement Agencies (LEAs), public administrations, the EU Commission, and especially young people and their environment (parents and educators) with valuable information and recommendations to define appropriate policies and measures to combat cybercrime, marking a significant stride towards a safer and more secure online community.

## 1.2 Purpose of the Deliverable

The purpose of the "Pilot Studies Monitoring and Evaluation Results" deliverable is extensive and encompasses a thorough examination of pilot studies conducted across various phases and multiple countries within the RAYUELA project. The primary focus of this deliverable is to provide an in-depth analysis of the continuous monitoring and supervision efforts undertaken during these pilot studies. The overarching goal is to assess the effectiveness and impact of the RAYUELA solutions, with specific emphasis placed on the serious game component. This comprehensive report outlines the conclusions and achievements derived from the evaluations, encompassing various aspects of the pilot studies. It delves into areas such as data recorded, usability, user experience (UX), and the knowledge perception of the stakeholders involved.

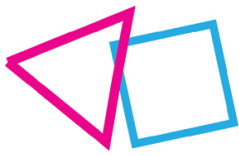


## 1.3 Scope and Objectives

This deliverable is linked to the multifaceted framework of the RAYUELA project, which revolves around the immersive utilization of game-based storylines to actively engage students in activities centered on cybercrimes. This deliverable seeks to provide a comprehensive analysis and assessment of the pilot studies undertaken within the project's trajectory.

An integral facet of this deliverable's scope involves the culmination of the pilot studies conducted across various phases and multiple countries, serving as a testament to the widespread applicability and significance of the RAYUELA project. It further extends its purview to investigate the implications of specific cybercrime storylines, including Online Grooming (OG), Human Trafficking (HT), Cyberbullying (CB), Cyberhate, Fake News, and Technological Vulnerabilities and Threats associated with connected devices.

With this breadth of exploration, the deliverable ultimately aims to distill valuable insights from the evaluations conducted across the pilot studies, resulting in a comprehensive understanding of the RAYUELA project's effects, strengths, and areas for improvement. The detailed structure of this report is outlined in its three main sections, each revealing different parts of the pilot studies and evaluations, all adding to the main goals of the RAYUELA project.



## 2. Methodology

### 2.1 Overview of the Pilot Study Design

The RAYUELA project successfully executed a comprehensive pilot study approach to test its serious game in supervised environments, with support from partner networks such as EA, UCLL, COMILLAS, and additional collaboration from LEAs. This testing strategy involved creating supervised testing groups and conducting educational workshops in schools and other educational centers. The pilot studies aimed to assess the effectiveness and impact of the RAYUELA solutions, with a particular focus on the serious game component. The pilot studies consisted of two applications of the serious game:

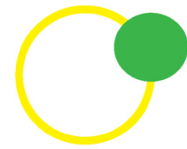
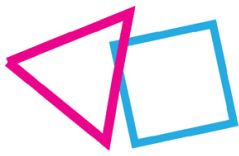
- **First Application:** This phase included describing the profile of minors and their acceptance of risks while using the Internet. It also explored the main motivators that minors seek when online.
- **Second Application:** In this phase, the effectiveness of feedback provided for cybercrime prevention was analyzed. Minors replayed the game after their initial playthrough, allowing RAYUELA to assess changes in decision-making and create individualized internet behavior profiles.

These supervised testing groups enabled close interaction with participants and helped measure the impact of the game's interventions. By comparing decision-making processes between the two game iterations, RAYUELA gauged the effectiveness of its approach in reducing risks. To broaden the scope of the pilot studies, RAYUELA leveraged online platforms and events for wider user engagement:

- **Open App Markets:** The serious game was made freely available through Android markets, enhancing accessibility. Social media integration, including platforms like Facebook, YouTube, Twitter, and Instagram, was also utilized to expand user reach.
- **Ad Hoc Data Tracking Campaigns:** Key events with high user traffic, such as influencer streams and cybersecurity workshops, were leveraged to involve a broader user base. ALLDIGITAL's efforts involved member organizations in testing the game during their ALLDIGITAL Week event.
- **Synergies with Other Projects:** Collaborations with ongoing research projects provided access to larger user groups for comparison and context, enriching the research outcomes.

RAYUELA's recruitment strategy followed a five-step approach, involving activities that ranged from informing and involving school communities and young audiences about the project's goals to empowering them to contribute actively to the game's development. The recruitment process included stages of awareness building, generating interest, motivating contribution, co-creation, and recognition. RAYUELA emphasized continuous user engagement and feedback to maintain high activity levels. Various tactics, such as feedback mechanisms, rewards, recognition, and forums, were employed to encourage sustained participation. The recruitment framework ensured active involvement of potential users at different levels, contributing to the development of a strong user community. The pilot study design integrated both supervised testing and online engagement strategies, ensuring comprehensive evaluation and impactful user involvement.





## 2.2 Data Collection Methods

The data collection methods employed in the RAYUELA project were carefully designed to capture a comprehensive understanding of the psychological and sociological processes underlying cybercrime-related behaviors. Recognizing the complexity of interpreting experimental data and the potential need for multilevel analysis, the project embraced advanced methodologies to ensure robust and meaningful insights. In this section, we outline the key approaches utilized for data collection and analysis.

The data collection methods employed for the pilot study validations encompassed two distinct phases. Each phase was carefully designed and executed to gather valuable insights into the usability and effectiveness of the RAYUELA serious game among young participants. The following sections detail the procedures followed during each phase of validations.

### 2.2.1 First Phase of Validations

During the first phase of validations, workshops were conducted in Belgium (UCLL school), Greece (EA school), and France (Council for Digital Good Europe event). The workshops utilized the initial prototype of the RAYUELA serious game, as outlined in [D3.4] and [D3.7]. An enhanced version of the usability questionnaire, detailed in section 4.1, was employed for data collection.

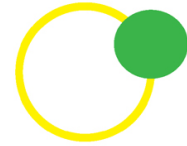
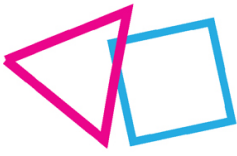
The protocol for the workshops involved the following steps:

- The workshops were conducted in rooms equipped with PCs, as the game was available only for PC at that time. The game was distributed via a link or pen-drive and installed on each computer.
- Participants logged into the game using the credentials: user - rayuela; password - rayuela.
- Translated usability questionnaires, based on [D5.1], were administered to participants in their respective languages.
- Participants played the RAYUELA game, completed the usability questionnaire, and engaged in brainstorming sessions to provide additional feedback.
- Consent forms were filled out by each participant.

### 2.2.2 Second Phase of Validations

The second phase of validations occurred in Spain. The main modification in this phase was the integration of the first prototype of the RAYUELA serious game with the backend, enabling data storage and the registration procedure. The protocol for this phase included the following steps:

- Participants accessed the RAYUELA registration page (<http://rayuelagame.com>) to obtain usernames and passwords for game access.
- Registered participants used the provided credentials to access the game.
- Usability questionnaires, translated into respective languages, were administered to participants.



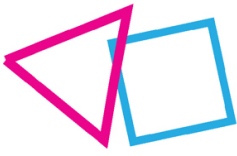
- Participants played the RAYUELA game, completed the usability questionnaire, and engaged in brainstorming sessions for additional feedback.
- Consent forms were filled out by each participant.
- As a contingency plan, participants could also use the protocol from the first phase if internet connection or backend issues arose, enabling offline gameplay.

### 2.2.3 Methodology for Questionnaire Analysis

The feedback collected from the workshops was meticulously analyzed to generate plots categorizing responses based on demographic features. Plots were used to depict the proportion of agreement for each question within specific demographic segments. The X-axis of the plots represented the level of agreement per question, ranging from “1- I strongly disagree” to “5- I strongly agree.” Positive and negative scale statements were used to facilitate analysis. Demographic segments, such as Gender and Age, were considered, although variations in participation were noted. Notably, specific segments showed higher or lower instances, impacting the representation of responses. The analysis involved a comprehensive visual exploration of each question, with accompanying descriptions to interpret the outcomes of the usability questionnaires. In summary, the data collection methods employed during the pilot study validations provided a robust foundation for understanding user interactions, perceptions, and feedback concerning the RAYUELA serious game. These methods facilitated a comprehensive evaluation of the game's usability and effectiveness, contributing valuable insights to the project's overall objectives.

To address the inherent variability and noise present in the collected data, RAYUELA employed Bayesian analysis tools. These tools effectively handled the complex and heterogeneous nature of the data, enabling accurate interpretation without compromising the analysis. By incorporating Bayesian techniques, the project ensured that data noise did not impede the extraction of valuable insights, fostering a more accurate representation of psychological and sociological processes. The project recognized the vast amount of information generated by the analysis of social interactions. To distill this information into meaningful descriptors, RAYUELA leveraged complex network analysis. By examining the intricate web of social interactions, the project could summarize large volumes of data into concise and informative patterns. This approach enabled the project to capture essential behavioral dynamics and trends, contributing to a comprehensive understanding of cybercrime-related behaviors. RAYUELA proactively addressed potential limitations in data volume by employing generative models for data augmentation. By expanding the dataset size through generative techniques, the project enhanced its ability to conduct in-depth investigations. Specifically, the project employed generative models to accomplish two key objectives:

- **Building Victim and Offender Profiles:** Generative models were utilized to construct victim and offender profiles. The identification of relevant patterns, such as tendencies towards online disinhibition effects or radicalization, and vulnerabilities to cyber abuse, was achieved through this approach.
- **Uncovering Insights on Online Victimization and Criminalization:** The use of generative models yielded actionable findings regarding online victimization and criminalization of minors. The project explored the impact of various factors, including geography, culture, politics, social dynamics, sex, gender, age, and economic status. By synthesizing and analyzing these factors, RAYUELA gained valuable insights into the complex landscape of cybercrime.



By integrating Bayesian analysis tools, complex network analysis, and generative models, RAYUELA achieved a holistic understanding of the intricate nuances underlying online behaviors related to cybercrime. These advanced methodologies enabled the project to navigate challenges posed by data variability, noise, and volume, resulting in actionable insights that inform the project's objectives and contribute to the broader landscape of cybersecurity and technological research.

## 2.3 Participants and Stakeholders

The successful execution of the RAYUELA project's pilot studies necessitated active engagement with a diverse range of participants and stakeholders, each contributing to the project's overarching objectives. The RAYUELA project engaged a diverse range of participants and stakeholders, encompassing a broad spectrum of expertise, influence, and engagement levels. The project's concerted efforts reached out to distinct audiences, each contributing to the project's overarching goals and objectives.

Here, we present an overview of the participants and stakeholders involved in RAYUELA:

### **LEAs and Other Security Bodies**

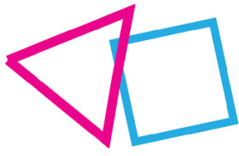
RAYUELA established direct communication channels with Law Enforcement Agencies (LEAs) and other security bodies, disseminating project information through the RAYUELA website, newsletters, capacity-building materials, social media, and factsheets. The project facilitated the familiarization of LEAs with RAYUELA concepts, offering resources to enhance skill acquisition and the understanding of implications and benefits associated with the solutions developed within the project. Furthermore, specialized journals and conferences about security served as platforms to disseminate RAYUELA insights. The engagement with LEAs aimed to provide updated information on cybercrime, including barriers and limits of their work and related public policies, contributing to a collective effort in the fight against cybercrime.

### **Policy Makers and Regulatory Bodies at National and EU Levels**

RAYUELA strategically engaged with policy makers and regulatory bodies through a multi-faceted approach. The project utilized its website, newsletters, and social media platforms to disseminate project updates and relevant information. Additionally, policy workshops were organized in Brussels, creating opportunities for direct interaction and knowledge exchange. Specialized communication channels, such as the EU Community, facilitated direct invitations to policy workshops in the EU context. RAYUELA aimed to inform policy makers and regulatory bodies about the project's objectives, methodologies, and outcomes, fostering an informed dialogue and potential policy implications.

### **RAYUELA's Supervised Testing Groups**

The project established direct communication with its supervised testing groups, primarily centered around educational centres including schools, universities, educational networks, and research centres. Through formal and informal interactions, RAYUELA engaged with these testing groups, ensuring their active involvement and first-hand interaction. This engagement aimed to secure the acceptance of RAYUELA's solutions and to demonstrate the expected impacts on behavior and attitudes, as outlined in section 2.1.



### **Children and Young Adults**

RAYUELA extended its outreach to children and young adults, leveraging its website, newsletters, and social media platforms to disseminate engaging content. The project sought to inform and educate these audiences about cybercrime-related behaviors, facilitating changes in behavior, and gauging the impact of such initiatives. Youth organizations and parents' associations played a crucial role in reaching and engaging children and young adults, enabling the collection of valuable data on behavior change, impact assessment, attitudes, and perceptions towards cybercrime.

### **Family Environment and Friends**

RAYUELA's engagement with the family environment and friends was carried out through a variety of channels, including the project's website, newsletters, capacity-building materials, social media, and factsheets. Educational institutions and ministries also contributed to this engagement, providing platforms for disseminating information and tools for familiarization and recognition. By involving family members and friends, RAYUELA aimed to capture insights into behavior changes, impacts of cybercrime, reactions, values, attitudes, and perceptions among this crucial demographic.

### **Teachers and Educational Environment**

The project engaged with teachers and the broader educational environment through its website, newsletters, capacity-building materials, social media, and factsheets. RAYUELA aimed to equip teachers with knowledge and resources related to privacy, ethics, and social innovation, fostering their engagement and expertise. The project established a feedback loop with educators, facilitating potential future cooperation at national, EU, and international levels, while also expanding the capacity-building and organizational structure.

### **Privacy, Ethics, and Social Innovation Experts**

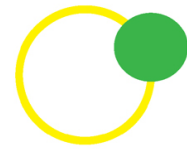
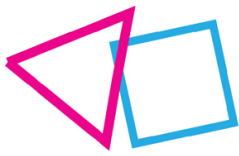
RAYUELA engaged with experts in privacy, ethics, and social innovation, utilizing various communication channels including the project's website, newsletters, capacity-building materials, social media, and factsheets. The project valued professional feedback and sought potential future collaboration in the realm of cybersecurity and cybercrime, both at national/EU and international levels.

### **Game Developers, Gamification, AI, and Data Modelling Experts**

Experts in game development, gamification, AI, and data modelling were engaged through diverse channels including the project's website, newsletters, capacity-building materials, social media, factsheets, internal networks, and professional events such as specialized journals and conferences.

### **Anthropology, Criminology, Psychology, and Sociology Experts**

RAYUELA extended its engagement to experts in anthropology, criminology, psychology, and sociology through a dedicated section on its website. The project utilized newsletters, capacity-building materials, social media, videos, and participation in specialized events to promote collaboration and knowledge sharing. By involving experts from diverse disciplines, RAYUELA enriched its understanding of cybercrime-related behaviors, contributing to a comprehensive and multidisciplinary approach.



## 2.4 Ethical Considerations

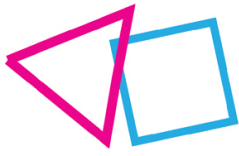
In this sector we present the ethical considerations for creating and piloting the RAYUELA game, particularly focusing on research involving school students. The key principles are as follows:

- **Respect:** RAYUELA Researchers respected the dignity, autonomy, and privacy of the participating students.
- **Honesty:** RAYUELA Researchers were transparent, honest, and unbiased in their interactions with the participating students. They ensured clarity in communication and upheld promises made during the research process.
- **Beneficence and Non-maleficence:** RAYUELA Researchers prioritized the well-being of the participating students, avoided harm, and minimized potential negative effects. They considered participants' stress and unease, and maintained the confidentiality of their personal choices within the game.
- **Justice:** Fair treatment of research subjects and equitable distribution of benefits and risks were essential. RAYUELA Researchers treated all participants equally and avoided biases based on characteristics like gender, ethnicity, or social background.
- **Responsibility:** RAYUELA Researchers were accountable for their work and upheld professional standards. They ensured that facilitators and mediators of the game testing were aware of ethical issues.
- **Integrity:** RAYUELA Researchers adhered to research integrity, followed rules and regulations, maintained proper research design, and promoted accuracy and truthfulness.

These principles have been applied in different aspects of the research process, including the creation of the game, working with adolescents, privacy and personal data protection, and using and disseminating research results.

We have addressed issues such as informed consent, data collection and storage, potential harms, recruitment, dealing with incidental findings, and ensuring safe usage of digital devices during the piloting process.

Our emphasis was on balancing research goals with the protection and well-being of the participating students, as well as the responsible and ethical use of research results.



## 3. RAYUELA Pilot Studies

The RAYUELA Project has heralded a new era of cybersecurity education, harnessing the potential of Serious 3D Gaming to empower students and reshape their understanding of online behavior and cyber criminality. This report details the remarkable journey through the pilot phases, highlighting the accomplishments of the project and its profound impact on European students aged 11 to 18.

### 3.1 Phase 1 – Initial Prototype

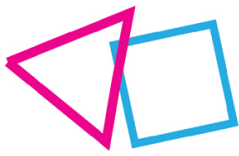
Phase 1: Prototype Usability and User Engagement (May 2022 - July 2022)

The journey commenced with the initial pilot phase, where an enthusiastic response from students surpassed expectations. Although the target participation was set at 60 students, a total of 125 eager learners from Greece, Spain, and Belgium engaged with the initial prototype of the Serious 3D Game. This phase focused on usability evaluation and gathering user feedback. Participants' insights through the Usability Questionnaire and dynamic focus groups played a pivotal role in refining the game's interface and aesthetics. This phase laid a strong foundation for subsequent developments, driven by the constructive insights of the engaged students.

### 3.2 Phase 2 – Enhanced Game

Phase 2: Enhanced Gameplay and Enriched Experiences (November 2022 - March 2023)

Building upon the successes of Phase 1, Phase 2 aimed to elevate user experiences and expand the game's horizons. The target participation of 450 students was exceeded with an impressive engagement of 719 students aged 11 to 16 from Greece, Spain, and Belgium. This phase delved deeper into refining gameplay mechanics and enriching the cybercrime scenarios. Facilitators' feedback and interactive discussions with students became instrumental in shaping the game's content. The enhanced engagement and invaluable insights paved the way for a more immersive and impactful learning experience.



### 3.3 Phase 3 – Final Product

Phase 3: Comprehensive Validation and Educational Enrichment (April 2023 - July 2023)

The final pilot phase marked the culmination of the project's ambitious goals, expanding its reach to include students from Italy, Serbia, Czechia, Hungary, Croatia, and Portugal. The initial target of 500 students was surpassed as a remarkable 1297 students actively participated. This phase encompassed comprehensive validation, focusing not only on usability but also on cognitive and affective aspects. The Serious 3D Game's educational value underwent rigorous evaluation, demonstrating its efficacy in enhancing students' cybersecurity knowledge, decision-making capabilities, and overall learning journey. Active involvement of students, along with facilitated discussions and feedback loops, contributed to refining the game's effectiveness.

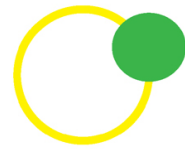
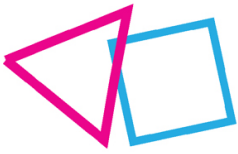
### 3.4 Conclusions from all Pilot Phases and Places

The RAYUELA Project's triumphant journey has left an indelible mark on European students aged 11 to 18. The engagement of 2141 students across the three phases, from diverse countries, reflects a resounding success, far surpassing initial targets. Through the immersive and interactive Serious 3D Game, students have gained a profound understanding of cyber criminality and the intricate nuances of online behavior. The project's innovative approach has transformed learning into an engaging adventure, equipping students with practical skills and knowledge to navigate the digital landscape with confidence and ethical responsibility. **Table 1** presents the achieved participation per phase and per country.

Table 1: Pilot Phase Achievements per Phase

	Rayuela Project Partner Countries									TOTAL
	Greece	Spain	Belgium	Estonia	UK					
Pilot Phase 1 - Target	10	40	10							60
Pilot Phase 1 - Achieved	12	102	11							125
Pilot Phase 2 - Target	150	150	150							450
Pilot Phase 2 - Achieved	262	245	212							719
Pilot Phase 3 - Target	100	100	100	100	100					500
Pilot Phase 3 - Achieved	173	292	250	100	51					866
All Digital & Other European Countries (Pilot Phase 3)	Italy	Serbia	Chezia	Hungary	Croatia	Portugal	Spain	Belgium	Total	
	75	48	75	48	32	106	30	17	431	
Overall Target										1010
Overall Achieved										2141





### 3.5 Photos from various pilots

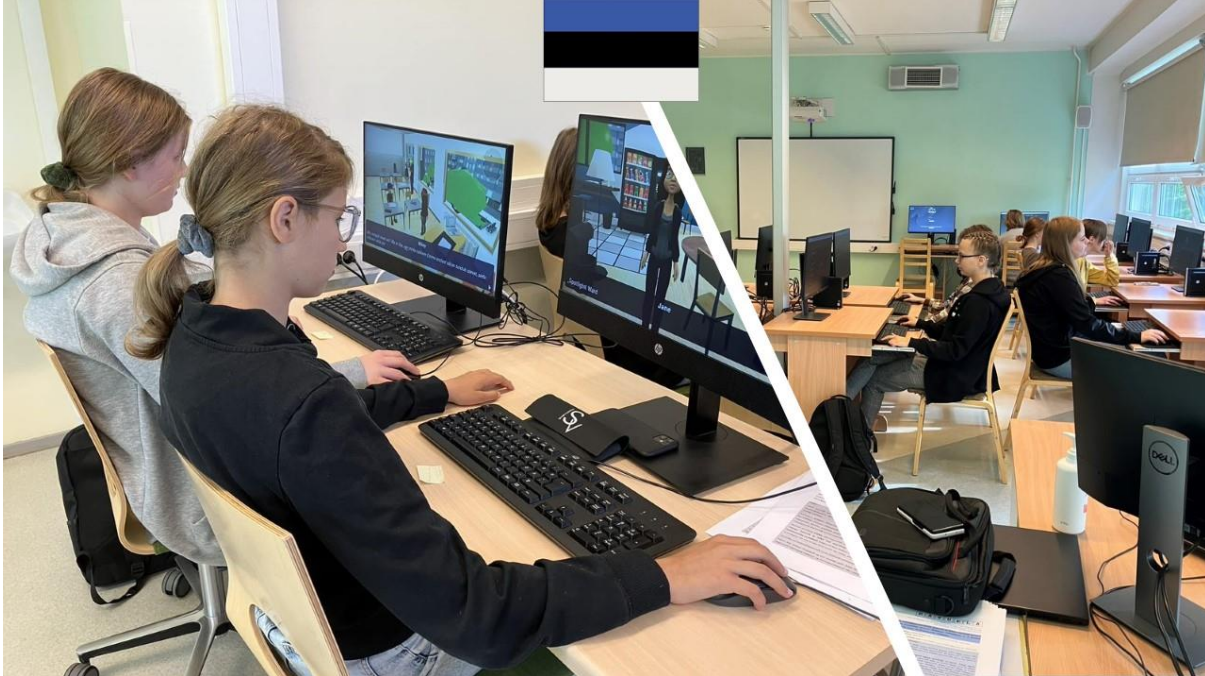
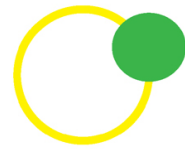
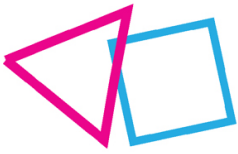


Figure 1: Implementation in Estonia



Figure 2: Implementation in Spain

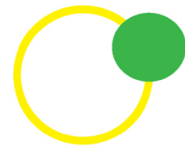
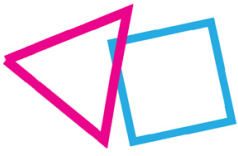




*Figure 3: Implementation in Belgium*



*Figure 4: Implementation in Croatia*



D5.5 Pilot Studies Monitoring and Evaluation Results



Figure 5: Implementation in Italy

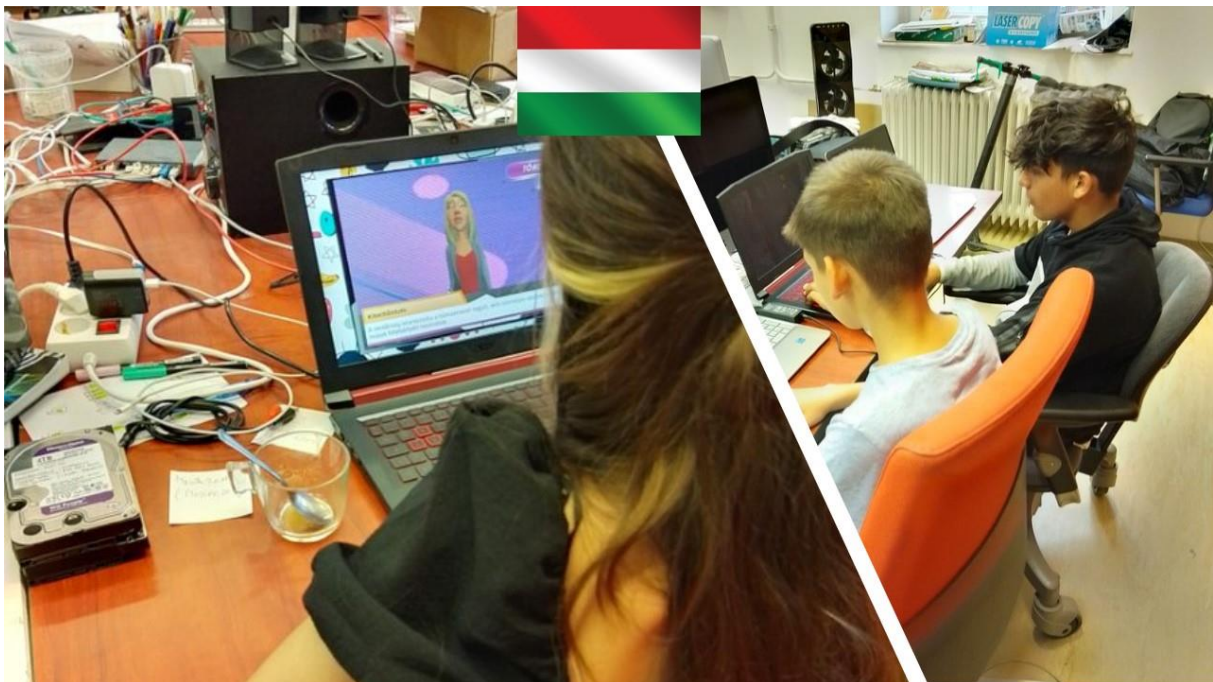
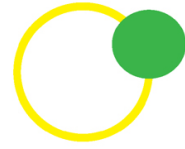
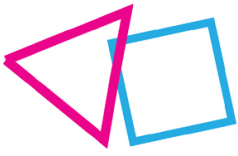


Figure 6: Implementation in Hungary

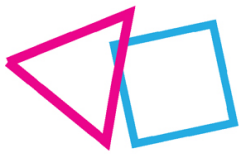




D5.5 Pilot Studies Monitoring and Evaluation Results



Figure 7: Implementation in Greece



## 4. Perception of RAYUELA Stakeholders

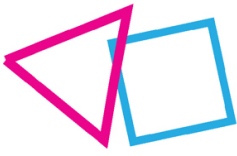
The successful realization of the RAYUELA project was made possible through active collaboration with a diverse array of stakeholders, each contributing unique perspectives and expertise. By embracing these varied perceptions and insights, RAYUELA's comprehensive engagement with stakeholders enriched its research, game development, and policy recommendations. This section highlights the perception and contributions of key stakeholders to RAYUELA's overarching objectives and anticipated impact.

### 4.1 Law Enforcement Agencies (LEAs) and Other Security Bodies

RAYUELA established direct communication channels with LEAs and other security bodies, facilitating their participation and collaboration throughout the project's stages. LEAs played a pivotal role in shaping the research framework by offering insights into critical topics related to cybercrime. Their involvement extended to identifying online grooming, cyberbullying, and human trafficking trends, sharing expertise and experiences from case studies and prior sentences and assisting in the interpretation of pilot study data. The engagement aimed to enhance LEAs' understanding of cybercrime drivers and implications, promoting a collective effort to combat cybercrime effectively. Law Enforcement Agencies (LEAs) and security bodies recognized the urgency of addressing cybercrime involving minors. They perceived RAYUELA as a collaborative platform to contribute their on-ground experiences, facilitating a deeper understanding of critical cybercrime topics such as online grooming, cyberbullying, and human trafficking. LEAs acknowledged the potential of RAYUELA's research framework to improve their efforts in cybercrime prevention and law enforcement. Their perception emphasized the need to forge stronger ties between LEAs and other stakeholders, fostering cross-border cooperation and enhanced policing strategies to combat the evolving landscape of cyber threats.

### 4.2 Policy Makers and Regulatory Bodies at National and EU Levels

RAYUELA strategically engaged with policy makers and regulatory bodies to foster an informed dialogue about the project's objectives, methodologies, and outcomes. Through targeted communication via the project's website, newsletters, and policy workshops, RAYUELA aimed to contribute to the formulation of effective tools, directives, and policies to address cybercrime among the EU youth. The direct interaction between RAYUELA and policy makers promoted awareness and understanding, potentially influencing policy implications. Policy makers and regulatory bodies viewed RAYUELA as an innovative initiative that could bridge the gap between research and policy formulation. They perceived the project's engagement as an opportunity to receive evidence-based insights directly from experts and data, enabling them to design more effective directives and policies to protect children and young adults from cybercrime. RAYUELA's focus on awareness and prevention resonated with policy makers, as it aligned with their efforts to address emerging challenges in the digital realm.



### 4.3 RAYUELA's Supervised Testing Groups

Engagement with supervised testing groups, primarily educational centers, enabled RAYUELA to secure active participation and first-hand interaction. By involving schools, universities, educational networks, and research centers, RAYUELA's serious game was tested in a controlled environment, yielding valuable insights into cybercrime-related behaviors and impact assessments. The engagement emphasized the role of education in fostering behavior change and informed decision-making among children and young adults. Participants from educational centers, including schools, universities, and research centers, embraced RAYUELA's engagement as a chance to empower the youth to navigate the digital landscape safely.

They saw the serious game as an innovative tool to educate and equip children and young adults with the skills to recognize and respond to cyber threats. Teachers perceived RAYUELA as a complementary resource to traditional education, promoting interactive and experiential learning on cybercrime-related behaviors. The engagement highlighted the importance of fostering digital literacy from an early age and leveraging educational institutions as critical hubs for cultivating awareness and resilience.

### 4.4 Children and Young Adults

RAYUELA extended its outreach to children and young adults, leveraging digital platforms to disseminate informative and engaging content. The project aimed to enhance awareness of cybercrime-related behaviors, encourage responsible online behavior, and gather data on behavioral changes and attitudes. By partnering with youth organizations and parents' associations, RAYUELA collected valuable information on perceptions and reactions to cybercrime. Children and young adults welcomed RAYUELA's efforts to engage them directly through engaging digital content.

They appreciated the interactive nature of the serious game, which allowed them to explore real-life scenarios and make decisions in a safe virtual environment. Participants perceived RAYUELA as a valuable tool that not only educated them about potential cyber threats but also empowered them to make informed choices while interacting online. The project's focus on involving youth organizations and parents' associations reinforced the importance of a collaborative approach to raising awareness and promoting responsible digital citizenship.

### 4.5 Family Environment and Friends

RAYUELA's engagement with the family environment and friends sought to capture insights into behavior changes, attitudes, and perceptions related to cybercrime. Through various communication channels, including the project's website and social media, RAYUELA involved family members and friends in the project's efforts to raise awareness and promote safe online behaviors. Family members and friends recognized RAYUELA's engagement as an opportunity to bridge generational gaps in understanding cyber risks. They appreciated the project's emphasis on involving families in discussions



about cybercrime and its impact on children and young adults. Parents and guardians perceived RAYUELA as a valuable resource for initiating conversations about online safety and fostering open dialogues with their children. The project's outreach through various communication channels provided families with accessible and relevant information, reinforcing their role as key stakeholders in creating a secure online environment.

#### 4.6 Teachers and Educational Environment

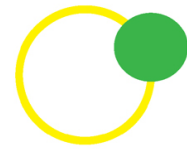
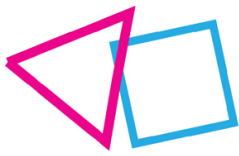
Engagement with teachers and the broader educational environment aimed to equip educators with knowledge and resources related to privacy, ethics, and social innovation. RAYUELA's engagement contributed to enhancing the capacity of teachers to address cybercrime-related topics in educational settings and fostered potential future cooperation at national, EU, and international levels. Teachers and educators valued RAYUELA's engagement as a means to enhance their capacity to address cybercrime-related topics in the classroom. They saw the project as an avenue to integrate real-world scenarios into their teaching approaches, making learning more engaging and relevant to students. Educators perceived RAYUELA's resources as valuable additions to their toolkit, providing them with the knowledge and materials to facilitate meaningful discussions on digital ethics, privacy, and cybersecurity. The project's collaboration with educational institutions highlighted the pivotal role of teachers in shaping responsible digital behaviors among the youth.

#### 4.7 Privacy, Ethics, and Social Innovation Experts

RAYUELA engaged experts in privacy, ethics, and social innovation to provide invaluable insights into legal and ethical considerations surrounding the project's activities. Their expertise guided the project's compliance with GDPR and relevant national data protection legislation, ensuring the responsible handling of data. Privacy, ethics, and social innovation experts commended RAYUELA's commitment to responsible data handling and compliance with legal frameworks. They perceived the project's engagement as an opportunity to ensure that cybersecurity efforts align with ethical principles and respect individuals' rights to privacy. These experts saw RAYUELA as a promising example of how technology can be harnessed to address social challenges while upholding fundamental ethical standards. Their involvement underscored the importance of a multidisciplinary approach in shaping cybersecurity measures that are both effective and ethically sound.

#### 4.8 Game Developers, Gamification, AI, and Data Modeling Experts

Experts in game development, gamification, AI, and data modeling were instrumental in translating RAYUELA's research findings into an engaging serious game. Their contributions facilitated the design and development of a dynamic gaming environment that captured behavioral patterns and enabled the identification of profiles for cybercrime victims and offenders. Experts in game development, gamification, AI, and data modeling recognized RAYUELA's serious game as a novel and engaging approach to collecting insights into online behaviors.



They perceived the game's interactive nature as a powerful tool for capturing behavioral patterns and motivations, enabling a deeper understanding of cybercrime dynamics.

These experts saw RAYUELA's collaboration with technology specialists as a successful fusion of research and innovation, demonstrating the potential of gamified platforms to drive meaningful change in behavior and attitudes related to cybersecurity.

#### 4.9 Anthropology, Criminology, Psychology, and Sociology Experts

RAYUELA extended its engagement to experts in anthropology, criminology, psychology, and sociology, enriching the project's understanding of cybercrime-related behaviors. Collaborative efforts among these experts contributed to a multidisciplinary approach that examined socio-demographic variables, personality traits, and social indicators influencing victimization and criminalization.

Experts from anthropology, criminology, psychology, and sociology acknowledged RAYUELA's multidisciplinary approach as a step forward in comprehending the intricate interplay of social, psychological, and demographic factors in cybercrime. They perceived the project's engagement as an opportunity to bridge gaps in knowledge by exploring the motivations behind victimization and criminalization. The collaboration with these experts enriched the understanding of cybercrime as a complex social phenomenon, shedding light on underlying causes and suggesting holistic strategies for prevention and intervention.

#### 4.10 RAYUELA's International Advisory Board

The project established an International Advisory Board (IAB) comprising public administrations, civil associations, and educational institutions committed to fighting cybercrime among EU youth. The IAB provided essential guidance, external support, and expertise to maximize the impact, visibility, and adoption of RAYUELA's results. The holistic engagement with these diverse stakeholders reflects RAYUELA's commitment to comprehensive research, innovative game development, and impactful policy recommendations. By fostering collaboration and understanding across various sectors, RAYUELA contributes to creating a safer digital environment for children and young adults, addressing the complex challenges posed by cybercrime. Through this collaborative approach, RAYUELA's impact resonates at both EU and international levels, underscoring its significance in combatting cybercrime and promoting digital security among vulnerable populations.

Members of the International Advisory Board (IAB) saw RAYUELA as a pivotal initiative that could contribute to shaping international efforts against cybercrime. They perceived the project's engagement as a means to leverage diverse expertise and collaborate across borders to tackle shared challenges. The IAB members recognized RAYUELA's potential to drive positive change through research, awareness, and policy recommendations. Their involvement demonstrated a collective commitment to fostering a safer digital environment for children and young adults, highlighting the project's significance in a global context.



## 5. Conclusions

This synopsis encapsulates the key findings, accomplishments, and future recommendations of the RAYUELA Project, focusing on its profound impact on European students aged 11 to 16. The RAYUELA Project's pilot phases witnessed an overwhelming response from students. In Phase 1, the initial target of 60 students was surpassed as 125 students enthusiastically engaged with the initial prototype. Phase 2, scheduled from November 2022 to March 2023, exceeded its target of 450 participants with 719 students actively participating. In Phase 3, from April 2023 to July 2023, the project expanded its reach to encompass students from Italy, Serbia, Czechia, Hungary, Croatia, and Portugal, surpassing the initial target of 500 with 1297 students actively engaging. This resounding success showcases the project's appeal and effectiveness. The iterative approach of the project allowed for the continuous refinement of the Serious 3D Game. The engagement of facilitators and students in discussions and feedback loops contributed significantly to enhancing gameplay mechanics and enriching cybercrime scenarios. As a result, students experienced a more immersive and impactful learning journey, fostering a deeper understanding of cybersecurity. The project's final pilot phase included comprehensive validation, encompassing usability, cognitive, and affective aspects. The Serious 3D Game proved highly effective in enhancing students' cybersecurity knowledge and decision-making capabilities. The active involvement of students, along with facilitated discussions and feedback loops, played a pivotal role in refining the game's educational value.

The RAYUELA Project has not only achieved its goals but has exceeded expectations in multiple dimensions. European students aged 11 to 16 have emerged from this project as informed, responsible, and empowered digital citizens. They have gained a profound understanding of cybercriminality and the complexities of online behavior. Furthermore, they have acquired practical skills and knowledge to navigate the digital landscape with confidence and ethical responsibility. The project's collaborative and participatory approach has empowered students as active contributors and co-creators of their educational experiences. Beyond cybersecurity, it has fostered an interest in technological research and innovation, laying the foundation for a future generation of digital leaders.

The impact of the RAYUELA Project extends far beyond individual students. The valuable insights gained from the pilot phases will inform the development of effective cybersecurity policies and measures, benefiting law enforcement agencies, public administrations, and EU citizens. This project has set a precedent for innovative education, transforming learning into an engaging adventure. The RAYUELA Project stands as a shining example of how innovative educational approaches can shape the future of cybersecurity education. As for the future, it could be interesting expanding the study to include more European countries, ensuring a more comprehensive understanding of the impact on students from diverse cultural backgrounds. Collaboration with educational authorities and institutions can facilitate the seamless adoption of this innovative approach, ensuring its sustainability and scalability.