

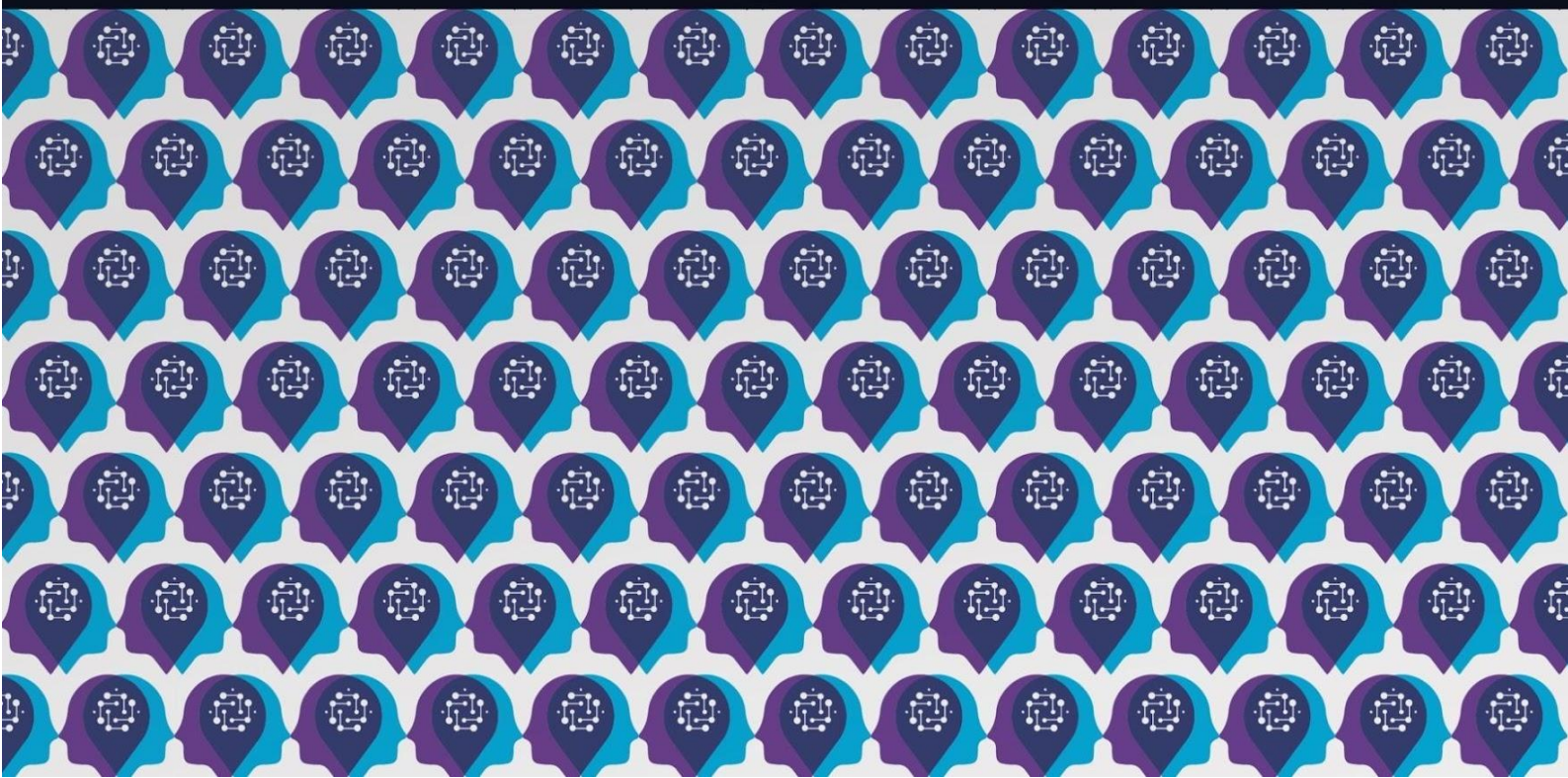


AI4Debunk

D10.5 REPORT ON THE DEFINITION OF THE
AR/VR ENVIRONMENTS APPLICATIONS
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Authors	Dr. Despina Elisabeth Filippidou (DOTSOFT), Karanasios George (DOTSOFT), Stavros Katsaridis (DOTSOFT), Katsakioris Dimitris (DOTSOFT), Nikas Marios (DOTSOFT), Simeonidou Anastasia (DOTSOFT), Nikopoulos George (DOTSOFT), Maragkos Christodoulos (DOTSOFT)
Contributors	
Reviewers	Georgi Gotev, Kalina Angelova (EUalive)
Abstract	This deliverable specifies TruthSpace, AI4Debunk’s flagship VR serious game, designed to strengthen citizens’ resilience to online disinformation through immersive training. Users collaborate with the in-game AI assistant NUTRU inside a Klein-Bottle-inspired virtual world that visualises algorithmic “information loops” and overload, progressively transforming into a calm “TruthSpace” as skills are applied. The experience operationalises five core critical-thinking strategies (source evaluation, emotional manipulation recognition, fallacy/tactic detection, conspiracy framework awareness, and reflective thinking) each embodied through dedicated levels and mini-games.
Keywords	AI4Debunk; TruthSpace; Virtual Reality (VR); Augmented Reality (AR); Serious Game; Disinformation; Media Literacy; Critical Thinking; AI Assistant (NUTRU); Klein Bottle; Unity; Usability Evaluation (SUS)

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STATEMENT ON MAINSTREAMING GENDER

The AI4Debunk consortium is committed to including gender and intersectionality as a transversal aspect in the project's activities. In line with EU guidelines and objectives, all partners – including the authors of this deliverable – recognise the importance of advancing gender analysis and sex-disaggregated data collection in the development of scientific research. Therefore, we commit to paying particular attention to including, monitoring, and periodically evaluating the participation of different genders in all activities developed within the project, including workshops, webinars and events but also surveys, interviews and research, in general. While applying a non-binary approach to data collection and promoting the participation of all genders in the activities, the partners will periodically reflect and inform about the limitations of their approach. Through an iterative learning process, they commit to plan and implement strategies that maximise the inclusion of more and more intersectional perspectives in their activities.

DISCLAIMER

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The AI4Debunk consortium is the following:

Participant number	Participant organisation name	Short name	Country
1	LATVIJAS UNIVERSITATE	UL	LV
2	FREE MEDIA BULGARIA	EURACTIV	BE
3	PILOT4DEV	P4D	BE
4	INTERNEWS UKRAINE	IUA	UA
5	CONSIGLIO NAZIONALE DELLE RICERCHE	CNR-IRPPS	IT
6	UNIVERSITA DEGLI STUDI DI FIRENZE	MICC/UNIFI	IT
6.1	CONSORZIO NAZIONALE INTERUNIVERSITARIO PER LE TELECOMUNICAZIONI	CNIT	IT
7	BARCELONA SUPERCOMPUTING CENTER CENTRO NACIONAL DE SUPERCOMPUTACION	BSC	ES
8	DOTSOFT OLOKLIROMENES EFARMOGES DIADIKTIOY KAI VASEON DEDOMENON AE	DOTSOFT	EL
9	UNIVERSITE DE MONS	UMONS	BE
10	NATIONAL UNIVERSITY OF IRELAND GALWAY	NUIG	IE
11	STICHTING HOGESCHOOL UTRECHT	HU	NL
12	STICHTING INNOVATIVE POWER	IP	NL
13	F6S NETWORK IRELAND LIMITED	F6S	IE

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ABBREVIATIONS

WP	Work Package
EC	European Commission
VR	Virtual Reality
AR	Augmented Reality
URL	Uniform Resource Locator
SUS	System Usability Scale
AI	Artificial Intelligence
KPI	Key Performance Indicator
UI/UX	User Interface/User Experience
NGO	Non-Governmental Organisation

EXECUTIVE SUMMARY

This deliverable defines the project’s VR environments applications with a specific focus on TruthSpace, AI4Debunk’s flagship standalone VR serious game for strengthening citizens’ resilience to online disinformation. Building on the wider AI4Debunk ecosystem (and complementing the separate work specified in D10.3), TruthSpace is designed for contemporary VR headsets and positions immersive training as a high-impact, user-centred intervention within WP10 (Education, Capacity Building & Awareness).

TruthSpace operationalises media-literacy and critical-thinking training through a distinctive world metaphor: a Klein-Bottle-inspired virtual environment that visualises the “looping” and self-reinforcing dynamics of algorithmically curated information feeds. Users begin inside an intentionally noisy and overloaded information space, dense with overlapping headlines, posts, and multimedia fragments, and progressively transform it into a calm, elevated “TruthSpace” above the clouds. This environmental transformation functions simultaneously as narrative progression, motivational feedback, and an embodied representation of how critical engagement can reduce confusion, overload, and susceptibility to manipulation.

At the centre of the experience is NUTRU, an in-game AI assistant that acts as guide, tutor, and reflective partner. Rather than positioning AI as an authority that “decides truth,” NUTRU is specified as a scaffold for user agency: introducing concepts, highlighting patterns, providing just-in-time hints, and prompting users to justify decisions and reconsider initial reactions. This design aligns with AI4Debunk’s broader ambition to combine human reasoning with AI-supported tools in a transparent and autonomy-preserving manner.

Pedagogically, TruthSpace is structured around five core critical-thinking strategies identified as essential for resisting disinformation: (1) source evaluation and credibility assessment, (2) recognition of emotional manipulation, (3) identification of logical fallacies and misinformation tactics, (4) awareness of broader conspiracy frameworks, and (5) reflective thinking (metacognition). Each strategy is embodied as a dedicated level and implemented through concrete VR mechanics and mini-games (e.g., tracing provenance through an “information skein,” sorting emotionally manipulative posts under time pressure, analysing fallacies in debate scenes, navigating a conspiracy “labyrinth,” and entering a “pause room” that rewards slowing down and examining one’s own assumptions). Scenarios are inspired by AI4Debunk case-study domains (including climate change and the war in Ukraine) while remaining fictionalised and de-personalised to support safe engagement, localisation, and cross-country adaptability.

Functionally and technically, the deliverable provides a consolidated specification of the game’s structure, narrative arc, interaction modes, reward system, characters, and environments, with implementation targeted to Unity and common VR interaction paradigms (grabbing, pointing, sorting, teleportation/comfort movement options). Particular emphasis is placed on accessibility and inclusivity: reducing cognitive load over time via environmental “calming,” supporting subtitles and multilingual UI pathways, designing legible and comfortable VR interfaces, and

enabling facilitated use in classrooms, workshops, and public engagement contexts where users may be VR novices.

To ensure the application can be piloted, assessed, and iteratively improved, the deliverable also defines an evaluation framework aligned to TruthSpace’s learning objectives and gameplay structure. It specifies KPIs spanning learning outcomes, behavioural and attitudinal change, in-game performance analytics, engagement and acceptance, and technical robustness. Usability is explicitly addressed through adoption of the System Usability Scale (SUS), including rationale, administration procedure, and interpretation approach, enabling benchmarking across pilots and successive builds.

Overall, this report serves as the design and implementation backbone for TruthSpace within WP10: translating AI4Debunk’s disinformation analysis into a coherent VR learning experience, and providing the shared reference needed by developers, designers, pedagogical experts, and evaluators to deliver a technically feasible, engaging, and measurable intervention. The defined next phase is pilot deployment across relevant user groups (citizens, youth/students, educators, journalists and practitioners), followed by data-driven refinement based on KPI results, usability findings, and facilitator/participant feedback, supporting eventual scalability and integration into broader media-literacy and awareness programmes.

1. INTRODUCTION

The AI4Debunk project develops a suite of tools, methods and learning experiences to strengthen citizens’ resilience against online disinformation, with a particular focus on highly polarised topics such as the war in Ukraine and climate change. Within this broader ecosystem, TruthSpace is conceived as the flagship immersive experience: an all-in-one VR serious game where users collaborate with an AI assistant, NUTRU, to recognise, filter and ultimately “clear” fake news and manipulative content from their information environment.

In parallel, the project’s AR requirement was addressed in Deliverable 10.3 through a dedicated mobile application; therefore, Deliverable 10.5 specifies a separate, standalone VR application (TruthSpace) that requires a VR headset (e.g., Oculus/Meta Quest-class devices).

The application places the user inside a dynamically transforming virtual world inspired by the geometry of a Klein Bottle, an endless loop where “inside” and “outside” collapse into one continuum, mirroring the way information flows in algorithmically curated feeds. In its initial state, this world is noisy, visually overloaded and filled with overlapping news items, social posts and headlines. As the user progresses through successive levels and mini-games, guided by NUTRU, this chaotic space gradually evolves into a calm, elevated environment above the clouds: a metaphor for a more stable, trustworthy digital “TruthSpace” that the user has helped to build.

The design of TruthSpace is grounded in a set of five critical-thinking strategies that have been identified in previous AI4Debunk work packages as key competencies for resisting disinformation: (1) source evaluation and credibility assessment, (2) recognition of emotional manipulation, (3) identification of logical fallacies and misinformation tactics, (4) awareness of broader conspiracy frameworks, and (5) active reflective thinking (metacognition). Each of these strategies is embodied as a dedicated level or scene in the VR environment, from tracing information back to its origin in “Find the Root” to navigating conspiracy-laden labyrinths and reflective “pause” spaces that challenge users to question their own reactions.

This deliverable consolidates the narrative, pedagogical and technical specification of TruthSpace as the main VR serious game developed in AI4Debunk. It serves as a bridge between the theoretical work on disinformation analysis and case studies (e.g. climate change, Ukraine) and their translation into an engaging, game-based learning experience.

1.1 PURPOSE OF THE DELIVERABLE

The primary purpose of this deliverable is to provide a clear and consolidated definition of the VR application that will be implemented and piloted within AI4Debunk, with TruthSpace as the core VR experience. It specifies the conceptual framework, pedagogical goals, narrative structure, character and set design, and technical assumptions that guide implementation.

More concretely, the document aims to:

- Describe the overall vision and gameplay concept of TruthSpace as an all-in-one VR platform that supports work, interaction and training in a misinformation-resilient environment.
- Translate the five critical-thinking strategies identified in earlier AI4Debunk work into concrete in-game mechanics, levels and user interactions.
- Define the structure of the serious game in terms of episodes, scenes and mini-games, including the scripted role of the AI assistant NUTRU and the transformation of the Klein Bottle environment.
- Provide a common reference for designers, developers, pedagogical experts and evaluators, so that subsequent implementation, testing and impact assessment activities are aligned around a shared specification.

By documenting these elements in a structured way, the deliverable ensures that the VR application remains faithful to AI4Debunk’s scientific outputs on disinformation patterns and critical-thinking training, while also being technically feasible and engaging for diverse user groups.

1.2 ALIGNMENT WITH AI4DEBUNK OBJECTIVES

TruthSpace is designed as a direct operationalisation of AI4Debunk’s objectives to analyse disinformation ecosystems, develop AI-supported debunking and detection tools, and foster citizen-level resilience through education and capacity-building.

- From case studies to interactive training. Previous AI4Debunk work has mapped disinformation narratives around topics such as climate change and the war in Ukraine, documenting typical tactics (e.g. exaggerated uncertainty, false analogies, historical revisionism) and emotionally charged framings (e.g. “genocide”, “puppet governments”, “Great Reset”).
- These insights are re-used in TruthSpace as in-game content: news snippets, posts, debate prompts and branching scenarios that expose players to realistic but fictionalised variants of these narratives.
- Embedding critical-thinking strategies. The five strategies are mapped one-to-one to the structure of the game and its levels (Source Evaluation, Emotional Manipulation, Logical Fallacies, Conspiracy Frameworks, Reflective Thinking), as also outlined in the skeleton of this document. This ensures that progression through the VR experience corresponds to progressively more advanced cognitive skills.
- AI-assisted guidance and feedback. NUTRU, the in-game AI assistant, acts as a narrative and didactic mediator that embodies AI4Debunk’s ambition to combine human reasoning

with AI support. NUTRU introduces the environment, explains underlying metaphors (e.g. the Klein Bottle as an information trap) and provides just-in-time hints, feedback and reflection prompts during mini-games.

Through this alignment, the VR application is not an isolated educational game but an integrated output of the project: it leverages analytical findings, supports the project's educational work package, and provides a high-impact demonstrator of AI-supported media literacy training.

1.3 RELATION TO WP10: EDUCATION, CAPACITY BUILDING & AWARENESS

WP10 focuses on translating AI4Debunk's research and technical outputs into educational resources, training activities and awareness-raising tools for different stakeholder groups. Within this work package, TruthSpace is the central VR serious game designed to support experiential learning around disinformation.

This deliverable contributes to WP10 in several ways:

- **Defining the pedagogical scope.** Section 2 of the report elaborates how the game seeks to enhance media literacy, help users recognise disinformation patterns and understand cognitive biases, and encourage fact-checking behaviours, all core objectives of WP10.
- **Specifying functional and technical scope.** By detailing platform choices (VR implementation in Unity), the use of multimodal assets (text, images, video), and mechanisms for tracking user progress and performance metrics, the deliverable provides the technical baseline for WP10's development, integration and evaluation activities.
- **Connecting to training and capacity-building formats.** The narrative and interaction design are conceived to be flexible enough to support different use contexts envisaged in WP10, from individual self-paced exploration to facilitated workshops in classrooms, media literacy campaigns, or training sessions for journalists and community moderators.

In this sense, this document forms the design backbone of WP10's immersive component: subsequent tasks will focus on implementation, pilot deployment, user studies and comparative evaluation of educational impact.

1.4 TARGET AUDIENCE & EXPECTED IMPACT

The VR application is intended for a broad but clearly defined set of user groups, corresponding to the roles and personas outlined in the overall game specification: citizens and youth, educators, media professionals and community-level actors.

- Primary users include citizen learners (general public), secondary and higher-education students, journalists, bloggers and teachers/educators who wish to strengthen their ability to navigate complex information environments.
- In TruthSpace, these users adopt the role of an everyday “citizen investigator” who must disentangle manipulative content from reliable information while collaborating with NUTRU.
- Secondary users include debunking committee members, researchers and analysts, and community moderators or civil-society practitioners. For these groups, the application can serve both as a training tool and as a demonstrator for workshops and public engagement events.

The expected impact of TruthSpace and of the VR environments defined in this deliverable can be summarised along three dimensions:

1. **Cognitive and behavioural impact.** By situating users inside a Klein-Bottle-inspired information trap and requiring them to actively “clean” their environment, the game aims to move beyond passive media literacy towards active, embodied practice of critical-thinking skills. The repeated exposure to realistic scenarios, such as emotionally charged headlines, conspiracy-driven narratives and ambiguous information sources, is designed to help users internalise habits of verification, reflection and skepticism.
2. **Engagement and motivation.** The presence of NUTRU as a friendly, visually distinctive AI “pentapus”, combined with the transformation of the environment from chaotic to serene, is intended to make the learning process both emotionally engaging and aesthetically memorable. Game elements such as mini-games, progression through levels and feedback on performance are expected to increase motivation compared to traditional media-literacy formats.
3. **Transferability and awareness-raising.** Although the narrative is set in a fictional VR world, the disinformation patterns and critical-thinking strategies it illustrates are directly transferable to real-world online platforms and information ecosystems. By making the invisible dynamics of feeds, emotional manipulation and conspiratorial framing tangible, TruthSpace can support wider awareness-raising campaigns and serve as a conversation starter in educational and public contexts.

Overall, this section frames TruthSpace not merely as a game, but as a carefully designed VR intervention within AI4Debunk, one that connects research on disinformation with immersive, user-centred learning experiences aimed at building more resilient digital citizens.

2. SCOPE OF THE SERIOUS GAME

2.1 PEDAGOGICAL SCOPE

TruthSpace is conceived first and foremost as a critical-thinking training environment that operationalises AI4Debunk’s research on disinformation into an embodied learning experience. Its pedagogical scope is to move users beyond abstract media-literacy slogans (“check your sources”, “don’t believe everything you read”) and place them inside a simulated information trap, where they must actively practise concrete strategies for resisting manipulation. The Klein-Bottle-inspired environment, with its looping “inside equals outside” geometry, visualises how online feeds can become self-contained bubbles that endlessly recycle similar content, thereby providing a powerful metaphor for echo chambers and algorithmic amplification.

Within this setting, the game focuses on five critical-thinking strategies identified in previous AI4Debunk work packages as key to building resilience: (1) source evaluation and credibility assessment, (2) recognising emotional manipulation, (3) identifying logical fallacies and misinformation tactics, (4) understanding how isolated claims connect into broader conspiracy frameworks, and (5) engaging in active reflective thinking (metacognition). Each strategy is not only explained but enacted through a dedicated level or mini-game. For example, users trace information “threads” through a web of interconnected images to uncover dubious sources, categorise emotionally charged headlines under time pressure, debate misleading claims with NUTRU, navigate a conspiracy-laden labyrinth of choices, and finally enter a reflective “pause room” where they must examine their own reactions before deciding how to respond.

Pedagogically, TruthSpace uses realistic but fictionalised content inspired by AI4Debunk’s case studies on climate change and the war in Ukraine, exposing users to familiar narrative patterns (e.g. exaggerated uncertainty, victim-blaming, “puppet government” rhetoric, “Great Reset” conspiracies) while maintaining a safe distance from real individuals and current events. The aim is to help players develop transferrable heuristics: calibrating trust in information sources, spotting red flags in multimodal content, and pausing to interrogate their own biases before sharing or endorsing a piece of information. NUTRU, the friendly octopus-inspired AI assistant, functions as a narrative tutor who scaffolds this learning process with explanations, prompts and feedback, gradually shifting from directive guidance to more open reflection as the user progresses.

Overall, the pedagogical scope of the serious game is to enable users to experience the mechanisms of disinformation and their own susceptibility from the “inside” of an information

bubble, and to rehearse practical, repeatable strategies for escaping it, so that these strategies can be applied back to everyday digital environments outside VR.

2.2 FUNCTIONAL SCOPE

Functionally, TruthSpace is designed as an all-in-one VR platform that combines narrative exploration, interactive tutorials and a series of mini-games into a coherent serious game experience. Users enter the noisy interior of the Klein Bottle, surrounded by overlapping feeds, headlines and digital “noise”, and are welcomed by NUTRU, who introduces the purpose of the application and the overall goal of “clearing” the space. An initial tutorial episode familiarises them with core interactions, such as using gestures or controllers to bring up feeds, grab and inspect items, and sort information into categories, before they transition into the five main levels corresponding to the critical-thinking strategies.

The functional scope includes the use of curated, case-study-based scenarios drawn from AI4Debunk’s work on climate change and the Ukraine war. Users encounter multimodal disinformation fragments (text headlines, images, simulated social posts and short video snippets) which mirror typical manipulative patterns identified in the project (e.g. climate “hoax” rhetoric, anti-refugee narratives, geopolitical conspiracy frames). These stimuli are embedded in different gameplay formats: (a) exploratory webs where users follow strands of information back to their sources, (b) fast-paced sorting tasks where they must detect emotional manipulation under time pressure, (c) debate scenes in which they articulate counter-arguments to misleading claims, (d) branching labyrinths where choices between competing narratives determine the path forward, and (e) reflective questioning sequences that confront users with their own assumptions.

Across these activities, NUTRU provides contextual explanations, hints and performance feedback, while the environment itself responds to user success: as players correctly identify manipulation and apply critical-thinking strategies, visual noise is reduced, information webs thin out, and the Klein Bottle corridor gradually transitions towards the calm final room above the clouds. The serious game is designed to support both individual self-paced use and facilitated group sessions (e.g. in classrooms or workshops), with episodes and mini-games that can be replayed, paused or discussed in debriefing. In functional terms, TruthSpace does not attempt to cover every disinformation topic or platform; instead, it focuses on a limited number of richly developed, thematically coherent scenarios that exemplify the underlying tactics and cognitive challenges the project aims to address.

2.3 TECHNICAL SCOPE

Technically, TruthSpace is specified as a VR-first application implemented in the Unity game engine, targeting contemporary head-mounted VR displays with standard input devices (e.g. hand-held controllers or equivalent tracking solutions). The core virtual environment is modelled as a tall corridor derived from the vertical cross-section of a Klein Bottle, surrounded by semi-transparent shells that can dynamically change textures, colours and levels of visual “noise” to reflect the current state of the information environment. Within this base environment, additional sets are instantiated for individual levels (e.g. the “information skein” web, the emotional-manipulation sorting space, the debate table, the conspiracy labyrinth, the reflective “pause room”) and for the final open room above the clouds, complete with fountain, plants and data columns.

The application relies on a combination of 3D assets (NUTRU character model and animations, Klein Bottle structures, environmental props), 2D UI elements (menus, indicators, subtitles), and multimedia content (headline cards, images, short video loops) that instantiate the disinformation scenarios derived from AI4Debunk’s analytical work. NUTRU’s presence is delivered through animated 3D visuals and voice-over, with synchronised text captions to support accessibility and comprehension. Interaction mechanics are implemented through Unity’s VR toolchain, enabling grabbing, pointing, selecting, dragging and throwing gestures that correspond to the pedagogical actions users are asked to perform (e.g. “throw” emotionally manipulative items into a black hole, “push” reliable items towards the exit, “follow” strands of information by pulling them closer).

To support evaluation, the technical scope includes mechanisms for tracking user progress and performance metrics across sessions. At a minimum, the system records level completion, accuracy in classification or decision tasks, response times, and the number of attempts required to solve specific challenges, so that these data can be correlated with key performance indicators and standard usability measures (e.g. SUS) defined elsewhere in the deliverable. The application is built to operate primarily with locally stored, curated content; it does not ingest live social-media feeds, thereby avoiding privacy and safety risks while still exposing users to authentic narrative patterns. In summary, the technical scope defines a self-contained but extensible VR application that can be updated with additional scenarios and assets as AI4Debunk evolves, while providing a stable baseline for implementation, piloting and evaluation.

3. USER ROLES & PERSONAS

3.1 PRIMARY USERS

Citizen learners (general public)

Citizen learners are adults who engage with TruthSpace out of personal interest, as part of public awareness campaigns, library programmes, NGO workshops or informal online events. They are frequent users of digital media and social platforms but may not have prior training in media literacy or critical thinking, and they often experience the information environment as noisy, polarised and overwhelming, the very state represented by the chaotic interior of the Klein Bottle at the beginning of the experience.

For this persona, the application emphasises recognisable everyday situations: emotionally charged headlines about refugees, climate policies or geopolitical conflicts; ambiguous images and posts; and algorithmic “rabbit holes” visualised as webs and labyrinths. Mini-games such as tracing the origin of a news item (“Find the Root”), sorting manipulative content under time pressure, or navigating conspiracy-laden corridors are framed as practical skills that can be applied directly to how they consume news and social media.

Youth and students (upper-secondary, vocational and early tertiary education)

Youth and students are a central audience for AI4Debunk and for TruthSpace in particular. This persona includes learners in upper-secondary schools, vocational education and early university, often encountering disinformation in highly visual, fast-paced environments (short-video platforms, memes, influencer content). The VR format and the strong, colourful visual identity of NUTRU are leveraged to create a playful and emotionally engaging entry point into topics that might otherwise appear abstract or “lecture-like”.

For this group, the narrative emphasises personal agency, “escaping the trap” of the Klein Bottle, learning to resist emotional manipulation and peer pressure, and turning impulsive reactions into reflective decisions. Difficulty ramps are tuned to gradually move from guided tasks with clear feedback (e.g. basic source evaluation) to more open, debate-based scenes where students must articulate their own reasoning in dialogue with NUTRU. The experience is designed to be used both individually and in classroom settings, where teachers can pause after levels to discuss strategies and examples.

Journalists, bloggers and content creators

Journalists, bloggers and other content creators form a professional persona for whom TruthSpace acts as a reflective training and calibration tool. They are familiar with information workflows and may already practise source verification, but they are exposed daily to time pressure, emotionally charged narratives and audience polarisation. For them, the game foregrounds scenarios where small lapses in verification or framing can amplify disinformation, such as quickly sharing an emotionally resonant but poorly sourced post, or uncritically repeating conspiracy framings in headlines.

Within the VR environment, these users are invited to rehearse slower, more deliberate responses in high-pressure situations: the “Pause Room” challenges them to resist impulsive sharing; debate scenes ask them to rephrase provocative titles into balanced formulations; and labyrinth-like branching choices illustrate how editorial decisions can lead audiences deeper into conspiratorial bubbles or towards more nuanced understanding. The experience can thus complement newsroom trainings or workshops on ethical reporting and debunking practices.

Teachers and educators

Teachers, trainers and media-literacy facilitators interact with TruthSpace both as learners and as orchestrators of group activities. For them, the persona focuses on how the VR experience can be integrated into curricula, workshops or non-formal learning settings. Educators may not be advanced VR users; therefore, the application emphasises straightforward session setup, clear episode boundaries and the possibility to replay or select specific levels (e.g. only the “Source Evaluation” or “Conspiracy Labyrinth” episodes) to support focused teaching objectives.

From a pedagogical perspective, TruthSpace provides educators with a shared reference point and a set of concrete scenes, such as the tangled information skein, the emotional-manipulation black hole, or the final calm space above the clouds, that can be used in debriefing discussions about how disinformation works and how critical-thinking strategies can be transferred to students’ everyday media use.

3.2 SECONDARY USERS

Debunking committee members and fact-checking practitioners

Within AI4Debunk, national or organisational debunking committees and professional fact-checkers are envisaged as secondary users who can employ TruthSpace as a demonstrator and training tool. For this persona, the VR application offers a way to externalise and visualise the

abstract cognitive steps they already perform (tracing sources, recognising patterns of manipulation, situating claims within broader conspiracy frameworks) so that these processes can be communicated more effectively to non-expert audiences.

Debunking practitioners may use the game to co-design additional scenarios, test how lay users react to certain narrative structures, or showcase their work during public engagement events. Their feedback is also expected to inform iterative refinement of content difficulty, realism and alignment with emerging disinformation trends.

Researchers and analysts

Researchers in disinformation studies, cognitive psychology, human-computer interaction and related fields form another secondary persona. They primarily view TruthSpace as an experimental environment where the mechanisms of belief formation, emotional manipulation and corrective feedback can be observed under controlled but ecologically valid conditions. The game's levels map directly onto the five critical-thinking strategies identified in previous work packages, providing a structured framework for examining how users perform on tasks such as source evaluation, detection of logical fallacies or navigation of conspiracy-laden narratives.

Analytics captured by the application (e.g. response times, accuracy of classifications, choices in branching narratives) can support quantitative and qualitative studies on learning effects, transfer to real-world behaviour and the impact of AI-assisted feedback through NUTRU. In this sense, researchers and analysts act both as users of the environment and as interpreters of the data it generates.

Community moderators, civil-society practitioners and campaigners

Finally, community moderators, NGO workers and civil-society campaigners constitute a persona that uses TruthSpace as a capacity-building and awareness-raising tool in their local contexts. These users are often responsible for moderating online communities, supporting vulnerable groups or running public information campaigns, but they may lack engaging, immersive resources for illustrating how disinformation operates.

For them, the game functions as a portable “mini-lab” they can bring into workshops, youth centres or community events, allowing participants to experience the dynamics of information overload, echo chambers and conspiracy narratives from the inside. Moderators can then link in-game experiences, such as being trapped in the Klein Bottle corridor or trying to escape the

conspiracy labyrinth, to concrete examples from their communities, helping participants to connect the metaphor of TruthSpace to their everyday digital realities.

3.3 ACCESSIBILITY & INCLUSIVITY CONSIDERATIONS

From its conception, TruthSpace is designed to be an inclusive environment that can be safely and meaningfully experienced by users with diverse ages, backgrounds and abilities. Accessibility is treated as a core design constraint rather than an add-on, influencing narrative choices, interaction mechanics and technical implementation.

Language options and cultural adaptability

Given AI4Debunk’s European scope and the cross-border nature of disinformation, the application is planned to support multiple language options for interface elements, subtitles and (where feasible) voice-overs. This is essential to make the experience accessible to youth, citizen learners and practitioners who are not comfortable engaging with complex topics in English. At the same time, texts are written in clear, non-technical language, with NUTRU serving as a friendly guide who explains concepts such as “logical fallacies” or “conspiracy frameworks” through concrete examples rather than jargon.

Cultural adaptability is addressed by using realistic but fictionalised news items and narratives inspired by AI4Debunk’s case studies on climate change and the war in Ukraine, without replicating real individuals or live events. This allows scenarios to be localised or adapted to different socio-political contexts while preserving core disinformation patterns (e.g. scapegoating refugees, exaggerating scientific uncertainty, invoking “puppet governments” or “Great Reset” conspiracies).

Cognitive load reduction and safe challenge

The Klein-Bottle-inspired environment is intentionally overwhelming at the beginning, filled with visual noise, overlapping feeds and tangled information webs, but is gradually simplified as users progress and successfully apply critical-thinking strategies. This transformation is not only narrative but also an accessibility feature: it ensures that cognitive load decreases over time, preventing sustained overload, fatigue or motion sickness.

Tasks within each level are broken into short, focused interactions with clear objectives and feedback. NUTRU explains each activity step by step, models the desired strategy (e.g. how to follow information threads or how to reframe an emotionally manipulative title), and offers hints

when users struggle. Time-pressure elements (such as rapid sorting of news items) are introduced gradually and can be tuned or disabled in educational settings where lower stress is preferable. The final reflective scenes emphasise calm, slow decision-making in a visually serene environment above the clouds, reinforcing the idea that taking a “pause” is both cognitively and emotionally beneficial.

UI/UX for diverse age groups and abilities

User interface and interaction design are kept deliberately simple and legible. Key elements, such as interactive headlines, icons indicating emotional manipulation, or strands of information leading to sources, are large, high-contrast and positioned within comfortable reach zones in VR. NUTRU’s design as a friendly, colourful octopus-like entity with flowing movements aims to reduce intimidation and create a sense of companionship, particularly for younger or VR-novice users.

Different locomotion options (e.g. teleportation versus continuous movement) and comfort settings (e.g. vignette during motion, adjustable height, audio/subtitle balance) are considered to accommodate users who are prone to motion sickness or have mobility constraints. The experience is also designed to be observable from an external screen, allowing facilitators to support users who may need assistance with controls or who cannot wear a headset for long periods. In future AR or desktop extensions of AI4Debunk, equivalent interaction patterns (point-and-click, touch gestures) will mirror the VR mechanics to provide an accessible pathway for users without access to dedicated VR hardware.

Taken together, these accessibility and inclusivity measures ensure that the TruthSpace experience is not restricted to a narrow group of technically adept users, but can function as a shared training and awareness-raising tool across age groups, professions and cultural contexts, in line with AI4Debunk’s broader educational and societal objectives.

4. STRUCTURE OF THE GAME

TruthSpace is structured as a linear but episodic VR experience that combines narrative exposition, guided tutorials and progressively more demanding mini-games, all anchored in the five critical-thinking strategies identified in AI4Debunk. Each strategy corresponds to a distinct level, framed diegetically as a step in escaping an information “trap” and co-constructing a calm, trustworthy TruthSpace together with the AI assistant NUTRU.

The game is organised around a strong world metaphor: the user begins inside the noisy interior of a Klein-Bottle-inspired corridor, moves through a sequence of scenes that unfold along its narrowing neck, and eventually exits into an open, sunlit environment above the clouds. At each step, the visual state of the world, NUTRU’s commentary and the specific interaction patterns reinforce the underlying learning objective of the corresponding level.

4.1 NARRATIVE FRAMEWORK & WORLDBUILDING

The narrative framework of TruthSpace is built around the idea that contemporary information environments can become self-contained bubbles where “inside” and “outside” are difficult to distinguish. This is visualised through a Klein Bottle: an impossible shape whose inner and outer surfaces form a single continuous loop, standing in for algorithmically curated feeds that endlessly recycle similar content. The user’s journey is framed as an attempt to understand, navigate and ultimately escape this space.



FIGURE 1: FIGURE OF A KLEIN BOTTLE

At the beginning of the game, the player materialises in a tall, tunnel-like corridor derived from the vertical cross-section of the Klein Bottle. The walls are covered with a shifting net of floating monitors and headlines, social-media posts and visual “noise”, giving the impression of being physically entangled in overlapping information streams. NUTRU first appears as a voice and

waveform projected on the environment, welcoming the user to TruthSpace and acknowledging the gap between the promised calm workspace and the chaotic reality surrounding them.

Early scenes establish key narrative metaphors: the Klein Bottle as an information trap; the web or skein of content as disinformation threads; the black hole and upward “exit” channel as opposing outcomes for manipulative versus trustworthy information; and finally the distant, serene room above the clouds as a persistent visual goal. The user is repeatedly reminded that their actions in the mini-games have tangible effects on the environment: each correct decision makes the space quieter, clearer and more structured, signalling progress both narratively and pedagogically.

NUTRU functions as both a guide and an in-universe system interface. Its octopus-inspired, “pentapus” body with marble-and-metal textures and colour-shifting surface communicates fluidity, adaptability and emotional warmth, in contrast to the cold, glitchy aesthetics often associated with AI. Throughout the experience, NUTRU contextualises each level (“Now we will look at where information comes from...”, “Let’s see how news try to push your emotions”) and provides reflection prompts that explicitly connect the VR metaphor to players’ everyday media use.

4.2 GAME FLOW OVERVIEW

The overall game flow follows a clear arc from orientation to mastery and reflection, structured as a clear sequence: (1) initial user information input/personalisation, (2) onboarding and tutorial, (3) five core training stages/levels, and (4) an epilogue where the final scoring and feedback are presented.. This structure allows TruthSpace to be experienced in a single extended session or broken into shorter modules for classroom or workshop use.

The experience begins with a short user-information input step used to configure settings and personalise guidance and feedback.

Onboarding (Episodes 1-2)

After the user enters their information, the experience opens with a welcoming scene inside an abandoned and busy workspace. NUTRU introduces itself as the user’s AI partner, explains the purpose of TruthSpace as an all-in-one VR space for working, meeting and staying informed, and openly acknowledges that the current environment does not yet match that promise. A short optional branch allows curious users to ask for more information about the methodology behind

the application, the way the environment adapts to their training and the connection to the wider AI4Debunk project.



FIGURE 2: TUTORIAL SCENE

This is followed by a tutorial episode in which users learn core interactions: bringing up feeds and environments, grabbing and rotating objects, swiping through content, and sorting items into different spatial targets. These mechanics are introduced in a low-stakes context so that motor and interface learning can be separated from the later cognitive challenges.

In a second onboarding episode, NUTRU reveals a holographic Klein Bottle, explains its symbolism as a shape where the inside and the outside are indistinguishable, and positions the user as being “trapped” at its bottom. At this point, the five critical-thinking domains that structure the remainder of the game (source evaluation, emotional manipulation, logical fallacies, conspiracy frameworks and reflective thinking) are introduced as the skills needed to climb out of this trap.

Core training arc (Episodes 3-7)

The central part of the game consists of five levels, each corresponding to one critical-thinking strategy. Every level combines a short cinematic or conversational introduction by NUTRU with one or more interactive mini-games tailored to that strategy (e.g. tracing information strands, sorting items under time pressure, debating, navigating a branching labyrinth, completing a reflective test). The user advances linearly through these levels; difficulty and autonomy increase gradually, while direct guidance decreases.

Epilogue and transition to the final TruthSpace (Episode 8)

Once the five levels are completed, the user reaches a transparent door at the top of the Klein-Bottle corridor. Passing through leads to a spacious, minimal environment above the clouds: a marble-like platform with a fountain where NUTRU stands, scattered plants, an armchair facing the sun and vertical clusters of frozen data streams. Here, NUTRU offers a closing reflection and personalised feedback, and presents the final scoring summary (skill-point growth and earned badges/insights), summing up the user’s performance and emphasising how the strategies practised in VR can be applied to real information environments.

Throughout this flow, the game makes occasional use of “flash-forward” moments: brief glimpses of the serene final space are shown early on and then recalled after major milestones, reinforcing motivation and giving a sense of tangible progress towards a calmer TruthSpace.

4.3 LEVELS, CHAPTERS & PROGRESSION

Each level of TruthSpace is designed as a self-contained chapter that embodies one of the five critical-thinking strategies while building on skills acquired in previous levels. Progression is primarily linear but punctuated by short optional branches (e.g. additional explanations, alternative example sets) that adapt to user curiosity and performance.

Level 1: Source Evaluation - “Find the Root”

The first level focuses on the ability to trace information back to its origin and assess source credibility. The space in front of the user fills with a large, three-dimensional skein of images, headlines and icons suspended on strands, representing fragments of a news ecosystem. By grabbing an image and gently pulling on its strand, the user reveals connected items: logos, snippets of “about” pages, author names or other contextual clues.



FIGURE 3: “FIND THE ROOT” SCENE

A prototype scenario involves a dramatic image of a nuclear explosion with the headline “Korea stands next to Iran”. Following its strand reveals a logo for an outlet labelled only with an acronym, and then further reveals that this stands for a sensationalist “Shocking News Agency”. The player must decide whether to treat such a source as trustworthy, questionable or clearly manipulative, and is encouraged to contrast it with alternative, more reputable sources present in the same skein (e.g. international organisations, established media).

Correctly identifying red flags (missing authorship, altered logos, anonymous claims) causes the corresponding strands to dissolve and the overall web to become less dense. Errors, by contrast, may temporarily reinforce parts of the web, visually illustrating how uncritical sharing strengthens disinformation networks. In this way, the level establishes a basic loop of investigation, comparison and judgement that later levels build on.

Level 2: Emotional Manipulation - “Keep Calm”

The second level builds on mechanical familiarity to shift attention towards emotional triggers in information. The user remains inside the Klein Bottle, but the environment reconfigures into a cylindrical space with two prominent exits: a swirling black hole below and a luminous opening at the top of the corridor.



FIGURE 4: “KEEP CALM” SCENE

Groups of news items, social posts or short slogans float towards the player. Some are designed to provoke fear, outrage or moral panic (e.g. claims about “climate lockdowns” or scapegoating refugees), while others convey information in a more neutral tone. The user must quickly decide where each item belongs: emotionally manipulative content should be thrown into the black hole, while proportionate, factual or balanced pieces should be pushed upwards towards the exit.

As the level progresses, time limits shorten and emotional cues become subtler, forcing the player to rely less on obvious “clickbait” signals and more on nuanced reading (e.g. distinguishing strong but legitimate expressions of concern from manipulative fear-mongering). NUTRU comments on borderline cases, drawing attention to techniques like exaggerated language, loaded imagery or appeals to national pride, and reinforcing the idea that recognising emotional manipulation is a prerequisite for thoughtful judgement.

Level 3: Logical Fallacies & Misinformation Tactics - “Debate”

In the third level, the user moves closer to the narrowing neck of the Klein Bottle and finally encounters NUTRU face-to-face. The environment becomes more stable and conversational: a shared “debate table” appears, suspended in the corridor, and a sequence of provocative titles is projected between user and AI.



FIGURE 5: MEETING NUTRU FOR THE FIRST TIME

Topics draw on AI4Debunk case studies, such as climate change (“Fossil fuels vs renewables: the hidden truths”), the war in Ukraine (“Ukraine’s sovereignty: myth or reality?”), or broader questions about media and technology. For each title, NUTRU introduces typical misinformation tactics used in this domain (cherry-picking data, drawing false analogies, presenting false dilemmas) and invites the user to choose between alternative responses or to select which part of a given argument is fallacious.

Short, interactive debate rounds follow: the player may, for instance, be asked to identify whether a statement misrepresents scientific uncertainty, conflates correlation with causation,

or relies on a strawman version of an opponent’s position. Successful identification gradually unlocks more complex arguments, while mistakes trigger clarifying feedback and illustrative counter-examples. The level thus scaffolds users from recognising simple logical errors to analysing multi-step arguments embedded in emotionally charged narratives.

Level 4: Conspiracy Frameworks - “The Labyrinth”

The fourth level makes the structure of conspiracy narratives visible by turning the Klein Bottle’s neck into a twisting labyrinth. Walls of the corridor morph into branching tunnels, each marked by signs carrying different headlines or claims. Some represent overt conspiracy narratives (e.g. “The war in Ukraine is a Western puppet show”, “Global elites manipulate pandemics for profit”), while others describe legitimate but complex political or scientific issues.



FIGURE 6: THE LABYRINTH SCENE

At each junction, the user must choose which path to follow by selecting the title that seems more plausible or more evidence-based, or by explicitly rejecting both conspiratorial framings

presented. Behind the scenes, choices are mapped to underlying patterns: whether the user tends to favour simple, agent-driven explanations, how quickly they spot recycled tropes like “Great Reset” narratives, and whether they notice when disparate issues are being artificially tied into a single plot.

Correctly identifying conspiratorial framings leads to corridors that become progressively more open and better lit, whereas endorsing them sends the user into loops where similar claims reappear with minor variations. NUTRU periodically pauses the action to “zoom out”, showing the labyrinth as a web of interconnected nodes and revealing how isolated claims cluster into larger conspiratorial frameworks. This visualisation supports a key learning goal: understanding that conspiracy narratives are not random but systematically constructed to erode trust in institutions and democratic processes.

Level 5: Reflective Thinking - “From Mechanic to Conscious”

The final level shifts focus from external content to the user’s own reactions. The environment quiets down: the corridor straightens into a short passage ending in a transparent door, beyond which the calm TruthSpace is now clearly visible. NUTRU announces that the user has acquired the tools needed to exit, but that one final step remains, to examine how information affects them internally.

In this “pause room”, titles and short narratives appear one by one, echoing themes encountered earlier (e.g. attributing economic problems to refugees, speculating about hidden agendas in climate policy). For each, the user is presented not only with factual multiple-choice questions but also with reflective prompts: What emotion did this headline trigger first? What assumptions did it activate? How confident are you in your judgement, and what evidence do you rely on?

Instead of time pressure, the mechanics reward slowing down: activating an optional “pause” mode dilates time, allowing the user to inspect contextual information, compare alternative framings and listen to NUTRU’s reflections. Successful completion is defined not just by “correct” answers but by consistent use of reflective tools (taking the pause, checking context, revisiting earlier assumptions). Once this level is completed, the transparent door opens and the user transitions into the final TruthSpace epilogue described above.

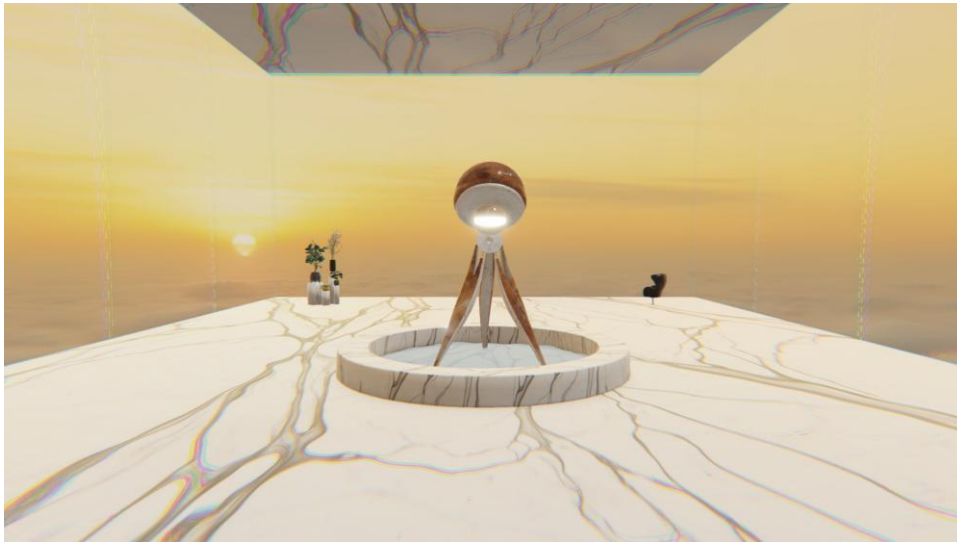


FIGURE 7: THE FINAL LEVEL

4.4 INTERACTION MODES

To support diverse learning styles and maintain engagement, TruthSpace combines several interaction modes that are reused and recombined across levels: exploration, decision-making, dialogue-based learning and evidence evaluation. These modes are implemented through standard VR interactions (gaze, pointing, grabbing, throwing, teleportation) but are always grounded in a specific cognitive task rather than purely in navigation or dexterity.

Exploration

Exploratory interaction underpins scenes where the user inspects the structure of the Klein Bottle, rotates holographic objects, or moves through the information skein and labyrinth. The design encourages users to look around, follow visual cues (glowing strands, shifting textures) and discover optional explanatory elements without fear of “failure”. Exploration is particularly prominent in the onboarding scenes, the source-evaluation web and the conspiracy labyrinth, where understanding the spatial layout itself is part of the learning outcome.

Decision-making

Binary and multiple-choice decisions appear throughout the game: throwing items into the black hole or towards the exit, choosing between alternative headlines at a crossroads, selecting which part of an argument is fallacious, or answering reflective questions at the end. These decisions are purposefully framed in spatial, embodied terms (push, pull, choose a path) to make abstract

judgements more tangible. Time pressure is used selectively (e.g. in the emotional-manipulation level) to simulate real-world conditions where users must react quickly to information; in other levels, decisions are deliberately slowed down to encourage reflection.

Dialogue-based learning

Conversational exchanges with NUTRU provide a narrative spine and a vehicle for just-in-time explanations. Branching dialogue trees allow users to request more detail about certain topics (e.g. “How does this Klein Bottle relate to my social-media feeds?”) or to challenge NUTRU’s statements, leading to short clarifications or counter-examples. In the debate level, dialogue becomes the primary mechanic, with users selecting argumentative moves and hearing NUTRU respond, thereby modelling constructive, reasoning-based discussion rather than adversarial “gotcha” exchanges.

Evidence evaluation

Finally, evidence evaluation is embedded as a cross-cutting interaction mode, most prominently in the source-evaluation and logical-fallacies levels. Users are invited to inspect metadata (logos, URLs, authorship, timestamps), compare multiple representations of the same claim (e.g. sensationalist versus institutional framing) and access optional background cards that summarise relevant facts from AI4Debunk case studies. These interactions are designed to mirror best practices in fact-checking, without requiring users to read long texts, so that the associated heuristics can be transferred to non-VR contexts.

4.5 REWARD SYSTEM

The reward system of TruthSpace is designed to reinforce learning and reflection rather than competition. It combines diegetic environmental feedback, intangible skill points and unlockable “insights” that together make progress visible while preserving the serious-game character of the application.

At the most immediate level, successful actions produce local visual and auditory rewards: disinformation strands dissolve, the intensity of background noise decreases, colours become warmer and the Klein-Bottle corridor feels less constricting. Conversely, repeated misjudgements may temporarily increase visual clutter or trigger gentle corrective comments from NUTRU, signalling that the user is strengthening, rather than weakening, the information trap.

In parallel, the game tracks three families of skill points aligned with the core objectives of AI4Debunk:

- Credibility awareness, reflecting performance in tasks related to source evaluation and evidence checking;
- Emotional resilience, capturing how well users recognise and resist emotionally manipulative content under different levels of time pressure;
- Analytical thinking, linked to detection of logical fallacies, navigation of conspiratorial frameworks and use of reflective tools in the final level.

These metrics are not foregrounded as competitive scores but are periodically summarised by NUTRU at natural breakpoints (e.g. after each level and in the final epilogue). Users receive qualitative feedback such as “You consistently checked the origin of information before deciding” or “You became more cautious about emotionally charged headlines”, alongside simple visual indicators showing growth in each skill area.

To complement these longitudinal rewards, the game also awards thematic badges when players demonstrate particular patterns of behaviour, such as “Source Detective” (for thoroughly exploring information strands), “Calm Navigator” (for high accuracy under emotional pressure), “Debate Analyst” (for spotting complex fallacies), “Labyrinth Mapper” (for recognising conspiratorial framings) and “Reflective Thinker” (for consistent use of the pause and reflection tools). Badges are presented within the fiction as elements of the user’s personalised TruthSpace profile rather than as external gamification tokens.

Finally, completing certain combinations of tasks unlocks insights, short, accessible summaries of key ideas from AI4Debunk’s analytical work (e.g. common disinformation tactics in climate narratives, typical frames in Ukraine-related propaganda). These appear as optional “data columns” in the final room above the clouds: when the user approaches them, NUTRU translates their content into everyday language and explicitly connects them to the strategies practised in the game. In this way, the reward system not only marks completion but also deepens understanding, linking the immersive experience back to the broader educational goals of the project.

5. KEY CHALLENGES ADDRESSED BY THE GAME

TruthSpace is designed not only as an engaging VR experience but as a targeted intervention against a set of recurring challenges identified across AI4Debunk’s case studies on climate change, the war in Ukraine and related disinformation ecosystems. Each challenge corresponds to a cluster of cognitive, emotional or socio-technical problems that hinder citizens’ ability to navigate complex information environments.

The structure of the game, from the noisy Klein-Bottle corridor to the calm room above the clouds, and the five critical-thinking strategies embedded in its levels (source evaluation, emotional manipulation, logical fallacies, conspiracy frameworks, reflective thinking) have been explicitly mapped to these challenges. Scenes such as the tangled “Find the Root” web, the emotional-sorting sequences, the debate table with NUTRU, the conspiracy labyrinth and the final reflective “pause room” are therefore not generic mini-games, but concrete responses to specific weaknesses that AI4Debunk aims to address in citizens’ interaction with digital media.

5.1 DEEFAKE & MULTIMEDIA MANIPULATION

A first key challenge is the growing sophistication of synthetic and manipulated multimedia content. Users increasingly encounter images, videos and composite posts whose credibility cannot be judged by “looking” alone and which often circulate detached from their original context. This challenge is exacerbated in polarised debates around climate change or the war in Ukraine, where emotionally charged imagery (explosions, protests, crowded borders) is routinely reused or altered to support conflicting narratives.

TruthSpace addresses this challenge by placing users inside a three-dimensional “information skein” where images, headlines and logos are connected through visible strands that can be followed back to their origin. In the “Find the Root” level, users grab a striking image (for example, a nuclear explosion) and, by tracing its strand, uncover the outlet behind it, its name, its visual identity and related items, including misleading acronyms or altered logos. This embodied tracing of provenance is complemented by tasks drawn from the “Info Market” concept in the critical-thinking strategies document, where players must distinguish between authoritative sources (e.g. scientific agencies, international organisations) and anonymous or sensationalistic outlets when collecting evidence on questions like sea-level rise or refugee impacts.

Rather than attempting to “teach” specific deepfake-detection tricks, the game focuses on durable habits: checking for authorship and institutional backing, comparing multiple representations of the same event, and treating visually dramatic content as a cue for further verification rather than immediate belief. The Klein-Bottle metaphor reinforces this message by showing how unchecked multimedia items weave themselves into a dense, self-reinforcing web that the user must actively dissolve through careful source evaluation.

5.2 CONFIRMATION BIAS & EMOTIONAL MANIPULATION

A second challenge is the interplay between confirmation bias, the tendency to favour information that aligns with existing beliefs, and systematic emotional manipulation. Disinformation campaigns rely heavily on fear, outrage, pride or disgust to override analytical thinking, using narratives such as “genocide” in Ukraine, “climate lockdowns” or scapegoating of refugees to trigger visceral reactions. In real-world feeds, such content is often consumed quickly and shared impulsively, reinforcing pre-existing attitudes without deliberate reflection.

TruthSpace translates this dynamic into an embodied sorting task in the “Keep Calm” level. Inside the Klein Bottle, users stand between a black hole beneath them and a luminous opening above, while short headlines and posts float into reach. Under gradually increasing time pressure, they must decide whether each item constitutes emotional manipulation, in which case it should be thrown into the black hole, or whether it presents information in a proportionate, fact-based manner and should be pushed towards the exit.

NUTRU’s commentary draws attention to linguistic and visual cues (exaggerated language, dehumanising labels, appeals to national or cultural superiority) and explicitly challenges users to notice when they are reacting “because it fits what you already fear or hope for”. By combining fast-paced classification with reflective feedback, the game makes the experience of being emotionally pulled by information tangible, while also modelling strategies for resisting such pulls, such as naming the emotion, slowing down and deliberately seeking alternative framings. This design directly operationalises the “Recognising Emotional Manipulation” strategy identified in previous AI4Debunk work.

5.3 MISINFORMATION NETWORKS & BOT ACTIVITY

A third challenge lies in the opaque, networked nature of contemporary disinformation. False or misleading claims rarely circulate in isolation; they are amplified by coordinated accounts, bots and algorithmic recommendation systems that create the appearance of consensus and inevitability. For end-users, these networks are largely invisible, leading to the impression that “everyone is saying this” when, in fact, automated or orchestrated activity may be driving the narrative.

TruthSpace responds by giving the underlying structure of misinformation a spatial, explorable form. The initial skein of interconnected items, the Klein-Bottle corridor and the later conspiracy labyrinth together visualise how fragments of content are linked and recycled. In the source-evaluation level, following strands reveals whether apparently independent posts originate from the same dubious outlet, mirroring the way bot networks reuse templates or talking points. In the “Conspiracy Web” and “Labyrinth” concepts described in the strategies document, users

trace how multiple claims, about the “Great Reset”, puppet governments or 5G surveillance, converge into a single overarching narrative when propagated through influencers and fringe channels.

By allowing players to “cut” or weaken strands when they correctly identify manipulative or conspiratorial content, the game frames debunking as a form of network hygiene: every critical decision reduces the density of the web and opens new paths. Conversely, uncritical endorsement sends the user deeper into loops where similar messages reappear with minor variations, making algorithmic echo chambers experientially salient. While the game does not simulate real-time bot detection, it equips users with an intuition for patterned repetition, recycled narratives and suspicious coordination, cues that can be transferred to their interpretation of trending topics or viral “storms” outside VR.

5.4 LOW TRUST IN INFORMATION SOURCES

A fourth challenge, particularly visible in highly polarised environments, is a generalised erosion of trust in information sources. Faced with conflicting narratives and repeated revelations of manipulation, many citizens oscillate between naïve belief in in-group sources and blanket cynicism (“nothing can be trusted”), both of which hinder constructive democratic deliberation. AI4Debunk’s aim is not to push users towards uncritical trust in specific institutions, but to foster calibrated trust: the ability to differentiate between more and less reliable sources and to justify that differentiation.

TruthSpace addresses this by embedding source evaluation and credibility assessment into its core progression mechanics. In the early levels, users are rewarded for distinguishing between institutional actors (e.g. recognised scientific bodies, refugee agencies) and anonymous or sensationalist outlets, based on metadata and contextual clues rather than ideological alignment. Later, during debates with NUTRU, they must weigh competing framings and choose which arguments are better supported by evidence, rather than which ones feel rhetorically appealing.

Crucially, NUTRU itself is designed not as an infallible oracle, but as a transparent mediator who explains how it arrives at its suggestions, encourages users to question its prompts and repeatedly reminds them that “it is your decision that clears the space”. The final epilogue in the room above the clouds reinforces this message: feedback focuses on how consistently the player checked sources, sought corroboration and changed their mind when presented with better evidence, rather than on always “getting it right” at first attempt. In this way, the game seeks to rebuild trust not in specific channels, but in a reflective process of evaluation that users can apply across diverse information environments.

5.5 OVERLOAD: DISTINGUISHING NOISE FROM FACTS

Information overload is a central challenge that TruthSpace tackles both metaphorically and mechanically. Contemporary users are constantly exposed to overlapping feeds, notifications and multimedia stimuli, making it difficult to distinguish what is relevant, reliable and meaningful. This state is represented in the game’s opening as a dense, visually noisy corridor inside the Klein Bottle, where headlines, images and data streams cover the walls like a shimmering net.

All subsequent levels are framed as efforts to “clear” this space by applying concrete strategies: tracing and pruning misleading threads, discarding emotionally manipulative items, untangling logical fallacies and refusing conspiratorial shortcuts. Each correct decision has an immediate environmental effect (strands dissolve, visual noise decreases, colours warm, the corridor widens) making the abstract concept of cognitive load reduction visible and embodied. By the time users reach the final room above the clouds, the environment is quiet: a spacious platform with a fountain, potted plants, an armchair facing the sun and a few remaining “data columns” that symbolise essential, curated information rather than an unfiltered stream.

Through this progressive transformation, the game conveys that the goal is not to consume ever more content, but to actively filter, prioritise and sometimes ignore. The simple contrast between the chaotic Klein-Bottle interior and the serene TruthSpace functions as a memorable visual anchor for discussions about digital wellbeing, attention management and the value of deliberate, focused engagement with information.

5.6 CULTURAL & CROSS-COUNTRY DIFFERENCES IN PERCEPTION

Finally, AI4Debunk operates in a European, cross-country context where the same disinformation narratives can be interpreted very differently depending on local histories, media ecosystems and cultural frames. Narratives about climate policy, refugees or geopolitical conflict resonate in distinct ways across audiences, and attempts to counter them risk being dismissed as partisan or foreign if they do not acknowledge these differences.

TruthSpace addresses this challenge in several ways. First, the content used in its scenarios is inspired by AI4Debunk’s case studies on climate change and the war in Ukraine, but is deliberately fictionalised and de-personalised, allowing adaptation to different national contexts without anchoring examples in specific real-world actors. Headlines and posts are written in clear, non-technical language that can be localised into multiple languages, while NUTRU’s

explanations focus on underlying tactics (scapegoating, exaggerated uncertainty, “puppet government” framings) rather than on the political alignment of particular countries or parties.

Second, the game’s design encourages users to reflect on their own assumptions and positionality in the final “From Mechanic to Conscious” level. Here, questions explicitly invite players to consider how their prior beliefs, media habits or national context influence their initial reaction to statements such as “Ukrainian refugees are responsible for local economic problems”, before they examine factual information. This metacognitive emphasis supports respectful, cross-cultural dialogue: rather than prescribing a single “correct” perception, the game equips users with tools to recognise how perceptions are shaped and how similar tactics can be repurposed in different countries or communities.

In combination, these design choices ensure that TruthSpace can function as a shared training and discussion catalyst across AI4Debunk’s diverse pilot sites, making visible both the common structures of disinformation and the legitimate plurality of perspectives from which citizens confront them.

6. CHARACTERS & STORY ELEMENTS

TruthSpace deliberately uses a very small cast of characters and a strongly metaphorical world so that players can focus on the internal processes of thinking, doubting and re-evaluating information. Rather than populating the environment with many non-player characters, the experience centres on the relationship between:

- the player, framed as an everyday “citizen investigator” navigating a dense information trap;
- NUTRU, a friendly AI mentor who guides, challenges and reflects with the user; and
- the information environment itself, which behaves almost like a living antagonist, taking the form of nets, webs, labyrinths and data storms that respond to the user’s decisions.

Across the episodes and mini-games, this compact cast supports a coherent narrative arc: from initial disorientation inside the Klein Bottle, through a sequence of structured challenges (source evaluation, emotional manipulation, logical fallacies, conspiracy frameworks, reflective thinking), to the final tranquil TruthSpace above the clouds.

6.1 MAIN CHARACTER PROFILE

Name, background and motivations

The main character of TruthSpace is intentionally unnamed and ungendered. The user plays “as themselves”, embodied through their hands and basic VR presence rather than a fully scripted avatar. This design choice is meant to maximise identification across diverse audiences and to signal that the skills practised in the game apply directly to each player’s real information environment.

In narrative terms, the protagonist is an ordinary digital citizen: someone who uses social media, online news and messaging apps in everyday life and who experiences their feeds as increasingly noisy, fragmented and emotionally draining. At the start of the experience they materialise at the “bottom” of the Klein Bottle, surrounded by overlapping headlines and visual clutter that metaphorically represent this overload.

Their explicit motivation, voiced in NUTRU’s introduction, is to collaborate with the AI assistant to “clear fake news and misinformation” from their environment and to build a stable, safe space for work and interaction, the TruthSpace that the application promises.

Role as “citizen investigator”

Throughout the experience, the player assumes the role of a “citizen investigator”: a non-expert who nonetheless takes responsibility for interrogating information, tracing its origin and questioning emotional and conspiratorial framings. This role is reinforced by a series of investigative actions: following strands of images back to their sources, comparing alternative headlines, inspecting logos and acronyms, and examining how seemingly separate claims connect into larger narratives.

Rather than casting the player as a passive recipient of AI guidance, the story repeatedly emphasises that NUTRU can only “open paths” and “highlight patterns”, while decisions belong to the human user. Correct or reflective decisions literally thin out the surrounding web and open the path towards the neck of the Klein Bottle, underlining that it is the citizen investigator’s agency that changes the environment.

Skill progression and personal storyline



The protagonist’s personal arc is closely aligned with the five critical-thinking strategies operationalised in AI4Debunk. At the beginning, they are overwhelmed by noise and unsure how to distinguish trustworthy content from manipulative narratives. As they advance, the story frames their increasing competence as a gradual “recalibration” of perception:

- In the “Find the Root” chapter they learn to slow down and actively seek source information, moving from surface impressions to questions like “Who is behind this?” and “What do other sources say?”.
- In “Keep Calm”, they become aware of how strongly emotional cues pull their attention and begin to categorise such cues instead of reacting impulsively.
- In the debate scenes, they practise spotting logical fallacies and incomplete arguments, moving beyond simple “for/against” positions.
- In the conspiracy labyrinth, they learn to recognise recurring conspiratorial motifs and to resist the appeal of totalising explanations.
- Finally, in “From Mechanic to Conscious”, the protagonist explicitly reflects on their own assumptions and emotional reactions before deciding how to respond to provocative titles, completing the journey from instinctive consumption to deliberate judgement.

By the time they reach the final room above the clouds, the main character has transitioned from a confused inhabitant of the Klein Bottle to a co-creator of TruthSpace: someone who has rehearsed practical, repeatable strategies for navigating disinformation and can carry them back into their everyday digital life.

6.2 SUPPORTING CHARACTERS

TruthSpace uses a minimal supporting cast to keep attention focused on the relationship between the user and the information environment. The key supporting figure is NUTRU; other “characters” are represented more abstractly, as voices, silhouettes or environmental elements that embody disinformation patterns rather than fully modelled individuals.

NUTRU is the AI assistant of TruthSpace and the only persistent non-player character. Visually, NUTRU is an octopus-inspired “pentapus”: a tall, five-legged entity with an elongated, egg-shaped head that combines marble-like, organic textures with metallic and glass-like surfaces. Concept sketches show a palette of colour variations (e.g. blues, greens, purples) and emphasise key attributes such as FRIENDLY, KIND, CLEVER, FLOW / LIQUID and COLORFUL, signalling emotional warmth and adaptability rather than cold technological distance.

NUTRU’s body subtly changes colour according to the phase of the narrative, echoing both the fluid nature of information and the user’s progress in clearing the space. In early scenes, it appears only as a waveform projected onto the noisy spherical walls; later, it materialises as a

small holographic Klein Bottle and finally as a full “pentapus” figure that stands beside the player at the neck of the bottle and in the final fountain.

Narratively, NUTRU plays multiple roles:

- **Guide and tutor**, explaining the Klein Bottle metaphor, introducing each critical-thinking strategy and providing step-by-step instructions during mini-games.
- **Reflective partner**, asking questions about what the user notices or feels in response to specific titles, and prompting them to pause, reconsider and seek evidence.
- **Narrative anchor**, maintaining continuity across episodes and providing a coherent voice that connects the research background of AI4Debunk with the in-game experience (e.g. references to how feeds loop content back, or to the idea of “escaping” an information trap).

In the final TruthSpace, NUTRU welcomes the user into the calm environment, congratulates them on their progress, summarises their strengths across the three skill families (credibility awareness, emotional resilience, analytical thinking) and explicitly encourages transfer of these skills to real-world media use.

Embodied disinformation: webs, storms and labyrinths

The main adversarial “characters” in TruthSpace are not individual villains but the various forms that disinformation takes within the environment. The tangled information skein, the net-covered walls, the swirling black hole that absorbs emotionally manipulative stories, the storm of provocative titles in the narrowing tunnel and the shifting labyrinth of conspiracy paths are all treated as semi-autonomous entities that react to the user’s choices.

For example, repeatedly sending sensationalist headlines upwards instead of into the black hole makes the corridor visually noisier for a time, while correctly identifying conspiratorial signposts in the labyrinth causes deceptive paths to collapse and the main exit to become more visible. This design reinforces the idea that disinformation ecosystems are dynamic: they strengthen or weaken as users interact with them, and they have their own “behaviour” even if no single agent is in control.

Voices and silhouettes in the content

Additional human figures appear indirectly, within the news items, posts and debate prompts that NUTRU and the user analyse together. These include, for instance, anonymous commentators or influencers making exaggerated claims about “climate lockdowns”, politicians invoking the “Great Reset”, or headlines framing Ukrainian refugees as economic threats.

In some debate scenes, these positions are voiced by synthetic debater personas or represented as silhouettes around the table, providing a sense of social context without turning the experience into a multi-character drama. The absence of fully fleshed-out antagonists is deliberate: it keeps the focus on structures of argument and manipulation rather than on demonising specific individuals or groups, facilitating cross-country adaptation of the content.

6.3 ENVIRONMENTS

The environments of TruthSpace function as both a setting and a storytelling device. The geometry of the Klein Bottle, the shifting shells of the corridor and the final open room above the clouds collectively narrate the transition from confusion to clarity. In addition, smaller “sets within the set” are used to ground specific mini-games and critical-thinking strategies.

The Klein Bottle corridor (core set)

The core environment is a tall, elongated corridor based on the vertical cross-section of a Klein Bottle. In its initial state, this corridor floats in a cosmic void and is wrapped in a semi-transparent shell that can display different textures and colours. The inner surfaces are densely covered with net-like patterns of headlines, posts and data streams, giving the impression that the user is physically entangled in overlapping information feeds.

A second, larger corridor surrounds the first like an outer skin, allowing for additional layers of visual noise (for example, “Matrix-style” digital rain or glitch effects) that can be intensified or subdued depending on the phase of the game and the user’s performance. This double-shell design supports the central metaphor that, in the digital age, “inside” and “outside” are hard to distinguish: information from the outer world is continuously pulled inside the user’s bubble and then looped back.

Within this core set, specific configurations mark different episodes: the tangled information skein of Level 1, the cylindrical sorting space with the black hole and exit channel of Level 2, the suspended debate table near the neck of the bottle, and the twisting tunnels of the conspiracy labyrinth. Each configuration reuses the same underlying geometry to create a sense of continuity while foregrounding the particular critical-thinking strategy being practised.

Mini-game sets and “training rooms”

To support the five strategies in a vivid way, the Klein Bottle corridor opens into a series of nested “training rooms” that are visually distinct but clearly part of the same world:

- The information skein space is a large, spherical volume filled with interconnected strands of images and logos. It is used for tracing sources and understanding how different items are linked in a misinformation network.
- The emotional-sorting chamber presents items drifting through the air between the black hole and the upward exit and emphasises motion, speed and pressure to simulate the real-world urgency of reacting to viral content.
- The debate platform near the neck of the bottle is calmer and more focused, with NUTRU standing opposite the user across a virtual table and titles projected between them; this environment supports concentrated analysis of arguments and fallacies.
- The conspiracy labyrinth warps the corridor into branching tunnels, lit in ways that make clearly deceptive paths appear superficially attractive while more evidence-based routes may initially seem less spectacular, thereby embodying the psychological pull of conspiratorial explanations.
- The reflective “pause room” is a short, straight passage leading to a transparent door, with subdued colours and slowed animations, encouraging users to take time before responding to provocative statements.

Together, these environments give concrete, spatial form to otherwise abstract cognitive strategies, turning them into places the user has “been to” rather than ideas they have merely read about.

The final TruthSpace room

The narrative destination of the whole experience is the final TruthSpace: a spacious, sunlit room above the clouds that appears as a distant goal from the very first scene and gradually comes into reach as the user progresses.

This room consists of a marble-like platform with an unobstructed horizon and soft, warm lighting reminiscent of dawn or sunset. At its centre is a circular fountain where NUTRU stands, associating water with cleansing, renewal and knowledge. Around the platform are small potted plants that introduce everyday, domestic elements into the otherwise abstract setting, emphasising that this is a lived-in environment rather than a purely symbolic space.

An armchair placed near the edge faces the sun, inviting the user to sit, pause and reflect. Between floor and ceiling, vertical clusters of suspended data resemble translucent columns or window frames, suggesting that information still exists but is now organised, transparent and filtered rather than overwhelming.

In narrative terms, this room represents both the successful “clearing” of the Klein Bottle and an idealised future workspace where critical-thinking strategies have become routine.

The personal desk (bridge to everyday life)

To connect the VR fiction back to users’ daily routines, a simplified personal desk environment is introduced as a recurring motif. At the beginning of the experience, NUTRU explicitly asks how calm the user’s “digital space” is in everyday life and contrasts the chaotic Klein Bottle with an ideal, focused workspace. In certain transition moments, elements of a desk (a screen, a chair, a small plant) are briefly overlaid on the corridor or the final room, hinting at how the TruthSpace principles could be applied to the user’s own physical environment (for example, by curating feeds, muting manipulative sources or setting aside “pause time” before sharing).

In future AR or desktop extensions of AI4Debunk, this personal desk motif can act as the anchor point where overlays and interactive widgets appear, making the connection between the immersive Klein Bottle journey and everyday device use explicit. Within the current VR specification, it already serves as a narrative bridge: a reminder that the ultimate goal is not to escape into a virtual sanctuary forever, but to return to one’s real desk with a clearer, more resilient approach to information.

7. THE SCRIPT (NARRATIVE AND DIALOGUES)

The script of TruthSpace is designed as a guided journey in which the user collaborates with the AI assistant NUTRU to progressively “clear” a noisy Klein-Bottle information space and transform it into a calm, trustworthy TruthSpace above the clouds. The narrative is tightly coupled to the five critical-thinking strategies of AI4Debunk (source evaluation, emotional manipulation, logical fallacies, conspiracy frameworks and reflective thinking) and uses dialogue, environmental changes and game mechanics to make these strategies experiential rather than abstract.

7.1 OVERVIEW OF THE NARRATIVE ARC

The overall arc follows six major phases:

1. Onboarding in the chaotic Klein Bottle

The user wakes inside a dense, net-covered corridor inspired by the vertical cross-section of a Klein Bottle, with overlapping news items and feeds forming a visual “web” around them. A

waveform of NUTRU’s voice appears on the walls, welcoming the user to the beta version of TruthSpace and immediately contrasting the current noisy environment with the calm, focused workspace they wish they had in everyday life.

2. Meeting NUTRU and framing the challenge

NUTRU introduces itself as a friendly “fifthopus” AI assistant, explains that the user is trapped inside a Klein Bottle that loops information back on itself, and frames the common goal: to collaborate in clearing fake news, manipulative content and clutter so that a stable, safe TruthSpace can emerge.

3. Explaining the five critical-thinking fields

Using a holographic Klein Bottle and interactive prompts, NUTRU introduces the five “fields” on which they will train together: (1) Source Evaluation & Credibility Assessment, (2) Recognising Emotional Manipulation, (3) Identifying Logical Fallacies & Misinformation Tactics, (4) Awareness of Broader Conspiracy Frameworks, and (5) Active Reflective Thinking (Metacognition). Each field is associated with a distinct training room nested inside the Klein Bottle corridor.

4. Sequence of themed mini-games (“investigation missions”)

The middle part of the narrative is a progression through five levels:

- *Find the Root*: tracing information strands in an “information skein” and an “Info Market” to evaluate sources.
- *Keep Calm*: sorting emotionally manipulative posts into a black hole while non-manipulative content escapes through an exit channel.
- *Debate Table*: spotting logical fallacies in structured debates.
- *Conspiracy Labyrinth*: navigating a tunnel filled with conspiratorial and non-conspiratorial headlines.
- *Pause Room*: a reflective space where the user tests their own reactions to provocative statements.

5. Final challenge: viral campaign debunking

After training, the user faces an integrated “viral storm” scenario: a composite feed around a fictional but realistic climate-and-war-related controversy. They must apply all five strategies (checking provenance, noticing emotional triggers, assessing reasoning, identifying conspiratorial framings and pausing before reacting) to decide how to respond. This final mission echoes AI4Debunk’s emphasis on real-world viral narratives rather than isolated claims.

6. Epilogue in the final TruthSpace room

Having succeeded, the user exits the Klein Bottle into the final TruthSpace: a marble-like platform above the clouds, with a central fountain where NUTRU stands, small plants, an armchair facing the sun and translucent columns of organised data. NUTRU summarises the user’s progress, highlights badges and insights earned, and explicitly links the VR journey back to the user’s everyday digital desk.

Throughout, disinformation appears not as human villains but as semi-autonomous phenomena (webs, storms, labyrinths) that react to the user’s decisions, reinforcing the idea that information ecosystems strengthen or weaken based on how people interact with them.

7.2 EPISODE-BY-EPISODE SCRIPT STRUCTURE

This subsection summarises the scripted structure of the main episodes, with indicative dialogue excerpts. The text is conceived as a reference for implementation rather than as a fixed shooting script; wording may be adapted during localisation and playtesting while preserving intentions and key beats.

Opening cinematic

Narrative goal:

Introduce NUTRU, establish the Klein Bottle metaphor, and confront the user with the contrast between their ideal “digital desk” and the current chaotic state of their information space.

Setting & action:

Inside a strange, net-like environment, headlines and posts stretch across spherical walls. A waveform representing NUTRU’s voice gently pulses around the user. For a brief moment, the scene flickers to a serene room above the clouds, the future TruthSpace, before collapsing back into noise.

Key dialogue (NUTRU):

- “Hello. I’m NUTRU, your AI partner. Welcome to the beta version of TruthSpace, your all-in-one VR space for work, meeting, creating, and staying informed.”
- “What you see around you isn’t quite that calm yet. This is what happens when your feeds fill with unchecked posts, misleading headlines and recycled rumours.”
- “Together, we’ll clear this web of disinformation and build a space that works for you, not against you. Shall we begin?”

The cinematic closes with the environment “breathing”, noise slightly receding as the user gains control and a minimal interface appears.

Tutorials with narrative elements

Narrative goal:

Teach core interactions (gaze, hand tracking, grabbing strands, sorting content) while reinforcing the fiction that NUTRU is configuring a personalised TruthSpace “beta build” for the user.

Episode 1 - Interaction tutorial

Users learn how to bring up feeds, rotate content, and sort items via gestures. Tutorial prompts are spoken diegetically by NUTRU rather than appearing as generic UI.

Sample dialogue:

- NUTRU: “Try reaching out to one of these items. When you pull, you’re not just moving an image, you’re tugging on the strand of information behind it.”
- NUTRU: “Swipe it to your left to dismiss it for now, to your right to pin it as ‘interesting’. Don’t worry, nothing you do here is public. This is our training space.”

Episode 1 (optional) - Q&A with NUTRU

If the user lingers or selects an “Explain more” option, a radial menu of questions appears (e.g. “How does TruthSpace filter fake content?”). NUTRU answers concisely, emphasising transparency and adaptability:

- NUTRU: “I don’t decide truth alone. I cross-check multiple sources, highlight patterns and show you why something might be unreliable, so that you can decide with clearer information.”

This tutorial establishes NUTRU’s role as a guide rather than an infallible authority.

Dialogue scenes (mentor, adversaries, victims of disinfo)

These scenes give voice to different positions around climate and the war in Ukraine, using fictionalised but realistic narratives drawn from AI4Debunk case studies. They are scripted so that manipulative framings are clearly presented as claims to be analysed and challenged, not as endorsed truths.

Explaining the Klein Bottle and the five fields

In Episode 2, NUTRU appears as a small holographic Klein Bottle in front of the user. The environment dims to focus attention.

Sample dialogue:

- NUTRU: “This is a Klein Bottle. Imagine being trapped deep inside it. Its inside is also its outside, information from the world keeps looping back in, again and again.”
- NUTRU: “Right now, your feeds work similarly. Content flows in, gets recycled, and rarely leaves. Our goal is to find a way out of this loop.”
- NUTRU: “To do that, we’ll train in five fields: checking sources, noticing emotional pull, spotting flawed arguments, recognising conspiracy patterns, and pausing to reflect before we act.”

The five fields materialise as illuminated gateways along the corridor.

Debate table with NUTRU and synthetic debaters

Near the neck of the bottle, the user encounters a suspended debate platform. Titles hover between NUTRU and the user, while silhouettes around the table occasionally voice arguments.

Example debate prompts (explicitly framed as contentious titles to be critiqued):

- “Fossil fuels vs. renewables: The hidden truths”
- “Ukraine’s sovereignty: Myth or reality?”
- “Media bias: Truth-tellers or agenda machines?”

Sample exchange:

- Synthetic debater: “See? If one cold winter proves renewables can’t cope, it’s obvious we should stick with fossil fuels.”
- NUTRU (to user): “Listen to the structure of that argument. Are they using one example to claim an absolute rule? What evidence is missing?”
- User chooses from responses such as: “This is a hasty generalisation; one winter doesn’t prove a global trend.”

The scene focuses on identifying logical fallacies and misleading framings rather than winning a partisan debate.

Voices and silhouettes from the content

Across the game, disinformation narratives appear in headlines and posts, sometimes voiced by synthetic influencers or commentators. For instance, claims about “climate lockdowns” or suggestions that “Ukraine wants your taxes”.

NUTRU regularly intervenes to label these as examples to examine critically:

- NUTRU: “You’re hearing a claim that climate policies are just a way to ‘control your freedom’. Before we react, let’s ask: who is saying this, what evidence do they provide, and what emotions are they trying to trigger?”

Investigation missions

Investigation missions are the core mini-games through which the user practises the five critical-thinking strategies. They combine environmental storytelling with concise instructions from NUTRU.

Mission 1 - Source Evaluation: “Find the Root / Info Market”

In the information skein space, a tangled web of images, headlines and logos hangs in front of the user. Grabbing an eye-catching image pulls a strand forward, revealing its underlying outlet, logo and related items.

Parallel to this, “Info Market” stalls present mixed information about questions such as whether sea-level rise is exaggerated or whether Ukrainian refugees are responsible for local economic problems. Trusted sources (e.g. scientific agencies, refugee organisations) appear alongside dubious blogs and anonymous channels with altered logos or missing authorship.

Sample dialogue:

- NUTRU: “This dramatic image of an explosion claims to show a recent attack. Follow its strand. Where does it really come from?”
- After the user traces the strand: “We’ve reached ‘Shocking News Agency’, a site that imitates real outlets but hides its authors. That’s a red flag.”
- At a stall: “Compare these two panels on sea-level rise. Which one cites a recognised scientific body, and which one offers only a graph with no source?”

The mission reinforces that evaluating credibility is about provenance, transparency and context, not about whether a message aligns with prior beliefs.

Mission 2 - Emotional Manipulation: “Keep Calm / Viral Feed”

The user enters a cylindrical chamber where news items drift between a glowing black hole and an upward exit. Posts with strong emotional triggers glow more intensely.

Examples of emotionally loaded posts include headlines such as:

- “Climate lockdowns to control your freedom”
- “NATO is provoking World War III”

- “Youth activists are hypocrites with huge carbon footprints”

Sample dialogue:

- NUTRU: “Some of these posts are crafted to make you angry or afraid first, think later. Use your hands: send obvious emotional bait into the black hole, and let more balanced items rise toward the exit.”
- After a correct choice: “Good. You noticed how that headline used fear without giving concrete evidence. Naming the emotion is the first step to resisting it.”

As the user improves, time limits shorten, increasing pressure while NUTRU reminds them to maintain calm judgement.

Mission 3 - Logical Fallacies & Misinformation Tactics: “Debate Table / Maze”

Back at the debate platform, the user faces short, structured exchanges on topics such as energy policy or Ukraine. NPC debaters use tactics identified in AI4Debunk case studies, including cherry-picked data, false analogies and unfounded causal claims.

Sample dialogue:

- Debater: “Since some climate models had errors in the past, we can’t trust any climate science today.”
- NUTRU: “Which fallacy is at work here, strawman, false dilemma, or misusing uncertainty? Choose the best description to unlock the next door.”

Correctly identifying the tactic unlocks further rooms; repeated mistakes temporarily darken the environment to convey confusion.

Mission 4 - Conspiracy Frameworks: “Conspiracy Labyrinth”

The Klein Bottle corridor twists into a labyrinth of branching tunnels. At each junction, pairs of titles act as signposts: some represent conspiratorial narratives (e.g. “The war in Ukraine is a Western puppet show”), others are more evidence-based (“The geopolitical consequences of the Ukraine conflict”).

Sample dialogue:

- NUTRU: “Notice how this path promises simple answers, blaming hidden elites for everything. The other path sounds less sensational but invites you to look at context and evidence. Which direction moves you closer to reality?”

Selecting conspiratorial paths leads to visually impressive but ultimately looping corridors; choosing grounded titles collapses false routes and clarifies the main exit.

Mission 5 - Reflective Thinking: “Pause Room / From Mechanic to Conscious”

In the final training room, the environment becomes a straight corridor leading to a transparent door, with muted colours and slowed animations. Headlines appear one by one, such as “Ukrainian refugees are responsible for local economic problems”, followed by reflective questions.

Sample dialogue:

- NUTRU: “Before you react, step into the pause zone. What emotion does this headline trigger in you? What assumptions is it pushing?”
- Question prompt: “Can people fleeing war automatically be blamed for economic issues in a stable country?”
- NUTRU (after user response): “Taking a few seconds to ask yourself ‘What do I actually know?’ is a powerful defence against manipulation.”

Here, the emphasis shifts from judging external content to observing one’s own cognitive and emotional processes.

Final challenge: Debunking a viral fake campaign

After the five missions, the user is brought to a “storm room” where multiple strands from earlier scenes converge. A composite viral campaign unfolds across screens and floating posts. For instance, a fictional narrative suggesting that climate policies and support for Ukraine are part of a single coordinated plot to impoverish citizens. This draws on patterns described in the conspiracy-frameworks and emotional-manipulation analyses of AI4Debunk, while remaining clearly fictional.

The user must:

1. Trace the sources behind key posts (source evaluation).
2. Flag emotionally manipulative framings (emotional manipulation).
3. Identify core reasoning errors (logical fallacies).
4. Recognise how isolated claims are woven into a broader conspiracy story (conspiracy frameworks).
5. Decide, after a short pause, whether to share, ignore, report or discuss the campaign, and justify their choice (reflective thinking).

Sample dialogue:

- NUTRU: “This is what a viral ‘storm’ looks like when many strands converge. Before you act, let’s check three things: Who is pushing this? How are they trying to make you feel? And does their reasoning actually hold?”
- After the user completes the analysis: “You’ve just applied all five strategies to a complex, high-pressure scenario. This is the kind of thinking that can turn any feed into your own TruthSpace.”

This mission serves as the narrative and pedagogical climax: a practical rehearsal for real-life encounters with viral campaigns.

7.3 TONE & EMOTIONAL JOURNEY

The tone of the script balances accessibility, empathy and intellectual challenge:

- **NUTRU’s voice** is consistently friendly, kind and clever, matching the visual keywords and octopus-inspired design shown in the concept sketches. It avoids lecturing, instead posing questions, highlighting patterns and celebrating effort rather than perfection.
- **Emotional progression** follows the transformation of the environment: from the overwhelming, net-covered interior of the Klein Bottle, through increasingly focused training rooms, to the open, sunlit TruthSpace above the clouds. Soundscapes, colour palettes and the density of visual information are synchronised with the script to mirror users’ growing sense of control and clarity.
- **Handling of sensitive topics** (climate change, war in Ukraine, refugees, “Great Reset” narratives, etc.) is carefully framed. All contentious statements are clearly presented as in-game examples of misinformation or polarised framings to be analysed and questioned. When such a headline appears, NUTRU explicitly signals that “this is a claim to examine, not a fact to accept”, and prompts users to connect their analysis to evidence and multiple perspectives.
- **From dependency to autonomy.** Early scenes emphasise NUTRU’s guidance, “we’ll work together to free you”, while later scenes shift towards reinforcing the user’s own agency: “You are now ready to unlock this transparent door in order to reach your new TruthSpace.”
- **Closing mood.** In the final room, NUTRU’s dialogue slows and softens, recognising the user’s effort and linking badges and insights to concrete behaviours (“You consistently checked the origin of information before deciding”, “You became more cautious about emotionally charged headlines”). The tone is congratulatory but modest, emphasising that the journey of critical thinking continues beyond VR into the user’s everyday digital environment.

Taken together, the narrative and dialogues of TruthSpace are designed to make critical-thinking strategies emotionally resonant and memorable. Users do not merely read about techniques; they hear them voiced, see them embodied in space and feel their impact on an evolving environment that they co-create with NUTRU.

8. EVALUATION FRAMEWORK

The evaluation framework for TruthSpace is designed to demonstrate, in a transparent and measurable way, how the VR serious game contributes to AI4Debunk’s overarching goals: strengthening citizens’ resilience against disinformation on climate change, the war in Ukraine and related polarised topics, and operationalising the five core critical-thinking strategies embedded in the gameplay.

Evaluation is conceived as a multi-layered process combining:

- Educational and cognitive indicators (what users learn and can do after playing);
- Behavioural and attitudinal indicators (how they approach information, trust and doubt);
- In-game analytics (how they actually perform inside the Klein-Bottle-inspired environment and its levels);
- Usability and user experience indicators, with a specific focus on accessibility and inclusivity;
- Technical stability and adoption metrics relevant for large-scale deployment.

The framework is aligned with the game’s internal structure: users progress through levels that correspond one-to-one to the five critical-thinking strategies (source evaluation, recognising emotional manipulation, identifying logical fallacies and misinformation tactics, understanding conspiracy frameworks, and engaging in reflective thinking). Each level generates observable behaviours that can be translated into Key Performance Indicators (KPIs), while the narrative arc from the noisy Klein Bottle corridor to the calm TruthSpace above the clouds supports pre-/post comparisons of users’ knowledge, skills, attitudes and perceived overload.

Where feasible, evaluation will follow a pre/post within-subjects design, complemented in selected pilots by comparison groups exposed to non-immersive materials (e.g. traditional media-literacy resources). Short pre-tests and post-tests, standardised questionnaires and in-game logs will be combined with qualitative feedback from interviews and focus groups with different personas (citizen learners, students, educators, journalists, debunking practitioners).

8.1 KPIs

The KPIs for TruthSpace are grouped into five families: (a) learning and critical-thinking outcomes, (b) behavioural and attitudinal change, (c) in-game performance and analytics, (d) engagement, usability and acceptance, and (e) technical robustness and scalability. Together, they allow us to assess both the effectiveness and the practical deployability of the VR application across different contexts.

8.1.1 LEARNING AND CRITICAL-THINKING OUTCOMES

This KPI family assesses the extent to which TruthSpace helps users acquire and consolidate the five critical-thinking strategies that underpin the game design.

KPI 1 - Source-evaluation accuracy (pre/post)

Percentage of correct answers in short scenario-based tests where users must judge the credibility of different sources (e.g. distinguishing between an anonymous sensationalist outlet and an established scientific or humanitarian institution). Scenarios are derived from the “Find the Root / Info Market” training missions and climate/Ukraine case studies, but are not identical to in-game content to minimise memorisation effects.

KPI 2 - Emotional-manipulation detection

Improvement in users’ ability to label headlines or posts as emotionally manipulative versus proportionate/neutral, measured with a pre/post classification task using short items inspired by the “Viral Feed / Keep Calm” level (e.g. fear-based refugee narratives, outrage-driven climate framings).

KPI 3 – Logical-fallacy recognition

Change in the number of correctly identified reasoning errors (e.g. hasty generalisation, false dilemma, strawman, misused uncertainty) in written or audio mini-arguments that mirror those used at the debate table with NUTRU.

KPI 4 - Conspiracy-framework awareness

Improvement in users’ ability to recognise when isolated claims are being woven into a broader conspiracy narrative (e.g. “Great Reset”, puppet governments, “elites controlling everything”) and to articulate why such framings are problematic.

KPI 5 - Reflective-thinking tendency

Increase in self-reported use of reflective strategies (pausing before sharing, seeking additional information, questioning one's own assumptions) when confronted with provocative content, assessed through short Likert-scale items anchored in the "From Mechanic to Conscious / Pause Room" level.

For all five KPIs, the primary data source is pre/post questionnaires administered immediately before and after the TruthSpace session. In pilots with sufficient sample size, effect sizes (e.g. Cohen's *d*) will be calculated to estimate the magnitude of change attributable to the VR experience.

8.1.2 BEHAVIOURAL AND ATTITUDINAL CHANGE

Beyond specific skills, AI4Debunk aims to influence how users approach information in general, especially in relation to trust, doubt and responsibility. The following KPIs capture this broader impact.

KPI 6 - Calibration of trust

Change in users' ability to differentiate between "more" and "less" trustworthy sources instead of relying on blanket distrust or blind trust. Operationalised through rating tasks where participants assign trust scores to diverse outlets and briefly justify their choices.

KPI 7 - Willingness to verify before sharing

Self-reported likelihood of checking information (e.g. searching for additional sources, reading beyond the headline) before sharing, liking or commenting on social media. Items explicitly reference situations akin to those in the emotional-manipulation and viral-storm scenes.

KPI 8 - Perceived self-efficacy in dealing with disinformation

Users' confidence in their ability to deal with misleading or conspiratorial content, measured via a short scale (e.g. "I feel capable of noticing when information is trying to manipulate me emotionally") linked to behaviours rehearsed in the game.

KPI 9 - Attitudes towards AI support in media literacy

Perception of NUTRU and, by extension, AI-assisted tools as helpful, transparent and non-intrusive aids for critical thinking. This KPI is particularly relevant for AI4Debunk's aim to integrate human reasoning with AI support and will be monitored through items on trust, clarity of explanations and perceived autonomy ("NUTRU helped me think, but did not decide for me").

These indicators are collected via post-session questionnaires and, where possible, follow-up surveys several weeks after the intervention to explore persistence of attitudinal change.

8.1.3 IN-GAME PERFORMANCE AND ANALYTICS

The Klein-Bottle-based design and the five levels of TruthSpace naturally generate rich interaction logs. These in-game data are anonymised or pseudonymised and used to derive KPIs that complement self-report measures with behavioural evidence.

KPI 10 - Level completion and progression patterns

Proportion of users who complete each level; distribution of time spent and number of retries per mini-game. This indicates which critical-thinking strategies are most challenging in practice (e.g. more failed attempts in the conspiracy labyrinth than in source evaluation may signal the need for additional scaffolding).

KPI 11 - In-game task accuracy

Percentage of correct decisions in core tasks: correctly classifying sources, correctly sorting manipulative vs balanced items, correctly identifying fallacies, correctly choosing non-conspiratorial paths, and consistent use of the “pause” mechanism in the final level when appropriate.

KPI 12 - Use of help and hints

Frequency and timing of requests for NUTRU’s optional hints or explanations. High hint usage in particular segments can reveal where concepts are difficult or instructions unclear.

KPI 13 - Behaviour under time pressure

Changes in accuracy and decision latency as time limits tighten in the emotional-manipulation level, providing insight into how well users can maintain critical judgement in conditions that approximate real-world social-media use.

These KPIs support formative evaluation (iteratively improving level design and difficulty curves) and summative evaluation (quantifying how effectively the implemented version supports each targeted strategy).

8.1.4 ENGAGEMENT, USABILITY AND ACCEPTANCE

To be impactful, TruthSpace must be not only pedagogically sound but also engaging, comfortable and acceptable to diverse user groups, including VR novices. Engagement and usability KPIs therefore play a central role in the evaluation framework.

KPI 14 - Session duration and voluntary replay

Average time spent in the application and proportion of users who choose to replay levels or explore optional content (e.g. additional explanations from NUTRU).

KPI 15 - Perceived immersion and presence

Self-reported sense of “being there” inside the Klein Bottle and, later, in the final TruthSpace, using a short presence or immersion scale tailored to the project. High immersion is expected to reinforce the metaphor of being “inside” an information bubble.

KPI 16 - Overall usability (System Usability Scale)

Global SUS score and item-level patterns, described in detail in Section 8.2.

KPI 17 - Accessibility and comfort

User feedback on motion-sickness, clarity of UI elements, readability of texts, comfort of interaction modes (e.g. teleportation vs continuous movement), and suitability of the experience for different age groups and abilities. These data are collected via short questionnaires and facilitator observations, especially in school and community settings.

KPI 18 - Acceptance by educators and facilitators

Ratings by teachers, trainers and workshop organisers on ease of integration into existing programmes, clarity of learning objectives, and perceived added value compared to non-immersive materials.

8.1.5 TECHNICAL ROBUSTNESS AND SCALABILITY

Finally, for potential post-project exploitation, it is essential that TruthSpace performs reliably across different hardware setups and organisational contexts.

KPI 19 - Application stability

Number of crashes, freezes or critical bugs per playing hour during pilot sessions, logged automatically and cross-checked with facilitator reports.

KPI 20 - Performance across devices

Basic performance metrics (frame rate, loading times) on supported VR headsets, ensuring that visual complexity of the Klein Bottle sets and the final room above the clouds remains compatible with comfort and safety requirements.

KPI 21 - Deployment readiness

Time and effort required by host organisations (schools, libraries, NGO hubs) to install, configure and run TruthSpace, including dependencies on network connectivity and availability of trained facilitators.

These KPIs help determine whether the application can realistically support large-scale awareness-raising and training campaigns beyond controlled laboratory conditions.

8.2 USAGE EVALUATION - SUS

The System Usability Scale (SUS) is adopted as the primary instrument for assessing overall usability and perceived quality of the TruthSpace interface. SUS is a widely used, technology-agnostic questionnaire that yields a single score on a 0-100 scale, allowing comparison with other interactive systems and benchmarking of successive builds of the application.

8.2.1 RATIONALE FOR SUS

SUS was selected because it:

- Is short and easy to administer (10 items on a 5-point agreement scale), which is important in school and workshop settings where time is limited;
- Is neutral with respect to domain and technology, allowing comparison of TruthSpace with other AI4Debunk tools and with alternative media-literacy resources;
- Has been extensively used in VR and educational contexts, providing reference values for interpreting scores (e.g. “acceptable”, “good”, “excellent” usability ranges).

Using SUS alongside more specific KPIs helps ensure that positive learning outcomes are not achieved at the cost of a frustrating or confusing user experience.

8.2.2 ADMINISTRATION PROCEDURE

SUS will be administered as follows across AI4Debunk pilots:

- **Timing.** Immediately after completion of the TruthSpace session, once users have exited the headset and, where relevant, taken a short break to mitigate any physical discomfort. This ensures that impressions are fresh while avoiding responses driven purely by novelty.
- **Target respondents.** All primary user groups (citizen learners, students, journalists, educators) will be invited to complete SUS, except where age or local ethical constraints require parental consent. Educators and facilitators may complete a separate SUS instance focusing on their experience of setting up and orchestrating the application.

- **Language and localisation.** SUS items will be translated into the languages used at pilot sites, following standard translation/back-translation procedures to preserve meaning and polarity of statements (e.g. alternation between positively and negatively worded items).
- **Mode of delivery.** Depending on the context, SUS may be administered on paper, via tablets or through a short web form. In all cases, responses will be recorded anonymously or under pseudonyms compatible with the project’s data-protection framework.

Participants will be briefly reminded that SUS does not evaluate their performance or knowledge but only how easy and pleasant it was to use TruthSpace.

8.2.3 DATA ANALYSIS AND INTERPRETATION

SUS responses will be scored according to the standard method (item-wise transformation to a 0-4 scale and multiplication by 2.5 to yield a 0-100 score). For each pilot and user group, AI4Debunk will compute:

- Mean SUS score and standard deviation;
- Distribution of scores (e.g. proportion of users scoring above 70, often taken as a threshold for “acceptable” usability);
- Item-level averages to identify specific strengths and weaknesses (e.g. perceived complexity, consistency, need for technical support).

Results will be interpreted in conjunction with qualitative comments from participants and facilitators (e.g. open-ended questions about what they liked most/least, or suggestions for improvement), as well as with the in-game KPIs and learning outcomes described in Section 8.1. For instance, a level that produces good learning gains but systematically low SUS scores may require redesign of its interaction patterns, pacing or feedback.

8.2.4 INTEGRATION WITH THE OVERALL EVALUATION STRATEGY

SUS-based usage evaluation is not treated as an isolated exercise but as a core component of the iterative design cycle for TruthSpace:

- In early formative tests, SUS scores and item patterns will guide adjustments to navigation, UI layout, feedback timing and comfort settings in levels such as the emotional-sorting chamber and the conspiracy labyrinth.
- In later summative pilots, SUS results will be triangulated with learning KPIs, behavioural measures and adoption indicators to determine whether the VR application is ready for wider deployment in training and awareness-raising activities.

By combining SUS with domain-specific indicators, AI4Debunk ensures that TruthSpace is not only theoretically grounded and pedagogically effective, but also usable, enjoyable and accessible to the diverse communities it is intended to serve.

9. CONCLUSION & NEXT STEPS

The TruthSpace VR platform has successfully positioned itself as a unique and interactive tool to combat misinformation through critical thinking and AI-assisted guidance. By placing users in an immersive virtual environment inspired by the geometry of a Klein Bottle, TruthSpace offers a metaphorical and experiential approach to tackling disinformation. Users collaborate with the AI assistant, NUTRU, to navigate chaotic information environments, applying critical-thinking strategies to clear the space and build a more trustworthy digital ecosystem.

Key Takeaways:

- The application effectively translates AI4Debunk's research on disinformation into a hands-on learning experience. The five critical-thinking strategies (source evaluation, emotional manipulation detection, logical fallacy identification, conspiracy framework awareness, and reflective thinking) are implemented as core gameplay mechanics. These strategies are reinforced through mini-games, reflective challenges, and narrative-driven content, helping users develop practical skills for resisting misinformation.
- The use of immersive VR technology allows for embodied learning, where users physically interact with information structures and gain a visceral sense of how disinformation operates within digital environments. This enhances the transferability of learned strategies to real-world applications, such as navigating social media, evaluating news sources, and resisting emotional manipulation in online spaces.
- NUTRU, as the friendly AI mentor, has played an essential role in guiding the user journey, ensuring that the learning experience is both engaging and accessible. The system's feedback mechanisms and tailored prompts help users progress at their own pace, while the immersive world gradually transforms from chaotic to serene, visually representing the user's growing competence in managing information.

Next Steps:

1. **Implementation & Pilot Testing:** TruthSpace is ready for deployment in pilot settings, with multiple user groups, including students, educators, journalists, and the general public, set to engage with the platform. These pilots will allow for comprehensive testing of the application's pedagogical and technical effectiveness, identifying areas for refinement based on user feedback and in-game performance analytics.

2. **Evaluation & Iterative Improvements:** The next phase will involve gathering data through Key Performance Indicators (KPIs), focusing on user engagement, critical-thinking outcomes, and usability. Additionally, System Usability Scale (SUS) evaluations will help assess the application's accessibility and comfort across diverse age groups and abilities. Based on this data, further adjustments will be made to enhance gameplay mechanics, content clarity, and overall user experience.
3. **Scalability & Expansion:** The application will continue to evolve, with additional levels, content, and potentially real-time social-media feeds integrated into the experience. Future updates may expand to support multilingual and culturally diverse contexts, making the platform more adaptable to a wider international audience.
4. **Integration with Educational Programs:** TruthSpace has significant potential as a tool for media literacy workshops and educational programs. Partnerships with educational institutions, NGOs, and media organizations will facilitate its integration into curricula aimed at fostering resilience against disinformation.
5. **Post-Pilot Refinements:** Based on feedback from initial user testing, TruthSpace will be fine-tuned to better address any remaining challenges users face in applying critical thinking to disinformation. The development team will refine both the narrative structure and gameplay to ensure that the platform provides sustained, real-world applicability.

In conclusion, TruthSpace offers an innovative and engaging approach to combating misinformation, fostering critical thinking, and building resilience in today's information-rich digital environments. Through continuous improvement and adaptation, it holds the promise of empowering users worldwide to engage with information more responsibly, thoughtfully, and critically.

10. USER MANUAL AND TECHNICAL DOCUMENTATION

10.1 PURPOSE AND SCOPE

This section provides (a) a practical user manual for operating TruthSpace as a standalone VR serious game and (b) technical documentation to support deployment, maintenance, and iterative development. The application is designed as an immersive training environment where the user collaborates with the in-game AI assistant NUTRU to practise five critical-thinking strategies against disinformation through a sequence of levels and mini-games.

10.2 USER MANUAL

Intended users and usage contexts

TruthSpace is intended for citizen learners, youth/students, educators/facilitators, and media practitioners, and can be used either as a self-paced individual experience or in facilitated sessions (classroom/workshop/public engagement). The experience is structured episodically (onboarding → five training levels → epilogue) and can be replayed as separate modules when used for teaching or demonstrations.

Safety, comfort, and play-area preparation

Before launching the application, users should:

- Ensure a clear play area free of obstacles (especially for reaching/throwing gestures used in sorting tasks).
- Use comfortable footwear and secure headset straps.
- Prefer seated mode for first-time VR users or those susceptible to discomfort.
- Take short breaks between levels if they experience nausea, dizziness, eyestrain, or fatigue.

TruthSpace is explicitly designed to reduce cognitive load over time by transforming the environment from visually noisy to progressively calmer; nevertheless, users new to VR should begin with comfort-oriented locomotion options and shorter sessions.

Hardware and system requirements

TruthSpace targets contemporary VR headsets with standard VR input (hand-held controllers and/or tracked hands, depending on the device). The experience relies on common interaction paradigms such as pointing, grabbing, dragging, swiping, and throwing objects in VR.

First launch and onboarding flow

On first launch, the application follows a simple onboarding sequence:

1. **User information / session configuration:** a short step to configure basic settings and personalise guidance/feedback.
2. **Welcome scene:** the user starts in a noisy “information space,” introduced to the overall goal and the AI assistant NUTRU.
3. **Interaction tutorial:** users learn core actions (bringing up feeds/objects, grabbing/rotating content, sorting items, and progressing through prompts) in a low-stakes context.
4. **Concept introduction:** NUTRU explains the Klein Bottle metaphor (information loops/echo chambers) and introduces the five critical-thinking “fields” that structure the game.

Core interaction model (how to play)

TruthSpace uses consistent interactions across levels so users do not have to relearn controls each time:

- **Select / focus:** point or gaze at an item to highlight it for inspection.
- **Grab and inspect:** pick up items (headline cards, images, nodes in the information skein), rotate them, and bring them closer to read details.
- **Swipe / browse:** navigate through content sets (e.g., sequences of posts) using simple swipe gestures.
- **Sort / classify (embodied judgement):** move items into spatial targets (e.g., “black hole” vs “exit”), reinforcing the idea that user decisions actively reshape the environment.
- **Dialogue choices:** in certain scenes, choose from short responses/questions to drive a guided dialogue with NUTRU.

Level-by-level user guide

TruthSpace implements five training chapters, each mapped to a critical-thinking strategy and embodied as a distinct VR activity pattern:

Level 1 - Source Evaluation (“Find the Root”)

Users interact with a 3D “information skein” (web of connected items). By pulling strands from an item, they reveal provenance cues (logos, outlet identity, contextual fragments) and practise judging credibility. The intended behaviour is to trace origin, compare, and decide rather than accept surface impressions.

Level 2 - Emotional Manipulation (“Keep Calm”)

Items approach the user and must be classified quickly: emotionally manipulative content is thrown into a “black hole,” while more balanced content is sent upward toward an “exit.” Time pressure increases gradually, modelling real-world impulsive feed consumption and training recognition of emotional triggers.

Level 3 - Logical Fallacies & Misinformation Tactics (“Debate”)

Users encounter debate prompts (provocative titles/claims) and practise identifying fallacies/tactics with NUTRU’s guided feedback. The user’s task is to recognise flawed reasoning patterns (not to “win” an ideological argument).

Level 4 - Conspiracy Frameworks (“The Labyrinth”)

The environment becomes a branching labyrinth. Users navigate by selecting among signposted framings, learning to detect conspiracy-style patterning and “too-simple” explanations that loop them into repetitive paths. NUTRU periodically supports “zooming out” conceptually, connecting local claims to broader frameworks.

Level 5 - Reflective Thinking (“From Mechanic to Conscious”)

The final chapter slows down. Users are prompted to notice their own reactions (emotion, assumptions, confidence) before deciding how to respond. The mechanics reward pausing and reconsideration—reinforcing metacognition as a protective strategy.

Epilogue - Final TruthSpace above the clouds

After completing the levels, users enter a calm final environment where NUTRU summarises progress and provides feedback, reinforcing transfer of skills from VR to everyday media use.

Progress, feedback, and rewards

TruthSpace emphasises learning-oriented feedback, combining:

- **Environmental feedback:** successful decisions reduce visual noise and “untangle” the information space, signalling mastery through world transformation.
- **Skill-point families:** credibility awareness, emotional resilience, and analytical thinking are tracked and summarised at breakpoints and/or in the epilogue.
- **Badges/insights:** thematic achievements and short insights connect in-game performance to broader learning concepts, presented as part of the TruthSpace profile rather than competitive scoring.

Accessibility and usability options (user-facing settings)

To support diverse audiences (including VR novices), TruthSpace is designed with accessibility and inclusivity as core constraints. Recommended user-facing options include:

- Subtitles and multilingual UI pathways (where available), with clear language and reduced jargon.
- Comfort locomotion (e.g., teleportation/comfort movement options) and adjustable comfort settings for users prone to motion sickness.
- Legible VR UI with large, high-contrast elements placed within comfortable reach zones.
- Facilitated mode (recommended for workshops), where an external observer can assist the user and debrief between levels.

Troubleshooting (end-user)

Common operational issues and recommended responses:

- Tracking/interaction feels inaccurate: re-center view, recalibrate guardian/play area, ensure adequate lighting (for inside-out tracking devices), and retry the tutorial interactions.
- User feels discomfort: switch to comfort locomotion, reduce session length, take breaks between levels, and prefer seated mode.
- Text readability issues: move the item closer, use in-app text scaling (if enabled), and rely on subtitles rather than voice-only delivery.
- Audio unclear: adjust headset volume and balance; ensure subtitles are enabled for comprehension-critical segments (especially for novice users).

10.3 TECHNICAL DOCUMENTATION

Technical overview and design principles

TruthSpace is implemented as a VR-first application in the Unity game engine, structured around a Klein-Bottle-inspired environment that transforms from noisy to calm as the user demonstrates

critical-thinking skills. The application is designed as a self-contained training experience using curated, locally stored content (it does not rely on live social media ingestion), reducing privacy and safety risks while maintaining realism through fictionalised but case-study-inspired scenarios.

Scene and module structure (reference architecture)

A practical technical decomposition aligned to the specified user flow is:

- **Bootstrap / Session Configuration Module:** user info, language/accessibility preferences, comfort settings, calibration entry point.
- **Onboarding & Tutorial Module:** interaction training, NUTRU introduction, Klein Bottle explanation, navigation to Level 1.
- **Level Modules (1–5):** each level encapsulates its own scene logic, interaction tasks, and performance measures (accuracy, time, attempts, hint usage).
- **Epilogue Module:** final TruthSpace environment, feedback summary, badges/insights presentation.

This separation supports both linear play and modular replay (useful for workshops and targeted training).

Interaction and locomotion implementation

TruthSpace’s gameplay mechanics map to standard VR interaction patterns: grabbing, pointing, selecting, dragging, throwing, and simple menu selection. Comfort options should be implemented as configuration profiles that can be set at onboarding and changed at runtime, ensuring safe use across novice and experienced VR users.

Content model and scenario packaging

The application uses multimodal assets, like 3D models (NUTRU and environments), 2D UI, and curated “information items” (headline cards, images, short video snippets where applicable). Scenarios are thematically inspired by AI4Debunk case-study domains while remaining fictionalised to support safe engagement and localisation.

A recommended implementation approach is to define scenarios as structured content units (e.g., “item + metadata + intended label + feedback prompts”), enabling iterative updates and localisation without reworking core scene logic.

Telemetry, analytics, and evaluation instrumentation

To support the evaluation framework, the minimum recommended instrumentation records:

- Level completion status and time spent per level
- Task accuracy per challenge (classification correctness)
- Response times (especially in time-pressure sequences)
- Number of attempts / retries
- Hint usage and help requests from NUTRU

These measures align with the document’s KPI approach and enable correlation with usability instruments such as SUS administered post-session.

Data protection and privacy-by-design notes

Given the educational and public-facing context, the application is specified to operate primarily on local curated content and not ingest live feeds, which reduces exposure to personal data and platform-specific risks. Where user/session data are stored for evaluation, recommended practice is to:

- Use pseudonymous session identifiers (avoid storing directly identifying personal data by default).
- Provide clear facilitator/user disclosure about what is recorded (e.g., performance metrics and level progression).
- Separate analytics logs from any optional demographic questionnaires collected outside the headset.

Performance and comfort targets (implementation guidance)

Because comfort is a functional requirement for broad adoption, technical work should prioritise stable frame rate, predictable interaction latency, and legible UI. The design already supports comfort conceptually by reducing visual clutter over time; implementation should preserve this by controlling particle effects, animation density, and UI motion in early “noisy” scenes.

Build, deployment, and maintenance recommendations

- **Build profiles:** maintain separate build configurations for pilot deployment vs internal testing (e.g., analytics verbosity, debug overlays).
- **Localisation workflow:** keep all user-facing strings (NUTRU dialogue captions, UI labels, prompts) externalised for translation and back-translation, consistent with multilingual pilot needs.
- **Content update strategy:** because the experience uses curated content, updates should focus on swapping/expanding scenario packs while keeping core mechanics stable, enabling iterative refinement based on pilot findings.

Recommended facilitator workflow (for classrooms/workshops)

For facilitated sessions, the recommended operational pattern is:

1. Prepare the play area and headset comfort settings.
2. Run onboarding and tutorial with the user (especially first-time VR participants).
3. Complete 1-2 levels, then pause for a short debrief linking in-game decisions to real-world media habits.
4. Continue remaining levels or select only those aligned to the session’s learning goals.
5. Administer SUS and short post-session reflection immediately after headset removal, as described in the evaluation approach.

Review Sheet of Deliverable/ Milestone Report

D10.5 REPORT ON THE DEFINITION OF THE ARVR ENVIRONMENTS APPLICATIONS

Editor(s):	Dr. Despina Elisabeth Filippidou (DOTSOFT), Karanasios George (DOTSOFT), Stavros Katsaridis (DOTSOFT), Katsakioris Dimitris (DOTSOFT), Nikas Marios (DOTSOFT), Simeonidou Anastasia (DOTSOFT), Nikopoulos George (DOTSOFT), Maragkos Christodoulos (DOTSOFT)
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Review date	20/02/2026

Disclaimer: This assessment reflects only the author's views and the European Commission is not responsible for any use that may be made of the information contained therein"

Mark with X the corresponding column:

Y= yes	N= no	N = not applicable
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ELEMENT TO REVIEW	Y	N	NA	COMMENTS
FORMAT: Does the document ... ?				
...include editors, deliverable name, version number, dissemination level, date, and status?	Y			The report doesn't include editors' names.
...contain a license (in case of public deliverables)?			NA	
...include the names of contributors and reviewers?	Y			
...has a version table consistent with the document's revision?			NA	
... contain an updated table of contents?	Y			
... contain a list of figures consistent with the document's content?	Y			
... contain a list of tables consistent with the document's content?			NA	
... contain a list of terms and abbreviations?	Y			
... contain an Executive Summary?	Y			
... contain a Conclusions section?	Y			
... contain a List of References (Bibliography) in the adequate format, if relevant?			NA	
... use the fonts and sections defined in the official template?	Y			
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... conform to length guidelines (50 pages maximum (plus Executive Summary and annexes)	Y			
... conform to guidelines regarding Annexes (inclusion of complementary information)			NA	

ELEMENT TO REVIEW	Y	N	NA	COMMENTS
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ELEMENT TO REVIEW	Y	N	NA	COMMENTS
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Have you noticed any text in the document not well referenced? (copy and paste of text/picture without including the reference in the reference list)		N		
SOCIAL and TECHNICAL RESEARCH WPs (WP4, 5, 12, 13, 14)				
ELEMENT TO REVIEW	Y	N	NA	COMMENTS
Is the deliverable sufficiently innovative?	Y			
Does the document present technical soundness and its methods are correctly explained?	Y			
What do you think is the strongest aspect of the deliverable?				The clear and coherent integration of social research on disinformation with an immersive technical design.

ELEMENT TO REVIEW	Y	N	NA	COMMENTS
What do you think is the weakest aspect of the deliverable?				
Please perform a brief evaluation and/or validation of the results, if applicable.			NA	
AI AND TECNOLOGICAL WPS (WP6 – WP11)				
ELEMENT TO REVIEW	Y	N	NA	COMMENTS
Does the document present technical soundness and the methods are correctly explained?	Y			
What do you think is the strongest aspect of the deliverable?				Clear technical specification of the VR application.
What do you think is the weakest aspect of the deliverable?				Scalability details in the report are limited.
Please perform a brief evaluation and/or validation of the results, if applicable.			NA	
DISSEMINATION AND EXPLOITATION WPs (WP15 – WP17)				
ELEMENT TO REVIEW	Y	N	NA	COMMENTS
Does the document present a consistent outreach and exploitation strategy?	Y			
Are the methods and means correctly explained?	Y			
What do you think is the strongest aspect of the deliverable?				TruthSpace is designed as a highly visible, engaging flagship VR application that can be used in classrooms, workshops, public events and awareness campaigns.
What do you think is the weakest aspect of the deliverable?				More detailed exploitation strategy could be described.
Please perform a brief evaluation and/or validation of the results, if applicable.			NA	
DISSEMINATION AND EXPLOITATION WPs (WP18)				
ELEMENT TO REVIEW	Y	N	NA	COMMENTS

ELEMENT TO REVIEW	Y	N	NA	COMMENTS
Does the document present the main ethical aspects regarding the use of methods and human involvement?	Y			
What do you think is the strongest aspect of the deliverable?				
What do you think is the weakest aspect of the deliverable?				
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SUGGESTED IMPROVEMENTS

PAGE	SECTION	SUGGESTED IMPROVEMENT
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CONCLUSION

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