

Towards Immersive Training for Inclusive Education: Co-designing a Virtual Reality Application for Educators

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The European Conference on Education 2026
Official Conference Proceedings

Abstract

This study examines how educators' needs can inform immersive training scenarios for supporting learners with Autism Spectrum Disorder (ASD). Grounded in Design-Based Research, it used a sequential mixed-methods design: an online questionnaire-based survey, interviews and co-design workshops. Survey results showed a gap between direct experience and specific training, alongside conditional interest in virtual reality (VR)-based professional development. Interviews identified recurring challenges involving sensory overload, explicit communication, oral assessment, and unexpected transitions. Workshop participants evaluated eight interview-derived scenarios and prioritized three: instruction lost in classroom noise, refusal to give an oral presentation, and an unexpected classroom transition. The study contributes a traceable process linking field needs to refined, prioritized training scenarios and derives design implications for a future immersive educator training.

Keywords: inclusive education, Autism Spectrum Disorder, virtual reality, educator professional development, Design-Based Research

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Introduction

Inclusive education requires educators who are both equipped with practical strategies and confident in their ability to support learners with Autism Spectrum Disorder (ASD), yet international guidance continues to identify a persistent gap between the policy commitment to inclusion and the practical preparedness of the educators expected to deliver it (UNESCO, 2017). Immersive technologies, and virtual reality (VR) in particular, are increasingly explored as a way to let trainees rehearse difficult classroom situations from a first-person perspective, with recent systematic evidence suggesting a positive, if heterogeneous, effect of VR on teacher-education outcomes (Billingsley et al., 2019). Realizing this potential for ASD-inclusive training specifically requires deliberate design attention: autistic people are a heterogeneous population, and simulations that are not carefully designed risk flattening that diversity into a single, stereotyped portrayal (Maun et al., 2024; Newbutt & Bradley, 2025), underscoring the need for a solid, field-grounded design process to unlock VR's potential for ASD-inclusive educator training, rather than counting against its use.

This paper reports the needs-analysis phase of a Design-Based Research (DBR) project that aims to design and evaluate a VR application for training educators to support ASD learners. Rather than starting from a technological solution, the project starts from documented classroom experience: an online questionnaire-based survey and semi-structured interviews with educators were used to surface recurring difficulties and existing pedagogical strategies, and two co-design workshops with professionals then used this material to evaluate, refine, and prioritize pre-drafted candidate training scenarios. The paper's contribution is methodological and empirical: it shows how field-level needs were progressively translated into three concrete, prioritized immersive scenarios, and derives design implications for the next, still-ongoing development phase.

Related Work

Educator Preparedness for ASD-Inclusive Teaching

International policy frames inclusive education as a systemic transformation rather than an add-on (UNESCO, 2017), yet educators frequently report themselves under-prepared, describing persistent gaps between formal training and “real-world” practice (Devi et al., 2024). This gap is especially salient in higher education: autistic students remain an under-recognized university population whose sensory, communicational, and organizational needs persist or intensify under new academic demands (Anderson et al., 2017). Autistic students' own French accounts of university life echo this pattern, describing sensory overload, inconsistent accommodation, and the effort of seeking help (McPeake et al., 2023), while inclusive-pedagogy practice remains unevenly adopted among university staff themselves (Kennel et al., 2021). In-service training reviews similarly find active, practice-based components (coaching, modelling, feedback) consistently more effective than didactic delivery alone (Wang et al., 2024) - a direct rationale for an experiential, rehearsal-based medium such as VR.

Sensory Processing and the Case for Immersive Rehearsal

Between 60% and 96% of autistic people report sensory sensitivities, and difficulty filtering competing auditory input is a mechanistically distinct barrier to attention and social processing, not simply distractibility (Mallory & Keehn, 2021). VR and mixed-reality simulation are increasingly used to let teachers and educators rehearse communication and classroom-

management skills under repeatable, low-stakes conditions (Larson et al., 2025), with reported gains in preparedness for challenging behaviour specifically (Billingsley et al., 2019; Chen, 2022; Cumming et al., 2025). Evidence specific to autism shows VR-based perspective-taking can build longer-lasting empathy than traditional exercises (Herrera et al., 2018), and a randomized trial found VR effective for autism-awareness training specifically (Koniou et al., 2025).

Research Questions

Taken together, the literature highlights both a persistent need for practice based professional development in ASD inclusive education and the potential of immersive simulation to support experiential learning. However, less is known about how educators' field-reported needs and classroom experiences can be systematically translated into immersive training content. Accordingly, this study addresses the following research questions:

RQ1. What training needs and recurring classroom difficulties do educators themselves identify in relation to ASD-inclusive teaching?

RQ2. How can these needs be translated into, and prioritized as, immersive training content?

Method

Design-Based Research and Mixed-Methods Design

The study follows a Design-Based Research approach (Sanchez & Monod-Ansaldi, 2015), combining a sequential mixed-methods needs analysis (questionnaire-based survey followed by interviews) with co-design workshops. Each phase built on the previous one: survey responses informed the interview guide and identified volunteers for the interviews, and the interview themes were used to draft the eight candidate scenarios subsequently evaluated in the co-design workshops.

Questionnaire

An online questionnaire-based survey was made available in French and English versions; respondents completed whichever language version they preferred. It was distributed through professional mailing lists in higher-education based in France, academic social networks (Linkedin), and direct contact. The survey collected demographic information, direct ASD-related experience, prior training, current inclusive practices, and attitudes toward VR and co-design participation. It received 92 responses in total for analysis. The full questionnaire, including an English version, is provided as supplementary material.

Semi-structured Interviews

Thirteen individual video-call interviews were conducted with 14 participants (one session was a joint interview with two interviewees), recruited primarily from questionnaire-based survey respondents who indicated interest in further participation. All 14 were selected for their direct expertise in supporting ASD learners: each was an experienced practitioner (teacher, teacher-trainer, specialized educator, or pedagogical-support professional) who already had, or had previously had, at least one learner with ASD in their own classroom or caseload. Interviews were semi-structured: each opened with the same core question about the participant's professional background and ASD-related experience, after which further questions probed

classroom experiences, pedagogical strategies, institutional constraints, and attitudes toward immersive training, with question order and follow-up adapted to each participant's responses (full interview guide, including an English version, provided as supplementary material). Interviews were between 45 and 60 minutes. Each session was recorded and transcribed for analysis purposes only; recordings were not retained beyond the analysis or shared publicly.

Co-design Workshops

Two 2-hour online co-design workshops (8 and 10 December 2025) were conducted as live video-conference sessions (Microsoft Teams) using a shared Miro board to present eight pre-drafted candidate scenarios, each specifying a narrative summary, a point-of-view (learner or teacher), and an intended sensory/interactive mechanic. Eleven distinct professionals participated across the two sessions (6 in the first, 5 in the second; no overlap between the two groups). Ten had also taken part in the interview phase; one had not: a speech-language-therapy student recruited via the facilitator's professional network for the first session. The two sessions used an identical protocol and scenario set and were conducted independently: second session participants were not informed of the first session's discussion or votes, and the scenario materials were not modified between sessions. Participants rated perceived realism, discussed causes and possible teacher responses, and could cast up to three dot-votes to prioritize which scenarios to develop first in VR; 29 votes were placed across the two sessions. Both sessions were recorded and transcribed for analysis purposes only, on the same basis as the interviews; recordings were not retained beyond the analysis or shared publicly.

Data Analysis

Questionnaire-based survey data were analysed using descriptive statistics (frequencies, percentages, and selected cross-tabulations on the largest valid subgroups), computed directly from the cleaned response dataset; open-ended responses were grouped through thematic content analysis. Interview transcripts were imported into NVivo 14 (Lumivero, 2023) and analysed inductively: familiarization with each transcript, open coding of recurring difficulties and strategies, and consolidation of codes into higher-order themes through iterative comparison across participants. NVivo was used to organize the transcripts, manage the coding structure, and retrieve coded excerpts; coding decisions were made by the researcher, not automated. Workshop analysis combined verbatim session transcripts, written Miro contributions, realism assessments, and vote counts to identify recurring arguments, divergences, proposed adaptations, and scenario-prioritization criteria. The open-text item on current pedagogical practice was additionally visualized as a frequency-scaled phrase cloud (Figure 3) after removing common French stopwords and merging obvious spelling or accent variants. Qualitative coding (interviews and workshops) was conducted by one researcher, without a second coder or inter-rater reliability check.

Results

Figure 1 previews how the three phases connect to the three prioritized scenarios reported in detail below.

Figure 1

The Three-Phase Research Process, From Field Needs to Prioritized Immersive Scenarios



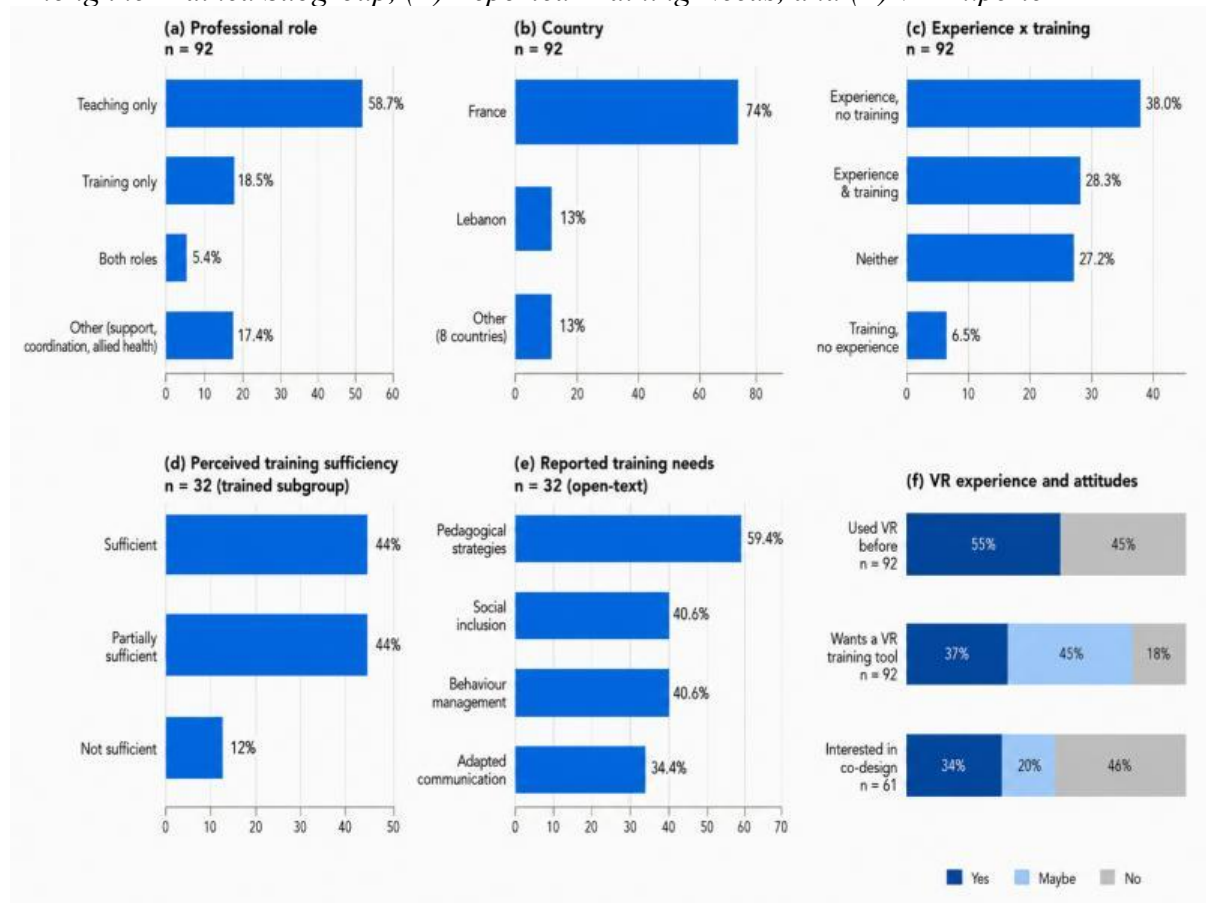
Questionnaire-Based Survey: Sample and Training Needs (N = 92)

Respondents were 51.1% female, 45.7% male, and 3.3% preferred not to say, with a mean age of 41.7 years (SD = 11.8) and a mean of 14.7 years of professional experience (SD = 10.4). Contrary to a general “school teacher” framing, most respondents reported teaching at university/higher-education level and identified primarily as teachers or teacher-trainers, with a minority in support, coordination, or allied-health roles (Figure 2a). The sample was drawn predominantly from France and Lebanon, with eight further countries (Switzerland, Belgium, Niger, Benin, Germany, Estonia, Spain, Slovakia) each represented by one to four respondents (Figure 2b). Because France and Lebanon differ in composition, we checked whether the overall patterns reported below are geographically confounded: higher-education status varies by country (88.2% of French respondents vs. 58.3% of Lebanese respondents teach at university level), whereas direct ASD experience does not vary as much (France 66.2%, Lebanon 75.0%, other countries 58.3%); these are descriptive comparisons on small national subgroups, not inferential tests, and are reported to make the sample’s composition transparent rather than to claim a country effect.

Sixty-six percent had already supported at least one ASD learner, mostly in higher-education or mainstream classroom settings, while only 34.8% had received specific ASD/inclusive-education training (Figure 2c); this asymmetry – 38.0% of respondents had direct experience without specific training, versus only 6.5% the reverse – indicates that direct classroom experience with ASD learners is not, on its own, translating into formal preparation for most respondents. Training itself did not fully close the gap: of the 32 respondents who had received specific training (the same 32 respondents throughout panels 2d and 2e below), only 43.8% rated it fully sufficient, and self-rated ASD knowledge was descriptively higher among this trained subgroup (M = 4.13/5) than the untrained majority (M = 2.78/5, computed from a separate self-rating item asked of all 92 respondents), a descriptive association rather than a tested effect. Among these 32 respondents, the areas they most wanted to deepen were pedagogical strategies and social inclusion (Figure 2e; respondents could select more than one area, so percentages sum to more than 100%). Fifty-five percent had already used a VR device, predominantly for recreational rather than professional or ASD-specific purposes; VR use was itself somewhat more common among French respondents (60.3%) than Lebanese respondents (33.3%). Prior VR use was not associated with stronger interest in a VR training tool (37.3% “yes” among prior VR users vs. 36.6% among non-users), but it was associated with more outright refusal (23.5% “no” among prior users vs. 12.2% among non-users) and less hedging (“maybe”: 39.2% vs. 51.2%) – prior exposure to VR appears to sharpen respondents’ opinions in both directions rather than simply increasing demand. Among the 61 respondents with direct ASD experience, 34.4% expressed interest in participating in a co-design study (Figure 2f).

Figure 2

Questionnaire Results Overview (N = 92): (a) Professional Role, (B) Country, (C) Direct ASD Experience Crossed With Prior Training, (D) Perceived Sufficiency of That Training Among the Trained Subgroup, (E) Reported Training Needs, and (F) VR Experience



The most frequently reported strategies for supporting ASD learners were adaptation of teaching materials (adaptation des supports; 17/60), individualized support (accompagnement individuel; 9/60), visual communication (communication visuelle; 8/60), and work in pairs (travail en binôme; 6/60), reflecting a broader emphasis on adapting instructional materials and formats, clarifying communication, and providing individually tailored support (Figure 3). Several respondents also reported exempting ASD students from oral presentations or group activities rather than adapting the activity itself – a real-world precedent directly relevant to one of the co-design workshops’ prioritized scenarios.

Figure 3

Frequency-Scaled Phrase Cloud of Pedagogical Strategies Reported by Questionnaire-Based Survey Respondents, in Their Original French Wording (Open-Text Responses, N = 60; Phrase Size Represents the Number of Respondents Who Mentioned Each Expression)



Interviews Recurring Themes

Thematic analysis of the 14 interview participants identified eight higher-order themes, presented below together with the scenario each most directly informed.

Sensory overload was the most pervasive concern, spanning two related themes: difficulty filtering a teacher's voice from competing classroom sounds (raised by most participants), and, more broadly, visual, tactile, and multisensory regulation – light, touch, smell, stimulating, and the stigma-risk of visible quiet spaces. Several participants, some of whom also drew on lived experience of autism, described their own post-lecture shutdowns in terms that illustrate the felt intensity of this difficulty, not only its frequency: “c’est comme si j’étais dans un concert sans bouchon d’oreille toute la journée” (“it’s like being at a concert without earplugs all day long”; anonymized interview excerpt, translated from French) – a first-person account that directly supports modelling this theme as an experiential rehearsal scenario rather than a lecture topic.

A near universal recommendation concerned the use of explicit, sequenced, and dually oral and written instructions. Participants also emphasized the importance of clarifying implicit social expectations and avoiding ambiguous language. Discussions of social inclusion and masking revealed an unresolved tension between respecting a learner's preference to work alone and encouraging participation in group activities. Oral-presentation anxiety emerged as a related concern, particularly when expectations, speaking order, or assessment criteria were unclear. More broadly, participants repeatedly stressed the need to interpret behaviours commonly perceived as challenging as possible signs of anxiety, sensory overload, or unmet needs rather than deliberate defiance. Sudden or insufficiently signposted changes in routine were frequently described as factors that could intensify distress.

Participants also identified institutional and systemic barriers, including difficulties related to disclosing a diagnosis, accommodations being implemented more consistently during examinations than in everyday teaching, and limited participation in autism-awareness training; one participant reported, for instance, that only around 30 of an estimated 800 eligible staff had attended such training at their institution – a self-reported figure that was not independently verified and is reported here as an illustration of perceived low uptake rather than an audited statistic. They also highlighted persistent misconceptions that an awareness-raising tool should address, particularly the tendency to portray autistic people as either exceptionally capable or severely impaired, without recognizing the wide diversity of profiles between these extremes, as well as misconceptions concerning eye contact.

Co-design Workshops: Scenario Evaluation and Prioritization

The eight candidate scenarios were derived directly from the interview themes and translated recurring classroom experiences into concrete situations suitable for immersive training. During both workshops, participants assessed their realism, discussed possible causes and pedagogical responses, and cast up to three votes for the scenarios they considered most relevant for future development. Because most workshop participants had also taken part in the interviews from which the scenarios were derived, realism assessments are best read as informed appraisal by an engaged practitioner community rather than fully independent validation; scenarios synthesized recurring patterns across the full interview sample rather than any single participant's account, which limits, without eliminating, the risk of participants simply re-endorsing their own prior statements. Across the 29 votes recorded (14 in the first workshop, 15 in the second), the three highest combined totals were obtained by Instruction Lost in Classroom Noise (4 + 4 = 8 votes), Refusal to Give an Oral Presentation (1 + 4 = 5 votes), and An Unexpected Classroom Transition (2 + 2 = 4 votes). The noise and transition scenarios received stable support in both sessions, whereas the oral-presentation scenario showed greater between-workshop variation (from the least-voted scenario in the first session to tied for most-voted in the second). The three scenarios were retained on this combined prioritization and the pedagogical richness of the discussions they generated; the five non-prioritized scenarios are documented in supplementary materials rather than in the main text, for space.

Table 1

Prioritized Co-design Scenarios: Brief Description and Targeted Educator Competencies

Scenario	Brief Description	Educator Competencies for Autism-Inclusive Practice
Instruction Lost in Classroom Noise	An important oral instruction becomes difficult to process because it is delivered amid competing classroom sounds and simultaneous visual or physical activity.	Recognizing sensory overload and auditory-filtering difficulties; reducing simultaneous stimuli; providing concise and multimodal instructions; using visual supports; checking individual understanding without interpreting confusion as inattention.

Refusal to Give an Oral Presentation	An autistic learner refuses to give an oral presentation in front of the group, creating tension between common assessment requirements and individual accommodation needs.	Distinguishing anxiety from defiance; applying equitable rather than identical treatment; clarifying expectations and speaking order; proposing equivalent assessment formats; communicating without minimizing the learner's distress.
An Unexpected Classroom Transition	A learner who has not completed or mentally closed an activity resists an unexpected transition to the next task.	Supporting cognitive flexibility and executive functioning; anticipating changes; using explicit and literal language; providing visual and temporal cues; clarifying how and when an unfinished task will be resumed.

Discussion: Integrating the Three Phases

What Each Phase Contributed

The three phases did not produce three disconnected findings; each narrowed and grounded the next, and together they answer RQ1. The questionnaire-based survey established the breadth of the training gap across the broader sample: two-thirds had direct ASD experience but only a third had received specific training, and over half of that trained minority still felt under-prepared, alongside broad but conditional openness to a VR training tool. The interviews supplied the situated and explanatory detail the survey could not reach: not just that “communication” and “behaviour management” were named needs, but why participants attributed lost instructions to competing sensory channels rather than simply to inattention, and why apparent “defiance” is more productively read as an unmet need. Read together, the survey and interviews show that educators’ self-identified training needs (RQ1) are recurring, situated, and only partly addressed by current practice, rather than a diffuse or idiosyncratic list of complaints.

Why These Scenarios Matter, and What This Study Contributes

The workshops answer RQ2. The three prioritized scenarios are not simply the most frequently mentioned difficulties; they share a structure well suited to immersive rehearsal. Each depicts a brief, high-stakes decision point at which a small, low-cost change in the educator’s own behaviour determines whether the situation de-escalates or compounds (for example, pausing before speaking, offering an alternative format, or giving advance warning of a transition): the kind of in-the-moment judgment that lecture-based training struggles to convey but a repeatable simulation can. They also cover complementary mechanisms rather than one repeated theme: sensory filtering, social anxiety, and executive-function/routine change, together representing a deliberately broad first slice of the difficulties surfaced across all three phases rather than a narrow or redundant set. This is an empirical description of what the workshops produced; the pedagogical claims that follow are our interpretation of why it matters, not a further finding.

Beyond the three scenarios themselves, this study's main contribution is methodological: a transparent, traceable progression from field-reported needs to prioritized training content, in which each scenario can be traced back to specific survey findings and interview themes and its inclusion justified by an auditable workshop vote count rather than by design judgment alone. The approach also operationalizes a principle several participants insisted on: that training content should be grounded in, and negotiated with, practitioners who have direct field experience of ASD-inclusive teaching, not designed about them in their absence. This is a standard for how the content was developed, not a requirement that future trainees already share that experience – the resulting scenarios are intended precisely for educators who do not yet have it. This study approximates that co-design standard through educator and researcher collaboration, while explicitly falling short of directly including autistic co-designers, an important direction for subsequent development phases.

Conclusion

This study set out to identify educators' self-reported training needs and classroom difficulties in ASD-inclusive teaching (RQ1), and to examine how these needs can be translated into, and prioritized as, immersive training content (RQ2). The questionnaire-based survey and interviews answer RQ1: educators across the sample described a persistent gap between direct classroom experience and specific ASD training, and identified recurring, situated difficulties – sensory overload, ambiguous or implicit communication, oral-assessment anxiety, and unsignposted transitions – that current practice addresses only unevenly. The co-design workshops answer RQ2: translating these needs into training content is achievable through a traceable process in which interview themes are drafted into candidate scenarios, then appraised for realism and prioritized by a second group of practitioners, yielding three concrete, evidence-grounded scenarios – an instruction lost in classroom noise, a refusal to give an oral presentation, and an unexpected classroom transition – together with concrete design implications for each. Taken together, these findings are a complete, self-contained contribution: a transparent, auditable path from field-reported needs to prioritized immersive training content, independent of whether a prototype is subsequently built. Developing and technically specifying these scenarios into a working VR prototype, and evaluating its usability, acceptability, and training effect once available, is future work that this study's findings make possible rather than work this study depends on to be complete. The study's scope is also its main boundary: the sample is weighted toward higher-education staff in France and, secondarily, Lebanon, so the difficulties and scenarios reported here should be read as grounded in that context rather than assumed to generalize directly to K-12 settings or to countries outside this sample; extending this needs-analysis-to-scenario process to other education levels and national contexts is a natural direction for future work.

Ethics and Data Protection

The study received a favourable opinion from the *Comité d'Éthique de la Recherche Arts et Métiers* (reference CER_AM_2025_012, committee session of 4 September 2025). Participation in the questionnaire, interviews, and co-design workshops was voluntary, and participants gave informed consent prior to data collection, with the right to withdraw at any time. Questionnaire respondents could optionally provide an email address to receive information about the continuation of the study or to volunteer for subsequent interviews and co-design activities. These contact details were stored separately from the analytical dataset and were not used in the analysis or reporting of results. Direct identifiers were removed from the data used for analysis; institutions are not named, interview quotations are presented as

anonymized excerpts, and workshop participants are described only by professional role. All data were stored securely and processed in accordance with the approved protocol.

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