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From Immersion to Narrative: Educational Experiences for Promoting the Responsible Use of Virtual Reality in Childhood

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Abstract: This study explores how 4-year-old children rework a brief immersive virtual reality experience within an adult-mediated procedure structured according to Tisseron's principles of Accompaniment, Alternation and Self-Regulation. The sample comprises 9 children involved in 11 immersive sessions lasting a maximum of approximately 5 minutes each. Data were collected using an ad hoc observational grid, integrating behavioural and emotional indicators, verbal accounts and graphic productions. The analysis, predominantly qualitative and supported by descriptive statistics, highlights form of perceptual, autobiographical and imaginative-narrative reworking, as well as individual differences in willingness to continue the experience. Five participants produced a total of six post-immersion drawings, considered as complementary qualitative material. The findings are interpreted in exploratory rather than causal terms, emphasising the role of adult mediation and the intentional transition between the virtual environment, verbalisation and non-digital representation.

Keywords: virtual reality; childhood; digital education; Tisseron's 3A framework; narrative; self-regulation.

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1. Introduction

The early diffusion of digital technologies has shifted the pedagogical debate from the opposition between risks and opportunities to the conditions that make experience meaningful. Outcomes do not depend on the device itself, but on the interaction between the child's characteristics, the quality of the content, the context of use and adult mediation (Vedechkina & Borgonovi, 2021). In early childhood, this perspective is particularly relevant, as self-regulation and executive functions are still developing (Garon et al., 2008).

Immersive virtual reality introduces a further element of complexity: sensory engagement and the sense of presence can make the experience highly intense and require attention to the distinction between representation and reality (DeLoache, 2004). Children may attribute a high degree of perceptual realism to virtual environments (Bailey & Bailenson, 2017), and immersive experiences may influence memory and interpretation processes (Segovia & Bailenson, 2009). Available reviews

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EDIZIONI UNIVERSITARIE ROMANE
editoria scientifica dal 1952

therefore emphasise the central importance of the design that precedes, accompanies and follows the use of the device (Hamilton et al., 2021; Aiello et al., 2012).

From this perspective, Tisseron's 3A model (2016) provides a framework centred on Accompaniment, Alternation and Self-Regulation: the active presence of an adult, the intentional transition between digital and non-digital activities, and the progressive opportunity for the child to recognise and communicate preferences, emotions and discomfort. The study employs this model as a theoretical and methodological framework to observe how a brief immersive experience is reworked at perceptual, emotional, autobiographical and imaginative-narrative levels.

One aspect that remains underexplored concerns what happens after immersion: not merely whether the child pays attention or expresses enjoyment, but how the experience is translated into words, memories, spatial relationships, desires and representations. This shift is particularly relevant to the present study, which does not treat virtual reality as an independent variable whose effectiveness is to be measured, but rather as a stimulus embedded within an observational and dialogic sequence. The analytical focus therefore concerns the forms of reworking that emerge during and immediately after the experience, and the way in which they are articulated within a procedure characterised by the presence of an adult.

2. Objectives and Research Questions

The general objective is to explore the ways in which 4-year-old children rework a brief virtual reality experience mediated by an adult. The main research question is: what forms of perceptual, emotional, narrative and autobiographical reworking emerge during and after the experience? A second question concerns the transition from perceptual description to reworking: what connections with memories, desires and imaginative productions emerge in the children's verbal accounts (Nelson & Fivush, 2004), and what function do the adult's questions assume within the procedure? The analysis also considers engagement, emotional states and the willingness to continue or interrupt the immersive experience, without attributing causal value to these indicators.

3. Materials and Methods

3.1. Sample and Study Design

The analytical sample comprises 9 children aged 4 years (N = 9), including 5 boys (55.6%) and 4 girls (44.4%). A total of 11 sessions were analysed: all participants experienced *Ocean* (9 sessions; 81.8%), and two children also chose *End of Dinosaurs* (2 sessions; 18.2%); *Camping*, although available, was not selected. Seven participants completed one session, while two completed two sessions (mean = 1.22). Sessions had a planned maximum duration of approximately 5 minutes and could be interrupted at any time. Quantitative data were used exclusively for descriptive purposes, distinguishing between participants (N = 9) and sessions (n = 11). Qualitative materials are presented using the anonymous codes P1-P9.

Choices by gender are reported for descriptive purposes only: all 4 girls experienced *Ocean*; among the 5 boys, all selected *Ocean* and 2 also selected *End of Dinosaurs*. The sample size does not allow inferences regarding the association between gender and scenario choice.

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3.2. Instrument and Materials

For each session, the researcher completed an ad hoc observational grid. The instrument integrated session data, behavioural indicators (curiosity, pointing/interaction, concentration, distractibility, physical reactions), willingness to continue or interrupt the experience, and five emotional states: joy/enthusiasm, fear/fright, wonder/surprise, calmness/relaxation, and confusion/disorientation. Presence indicators were coded as 0/1; continuation was coded on a three-level scale (-1 = interrupt; 0 = no position expressed; 1 = continue). Emotional intensity was recorded on a 0-2 scale and accompanied, to make it accessible to the children, by a bodily representation of the magnitude of the emotion through the opening of the arms.

The open-ended fields recorded descriptions of what the child saw, personal memories, negative emotions, inventiveness/imagination, and researcher notes. The qualitative material was examined according to four levels: perceptual-descriptive, emotional, autobiographical, and imaginative-narrative, consistently with perspectives that consider narrative a privileged tool for the construction of meaning and identity (Bruner, 1990), and with approaches that interpret technologies as educational mediators supporting learning and inclusion processes (Lecce, 2021).

Drawing was offered as a complementary, non-mandatory activity: 5 participants out of 9 (55.6%) produced 6 drawings, all relating to *Ocean*; one participant produced two drawings. The drawings were described in terms of their manifest content, without standardised assessment or psychological interpretation.

Table 1 Dimensions and Data Collection Procedures

Dimension	Indicators/Materials	Encoding
Engagement	Curiosity; interaction; concentration; distractibility; physical reactions.	0 = absent; 1 = present.
Continuation	Request to continue/stop	-1; 0; 1
Emotions	Joy; fear; wonder; tranquility; confusion	Presence 0/1; Intensity 0–2
Rework	Descriptions; memories; emotions; imagination; notes	Open text fields
Graphic production	Post-dive drawing, when available	Complementary quality material

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The analysis followed a predominantly qualitative logic, supplemented by frequencies and percentages of observational indicators. The verbalizations were brought back to the levels defined in the grid without transforming them into scores: perceptual and spatial description, emotional expression, autobiographical linkage and imaginative-narrative production. The categories could coexist in the same verbalization. Behavioral and emotional data were used to contextualize the textual materials and not as measures of effectiveness. Given the presence of two participants with two sessions, no inferential analyses or statistical comparisons between scenarios or subgroups.

3.3. Scenarios and procedure

The stimuli were three environments available on Delightex Edu: Ocean, marine environment with animals and objects; End of dinosaurs, characterized by dinosaurs and elements referring to their disappearance; Camping, camping environment and outdoor life. The scenarios were alternatives chosen by the child and not assigned experimental conditions. Ocean generated 9 sessions, End of dinosaurs 2, Camping 0. The procedure applied the 3A's as interconnected principles. Before the dive, the researcher presented the headset, clarified the simulated nature of the environment, briefly collected expectations and proposed the choice of the scenario (Accompaniment). During the experience, he stayed next to the child, observed the reactions and asked open-ended and non-evaluative questions about perceived elements, spatial relationships and emotions in line with approaches that attribute to the dialogic mediation of the adult a function of support and scaffolding in learning processes (Wood et al., 1976).

The child could ask to stop at any time (Accompaniment and Self-Regulation).

After the removal of the viewer, the child was invited to tell what he had seen and felt and to connect it, when it emerged spontaneously, to imagine memories, desires or actions. Whenever possible, the drawing was proposed. The intentional transition from the virtual environment to speech, memory and graphic representation concretized the Alternation. This transition also favored the comparison between virtual experience and lived reality, enhancing the reflection on the relationship between digital environments and real contexts that characterizes contemporary immersive experiences (Di Tore et al., 2022). Self-regulation was not assumed as an already acquired skill or as an effect of virtual reality, but observed in emotional expressions, preferences and requests for continuation or interruption. In fact, cognitive control and behavior regulation skills follow a progressive developmental path during childhood (Best & Miller, 2010). These skills continue to evolve throughout the developmental age (Diamond, 2013).

Table 2 Summary of the procedure according to the 3A.

Momento	Attività	Principio prevalente	Dati
Before	Presentation, virtual/real distinc-	Accompaniment	Expectations; Scenario

	tion, choice		
During	Exploration, adult presence, open questions	Accompaniment Self-regulation	Behaviors; emotions; verbalizations prosecuzione
After	Removal of viewer, story, memories, imagination, drawing	Alternation + Self-Adjustment	Verbal and graphic re-elaborations

4. Results

The analysis concerns only the 11 sessions of the 9 4-year-old children. The quantitative indicators describe the observational context; the verbalizations constitute the main material to examine the forms of re-elaboration.

4.1. Involvement, emotions and continuation

Curiosity was observed in all sessions (11/11), concentration in 10/11 and physical reactions in 9/11; indication/interaction and distractibility were recorded in 2/11 sessions each. In 9/11 sessions the child expressed the desire to continue, in one he did not express a position and in one he asked to stop. In the latter case, the request was accompanied by the verbalization of a physical discomfort ("my eyes burn"), a fact interpreted as communication of one's state and not as a negative outcome of the experience.

On an emotional level, joy/enthusiasm, wonder/surprise and tranquility are recurrent, but fear and confusion also appear. The coexistence of different states makes a positive/negative dichotomous reading inadequate. One participant, for example, reports: "At first I was a little afraid, but then I found it a beautiful experience." The verbalization documents a transformation of the emotional response during the same experience.

Table 3. Behavioral indicators in the 11 sessions.

Indicatore	Frequency (n)	Percentage (%)
Curiosity	11	100,0
Concentration	10	90,9
Physical reactions	9	81,8
Indication/interaction	2	18,2
Distractibility	2	18,2
Request to continue	9	81,8
No location	1	9,1
Request to stop	1	9,1

4.2. From perception to reworking

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The verbalizations show a first perceptual-descriptive level, in which the children name spatial elements and relationships. P4 describes Ocean as "the Dorians, fish with stripes, a glass with the ocean inside, above I see the sky and on the sides the ocean, a box"; another description includes "a chest that does not open, fish jumping up, a garbage and glasses [...] I see the sun. The chest and the fish seem close to me". In End of dinosaurs there are references to characteristics and distance: "A rock, a brown and yellow dinosaur, the dark, the dinosaur seems far away to me". Terms such as above, on the sides, near and far show that verbalization also includes perceived spatial organization.

A second nucleus concerns autobiographical connections. P1 states: "I only remembered shells because I like them very much"; other participants report "I remembered diving into the sea" and "It reminds me of the nice holiday I had with my parents". In some cases, the observation recalls aspects of the real world that are not strictly autobiographical: P4 notes that "there is also garbage in the ocean", while P5 mentions "a plastic, a plastic box, a small fish, the sea".

A third level concerns imagined desires and actions. Starting from the elements of Ocean, expressions such as "I would like to be able to open the chest", "I would like to go for a swim" and "I would like to take a dip in the sea" emerge. P5 also links the scenario to a known activity: "I would like to go to the sea and the pool because I dive in the pool". Perception, memory and imagination therefore appear superimposed, without configuring a linear sequence or an effect attributable to the device.

Overall, verbalizations do not return rigidly separated levels. The same experience can start with the identification of an object, recall a personal episode and turn into a desire or an imagined action. This is particularly evident in the Ocean scenario, which is also the most represented scenario in the corpus. For this reason, the frequency of autobiographical and imaginative references associated with the marine environment cannot be directly compared with End of dinosaurs: the different number of sessions makes it appropriate to have a descriptive reading within the corpus, not a comparison between stimuli.

4.3. Self-regulation and individual differences

Qualitative data show that observable involvement and personal preference do not necessarily coincide. P2, while participating, says: "I like coloring more than wearing a helmet." In another session, a participant initially shows distrust and hands the headset to his mother and then takes part in the experience. The episode of interruption due to eye discomfort also confirms the relevance of the possibility of communicating discomfort and stopping. These elements were read as manifestations located in preference and regulation within the relationship with the adult, not as evidence of stable self-regulatory competence.

4.4. Graphic reworking

Five participants (55.6%) made six post-dive drawings related to Ocean; P1 produced two works. The productions vary in the number of figurative elements, the use of color and the organization of space. These differences were not interpreted in terms of graphic competence or psychological meaning. The drawing is considered a further step from the immersive experience to a non-digital form of representation, consistent with the principle of Alternation.

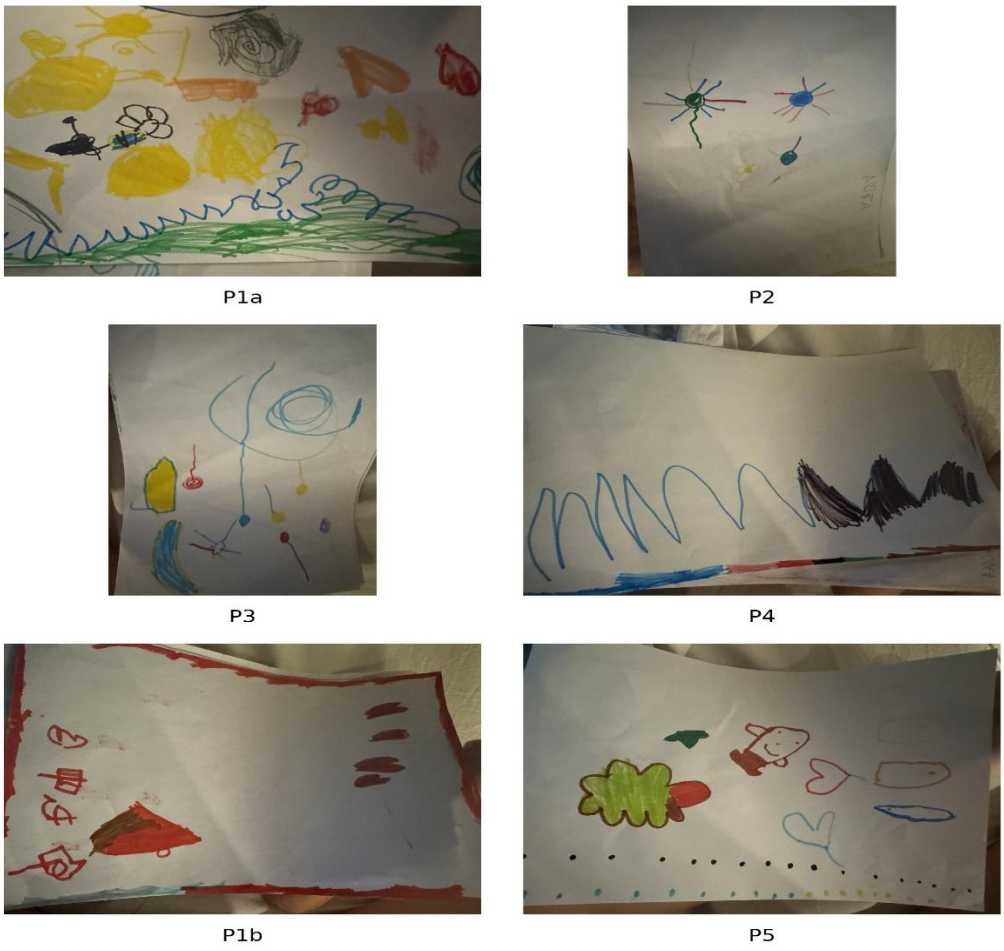


Figure 1. Post-dive graphic productions related to Ocean. P1a and P1b are two works by the same participant; the codes anonymize the children.

4.5. Summary of results

Considered together, the data shows four recurrent forms of re-elaboration: description of spatial elements and relationships; expression and transformation of emotional states; recall of personal experiences; elaboration of desires and actions not directly present in the scenario. These forms do not constitute ordered stages nor are they present uniformly in all participants. Their interest lies in the possibility of documenting how the immersive content is taken up in the child's language and connected to repertoires of experience already available.

The adult's questions are an integral part of the context in which these verbalizations were produced. However, the data does not allow us to establish whether the same re-elaborations would have emerged in the absence of questions or with a different mode of mediation. Consequently, the role of the adult is described as a component of the procedure and not as the cause of the observed

outcomes. Similarly, high involvemeshowss not taken as a sufficient indicator of the quality of the experience: the preference for alternative activities, the initial hesitation and the request for interruption show a variability that the observation of attention alone would not capture.

Graphic productions expand the corpus without constituting a parallel measure to verbalizations. Their availability for only five participants and the absence of a standardized delivery prevent comparisons between children. However, they document, for the available cases, the transition to a different representative code after the removal of the viewer. In this limited reading, their value is documentary: they show that post-immersion reworking can also take a graphic form, but they do not allow inferences about the development, learning or symbolic meaning of the individual elements represented.

5. Conclusions

The study explored how 4-year-olds rework a brief virtual reality experience within an adult-mediated procedure structured according to the 3A. The data show that the experience does not end in observable involvement: perceptual and spatial descriptions, autobiographical references, emotional expressions and imaginative developments emerge in verbalizations. These dimensions can coexist and intertwine, without authorizing a linear or causal reading.

The framework of the 3A's made it possible to organize and interpret the entire path. The Accompaniment concerned preparation, presence during the immersion and questions from the adult; the Alternation took the form of a return to the physical environment and the transition to speech and, for some children, to drawing; Self-regulation was observed in preferences, emotional expressions and the possibility of continuing or interrupting. The single episode of interruption associated with physical discomfort was therefore considered as a situated communication of one's state, not as proof of a permanently acquired ability.

The results must be read in the light of the limitations of the study: small sample (N = 9), 11 sessions with non-uniform distribution between scenarios, two participants with repeated observations, absence of a comparison group and a condition without adult mediation. It is therefore not possible to attribute the forms of re-elaboration to virtual reality or to the researcher's questions. The grid has been built ad hoc, and the quantitative indicators have an exclusive descriptive function; even the drawings, not produced by all children, constitute complementary qualitative material. Subsequent studies will be able to verify these patterns on larger samples and with comparative drawings capable of distinguishing the contribution of the different components of the procedure.

Finally, the exploratory nature of the study requires caution with respect to the transferability of the results. The prevalence of the Ocean scenario, the brevity of the sessions and the specific mode of conduct define the perimeter within which to interpret the data. The contribution therefore consists in the analytical description of a small corpus of mediated experiences, useful for formulating hypotheses to be tested in subsequent designs, not in the demonstration of generalizable effects of virtual reality.

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