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"MAKING THE INVISIBLE VISIBLE": THE RELATIONSHIPS BETWEEN NEW TECHNOLOGIES, EMPATHY, AND MARINE BIODIVERSITY CONSERVATION

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Literature review

I. CONTEXT

- Ocean plays a major role in climate regulation, yet it faces several threats (e.g., acidification, mammals' extinction)
- Taxonomic bias: research mainly focused on vertebrate, familiar and terrestrial animals (Bègue-Shankland, 2022)
- Inegal conservation where charismatic species are privileged (Small, 2011) 🐼 🐬
- Lack of strong environmental programs within the educational elementary level (Jaoul-Grammare & Stenger, 2022)
- Children can become powerful catalysts for change in environmental protection (Gottesdiener & Davallon, 1999)

II. EMOTIONAL CONNEXION

1. Emotional Regulation

2. Cognitive Empathy
3. Emotional Empathy



4. Motivational Empathy (or Compassion)

Four independent dimensions of empathy (Decety & Holvoet, 2021)

- Environmental empathy could lead to a more ethical relationship with the natural world (Tam, 2013)
- Compassion seems to encourage environmental education and pro-conservation behaviour (Wharton et al., 2019)
- Attractiveness of marine species: Fish, amphibians and reptiles generate **few empathic response** (Miralles et al., 2019)

To what extent this empathy can be extended to marine ecosystems within an educational context ?

III. IMMERSIVE TECHNOLOGIES



- Embodiment could enhance pro-social behaviour (Xu et al., 2024)
- XR act as an empathy machine ?

Extended Reality (XR) = VR+AR+MR

Virtual Reality (VR)

Augmented Reality (AR)

Mixed Reality (MR)



Research Hypotheses

- H1:** The use of extended reality will increase the emotional connectedness between the participants and marine species.
- H2:** There will be a disparity among the species used in the research, with a predominance of charismatic animals that are phylogenetically closer to humans.
- H3:** Some technical constraints or obstacles linked to the acceptability of immersive technologies could result in fewer research among children aged from 6 to 11 years old.

Method

- Systematic review following PRISMA guidelines, conducted from 12/2024 to 02/2025
- Articles from ERIC, Scopus, PubMed, APA PsychInfo, Google Scholar and Connected Papers



Results

- Among 733 articles, 10 have been selected:

Characteristics

- Ranged from 2016 to 2024
- Used a majority of women/university students in their sample
- VR is the most used device
- Measured empathy, compassion and pro-environmental behaviour
- Mostly quantitative studies
- Predominance of charismatic species (7 out of 10 studies)

H1: ✓ VR seems to enhance feelings of empathy, connectedness with nature and reduce compassion fade* thanks to the embodiment of marine species

H2: ✓ Among 10 studies, 7 focused on marine mammals or vertebrates, 2 on corals & 1 on marine life more generally



H3: ✓ No children from 6 to 11 years old were to be found in the research papers

*compassion fade: decrease in helping behaviour as the number of people in need of help increases

Discussion, Limitations & Future Research

- XR appears as a promising pedagogic tool to enhance the emotional connectedness with nature as well as pro-conservation behaviour towards marine species.
- VR could positively influence dispositional empathy towards nature (Sierra Rativa et al., 2020).
- VR seems to increase positive attitudes towards marine life rather than knowledge about the species (Fauville et al., 2020).
- Empathy remains not sufficiently defined and is sometimes confused with other notions.
- Absence of significative difference between scores of empathy in XR and written support conditions + effects of embodiment upon empathy disappear over time (Blythe et al., 2021).
- Studies measured intentions of helping rather than real actions.
- More longitudinal research among children - using less charismatic animals - is needed to measure concrete pro-environmental behaviour towards all marine species over time.

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