TRANSFERRING AND ADAPTING XR DESIGN PRINCIPLES ACROSS THE PACIFIC

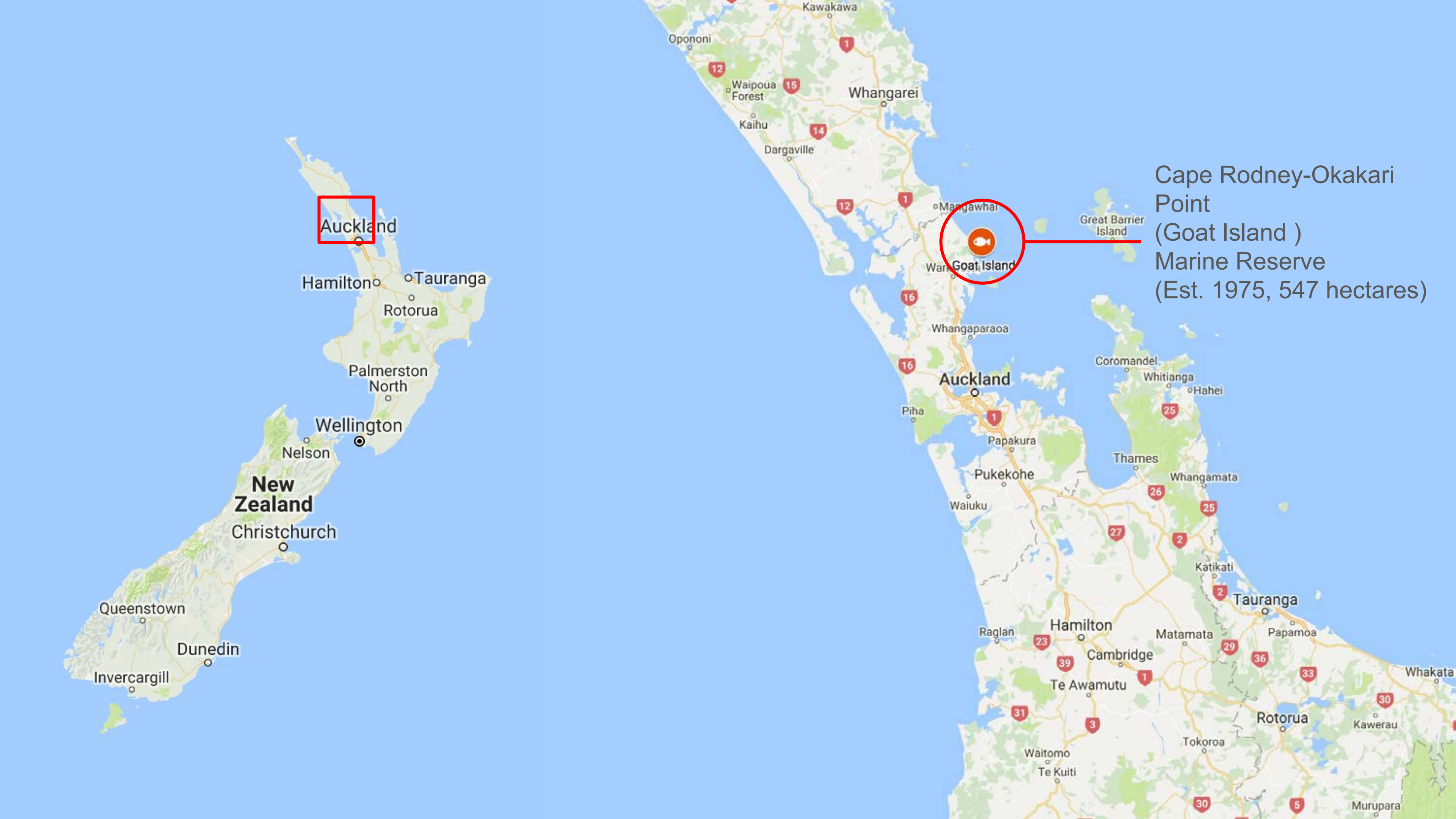
Claudio Aguayo
Auckland University of Technology

SoTEL Symposium 2022, 16-18 February, AUT City Campus / Online

TEACHING & LEARNING
RESEARCH INITIATIVE
NĀU I WHATU TE KĀKAHU, HE TĀNIKO TAKU

Designing mobile learning with education outside the classroom to enhance marine ecological literacy

Chris Eames and Claudio Aguayo


Cape Rodney-Okakari
Point
(Goat Island)
Marine Reserve
(Est. 1975, 547 hectares)
Goat Island
New Zealand
Auckland
Hamilton
Tauranga
Rotorua
Palmerston North
Wellington
Nelson
Christchurch
Queenstown
Dunedin
Invercargill
Kawakawa
Opononi
Waipoua Forest
Whangarei
Kaihu
Dargaville
Mangawhai
Great Barrier Island
Whangaparaoa
Coromandel
Whitianga
Hahei
Piha
Papakura
Thames
Pukekohe
Whangamata
Waiuku
Katikati
Raglan
Matamata
Papamoa
Cambridge
Te Awamutu
Whakata
Kawerau
Tokoroa
Waitomo
Te Kuiti
Murupara

GOAT ISLAND
MARINE DISCOVERY CENTRE
THE UNIVERSITY OF AUCKLAND
NEW ZEALAND
Te Whare Wānanga o Tāmaki Makaurau

PIPI'S WORLD

Mixed Reality Immersion Continuum

Real ⟷ **Digital**

RE - Real environment

AR - Augmented reality

VR - Virtual reality

XR - Immersive environment

Goat Island snorkelling

Real world
hands-on
experience

Kelp forest

Haptic
Plastic focus
Colouring

Goat Island REEF website

Focal point
Pre-visit
Local info

Pipi's world AR app

Lobster march
Food web
Plastic poster
Ocean acidification

QR codes 360 VR

Land,
underwater &
aerial
360 cardboard
tour

Pipi's VR adventures

Fully immersive
virtual reality
experience


Immersive learning continuum
unicef


The mouth and gill cavity of fish operate like two separate pumps, slightly offset in their timing. This ensures that water flows continuously across the gills and the maximum amount of oxygen is extracted from the water with minimum effort.
Many small or inactive marine organisms such as larvae or barnacles can diffuse gases across their skin or wave simple gill 'tufts' in the water. Larger, more active species such as fish and crayfish have specialised breathing apparatus for collecting oxygen. The gills of fish, for example, consist of thousands of thin filaments, each with very fine ridges that provide a huge surface area for oxygen and carbon dioxide to pass quickly and efficiently to and from the blood.
Like humans, cetaceans such as whales breathe air. They fill their lungs with oxygen-rich air at the surface through their blowhole. Marine mammals can stay submerged for long periods because they have high blood volumes and large levels of oxygen-carrying pigments in their muscles, which act as oxygen stores.
Coral
DEPOSIT FEEDERS
Mussels
Kina
Crayfish

Pipi’s World XR

Pipi’s World XR

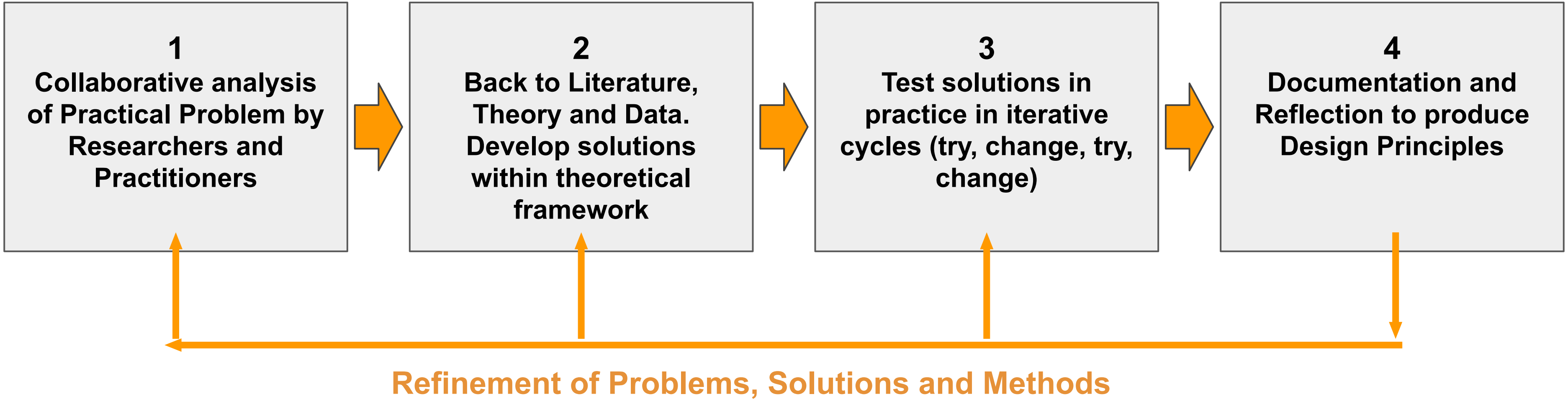
Pipi’s World XR

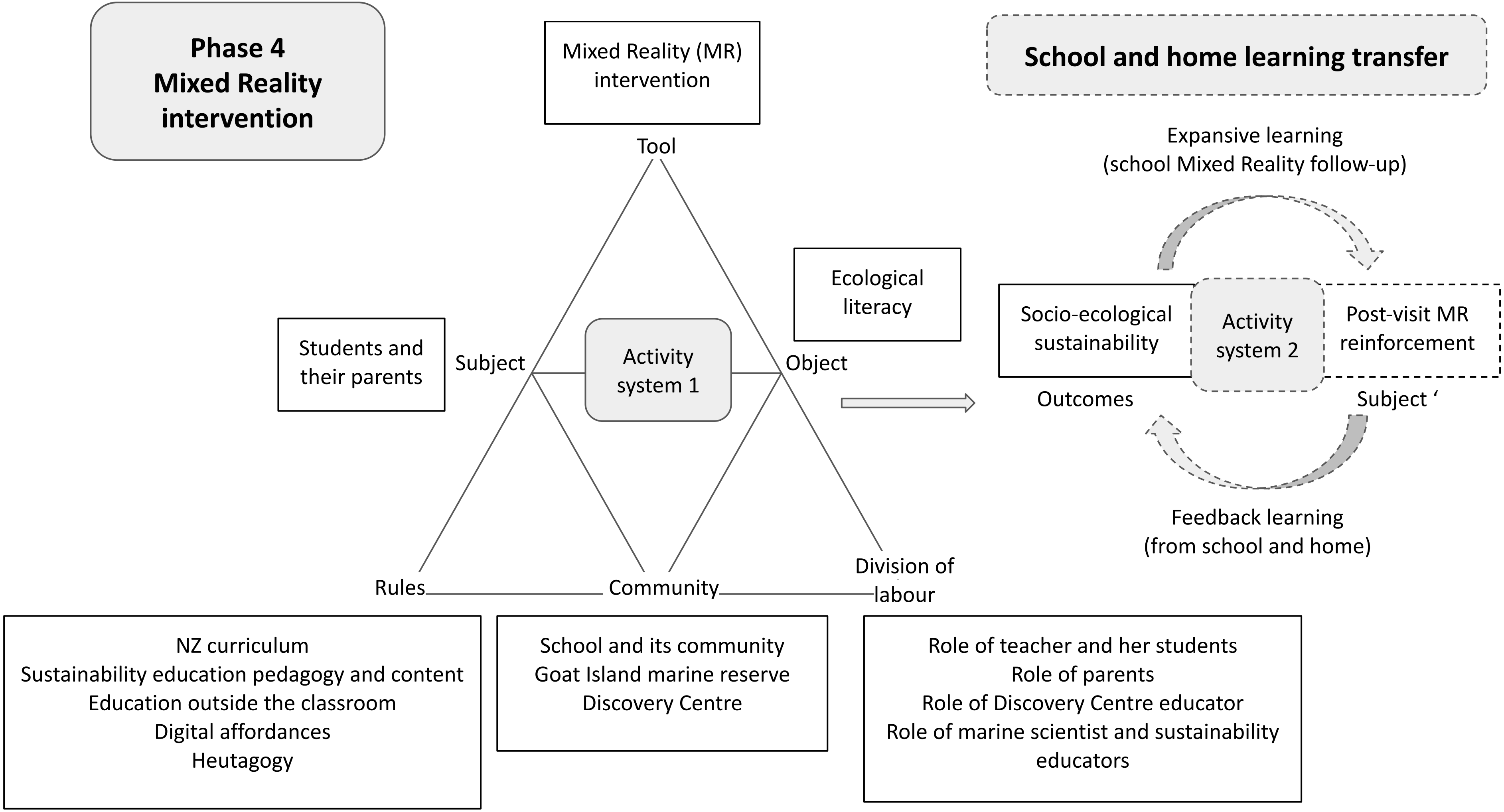

KŌ-RIMURIMU
We need your help to clean up this mess.

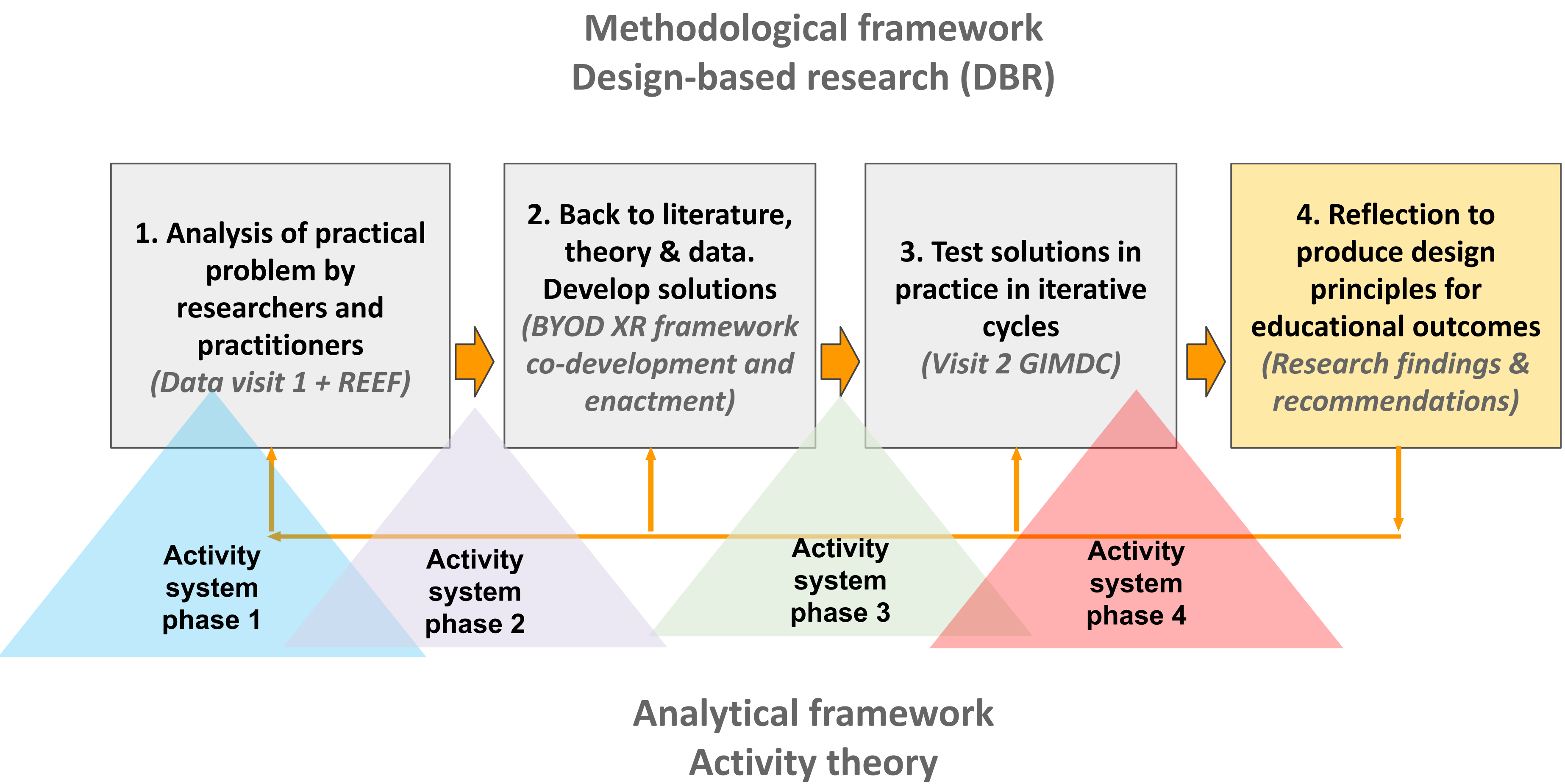

OCEAN ACIDIFICATION
NZ


16
SEAQUEL

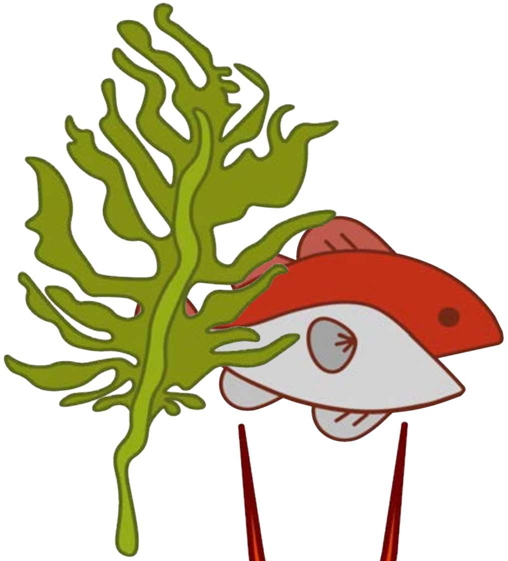
Design-Based Research (DBR) workflow

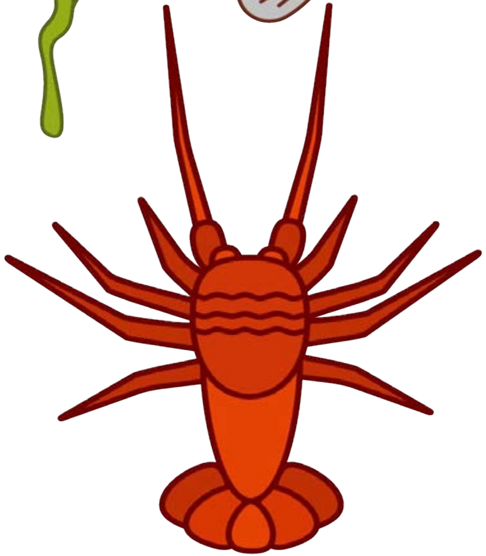



Phase 4
Mixed Reality intervention
Mixed Reality (MR) intervention
Tool
School and home learning transfer
Expansive learning
(school Mixed Reality follow-up)
Ecological literacy
Students and their parents
Subject
Activity system 1
Object
Socio-ecological sustainability
Activity system 2
Post-visit MR reinforcement
Outcomes
Subject ‘
Feedback learning
(from school and home)
Rules
Community
Division of labour
NZ curriculum
Sustainability education pedagogy and content
Education outside the classroom
Digital affordances
Heutagogy
School and its community
Goat Island marine reserve
Discovery Centre
Role of teacher and her students
Role of parents
Role of Discovery Centre educator
Role of marine scientist and sustainability educators

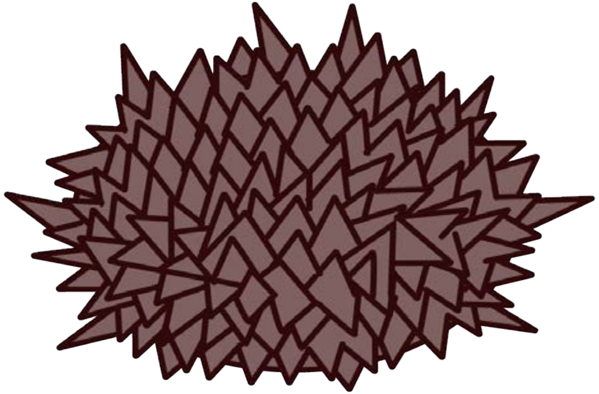


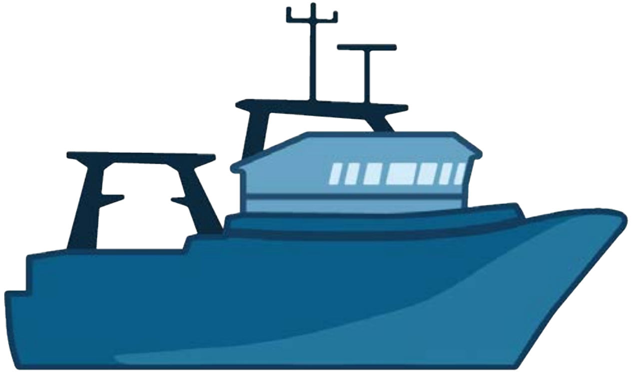
Methodological framework
Design-based research (DBR)
1. Analysis of practical problem by researchers and practitioners
(Data visit 1 + REEF)
2. Back to literature, theory & data. Develop solutions
(BYOD XR framework co-development and enactment)
3. Test solutions in practice in iterative cycles
(Visit 2 GIMDC)
4. Reflection to produce design principles for educational outcomes
(Research findings & recommendations)
Activity system phase 1
Activity system phase 2
Activity system phase 3
Activity system phase 4
Analytical framework
Activity theory





●●●●○ Carrier
8:08 AM
100%
This app lets you discover my world on special markers in the Discovery Centre.
SKIP
NEXT





Research in Learning Technology
Vol. 28, 2020

ASSOCIATION FOR LEARNING TECHNOLOGY ALT

ORIGINAL RESEARCH ARTICLE

A Framework for Mixed Reality Free-Choice, Self-Determined Learning

Claudio Aguayo[a]*, Chris Eames[b] and Thomas Cochrane[a]

[a]Centre for Learning and Teaching, Auckland University of Technology, Auckland, New Zealand; [b]School of Education, University of Waikato, Hamilton, New Zealand

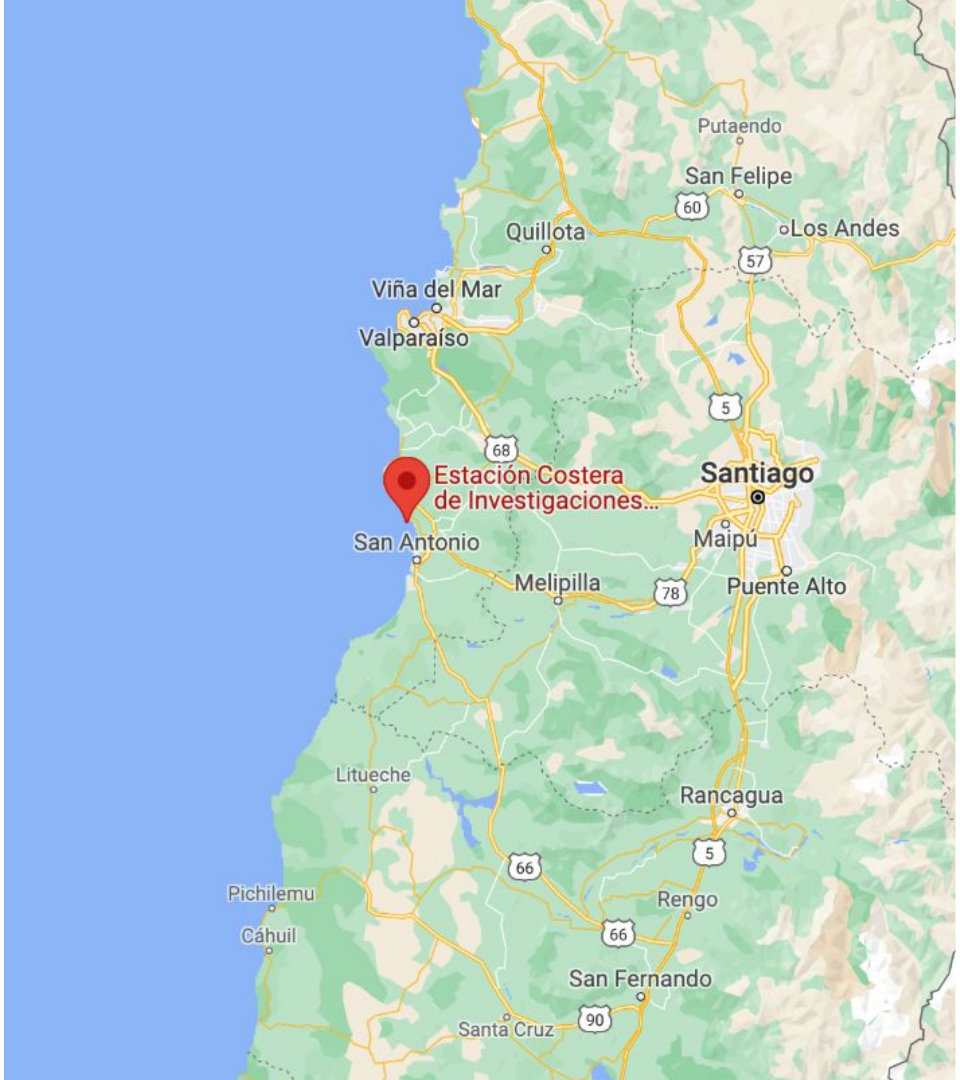
Received: 14 October 2019; Revised: 26 December 2019; Accepted: 8 January 2020; Published: 9 March 2020

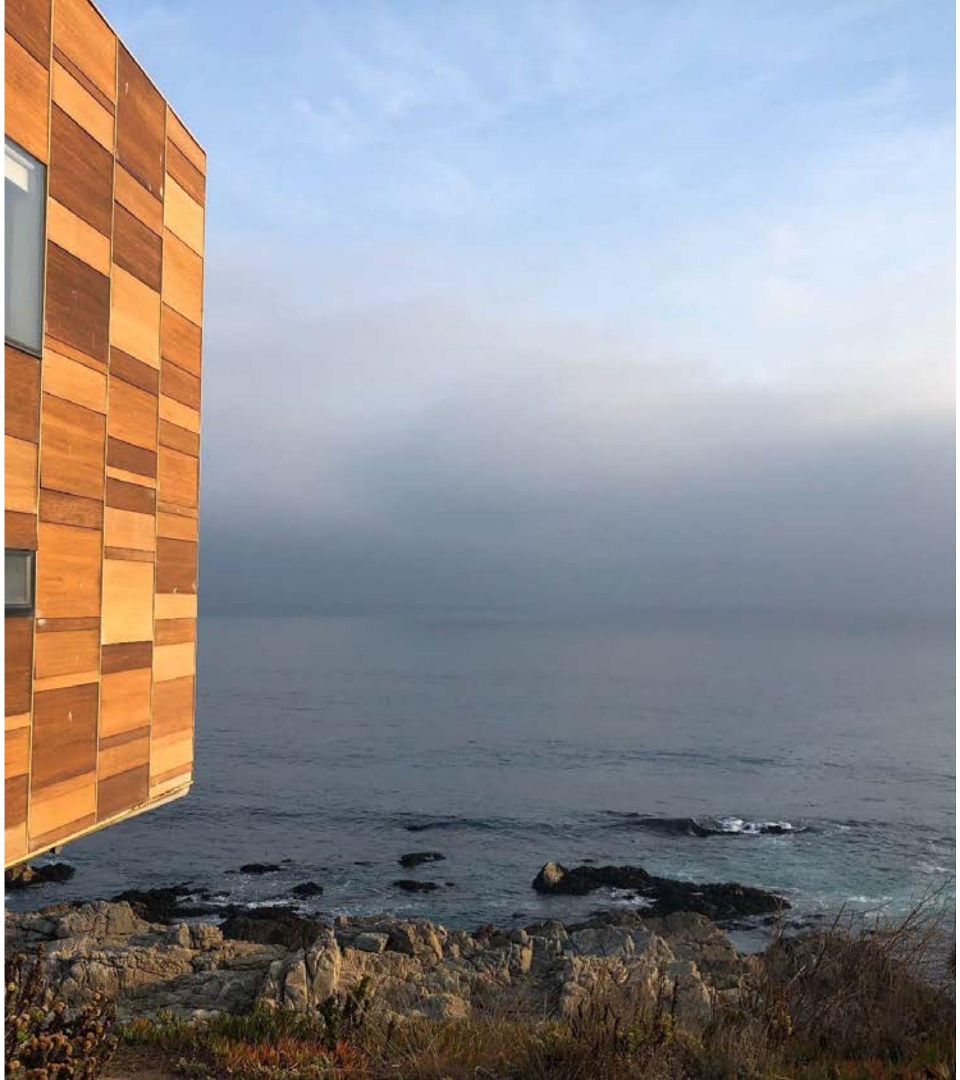
In this article, we present a theoretical framework for mixed reality (MR/XR) self-determined learning to enhance ecological literacy in free-choice educational settings. The framework emerged from a research study in New Zealand which aimed to explore how learning experiences which incorporate mobile technologies within free-choice learning settings can be designed to enhance learner development of marine ecological literacy. An understanding of how mobile technology

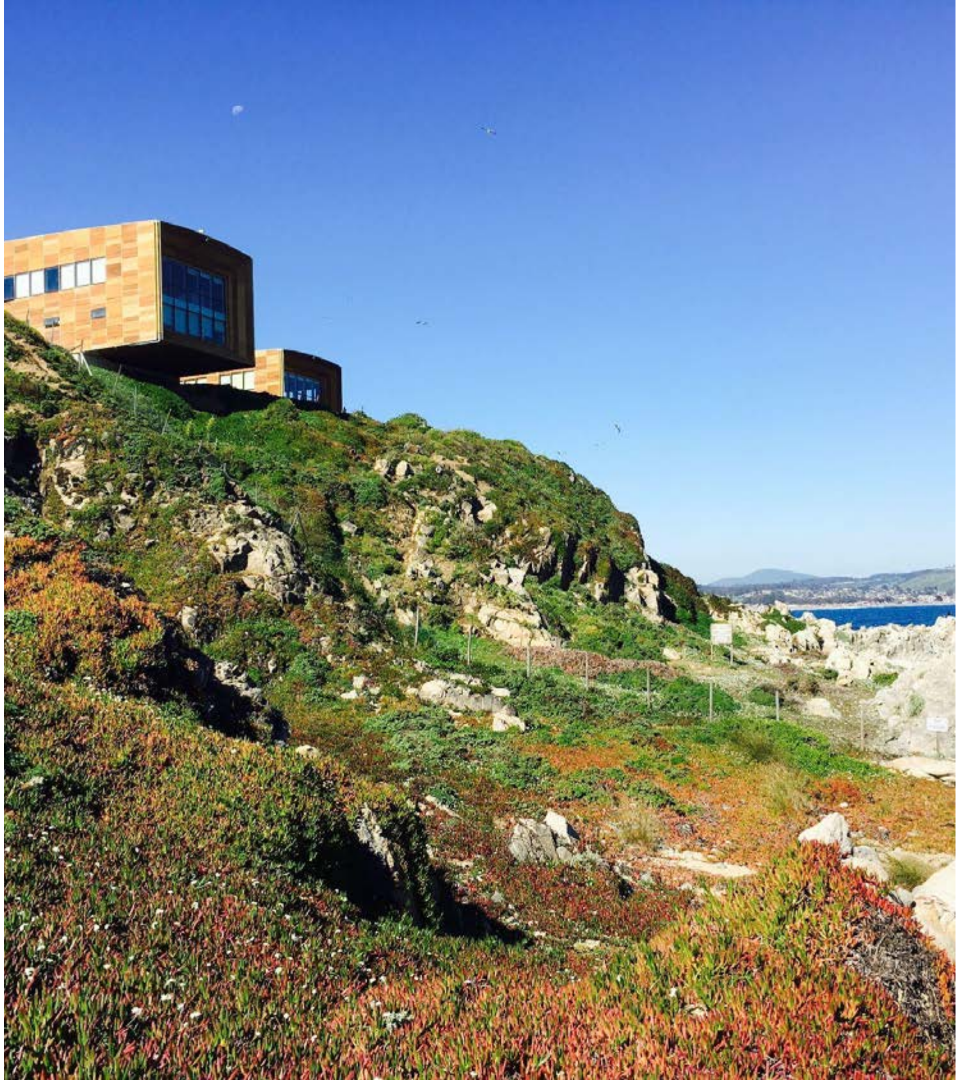
Table 1. A framework for complementary mixed reality (XR) and free-choice learning education.

(1). Mobile learning considerations
i. Mobile, immersive and real experiences should support and complement each other through a mixed reality approach (following current digital trends) ii. Mobile learning implementation and use (in free-choice education) must focus on bring your own device (BYOD), in part to manage the cost of technology. iii. Mobile learning opportunities should emphasise self-determined learning (heutagogy), so that the learning experience can unfold in unique ways for each learner based on their own motivations and needs. iv. User-informed design and co-creation should guide the design of mobile learning opportunities to promote meaningful learning. v. Mobile learning opportunities should be authentic to the context, integrated within and across learning areas and scaffolded for a clear learning pathway. vi. Mobile learning opportunities require access to technology (e.g. WIFI connectivity and IT infrastructure) and staff who are well prepared in the use of the technology and the pedagogy/heutagogy that can maximise learning. vii. Learners need prior training and exposure in the use of mobile learning resources (e.g. virtual reality) in order to be able to focus maximally on the learning intentions of their use.
(2). Pedagogy/heutagogy (teaching and learning principles)
i. Focus should be placed in self-determined (heutagogical) learning, where the learning is guided by learners' motivations and needs. ii. The placement of the outside-the-classroom visit within a teaching unit is pedagogically important. iii. The structure of the outside-the-classroom visit is pedagogically and logistically important. iv. Pre-visit resources can help to sensitise learners and initiate connections to place (the visit site). v. Use of the mobile learning resources (virtual/immersive environments) should be designed to complement and not detract from sensory (embodied/haptic) experiences in the real environment. vi. The visit should allow freedom to experience but also have some focus to scaffold learning, and to promote interactions between learners (social learning). vii. Opportunities for learners to interact with both real and virtual/immersive learning environments increase learner autonomy and engagement. viii. Learning needs to be reinforced post-visit to deepen knowledge, clarify attitudes and support next learning steps.
(3). The learning context (in this case: Marine science and conservation)
The key concepts in the context that underpin the unit of teaching which includes mobile learning and education outside the classroom, for example (in this case): i. Marine reserves conserve the marine environment through protection, research and education. ii. Marine reserves protect biodiversity (e.g. range of species within the reserve). iii. Marine reserves provide social and/or cultural benefits (e.g. cultural practices). iv. Biodiversity is crucial for interdependence (e.g. food webs snapper/kina). v. Pollution threatens marine environments (e.g. sedimentation runoff, plastics). vi. Global warming is threatening marine environments (e.g. ocean temperature change and acidification).
(4). Learning objectives (in this case: Development of ecological literacy)
What you intend students/adult learners to be able to know and do in response to the teaching and learning through mobile learning and education outside the classroom/free-choice education. i. To develop ecological literacy about marine reserves, learners need to: a. Gain knowledge of marine ecology and the impact of marine reserves (environmentally, socioculturally and economically) through authentic inquiry, system thinking and meaningful experiences b. Demonstrate holistic thinking that views marine reserves as systems that connect the natural environment with society and its culture and economy c. Reflect on their own and others' attitudes and values towards marine reserves d. Be motivated and able to think critically, plan and take action in respect of marine reserves.

EXPLORA Chile Es Mar

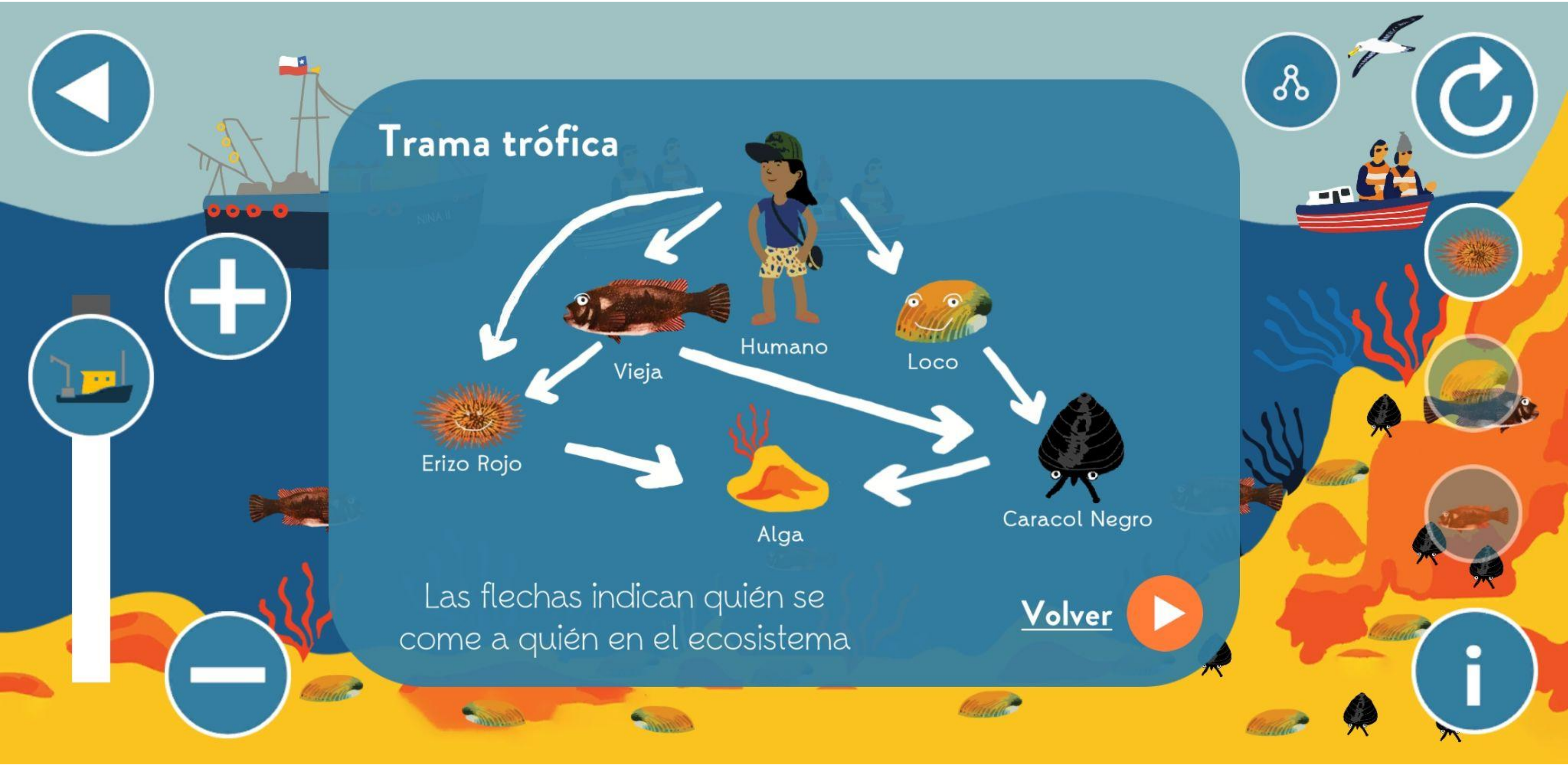

STATE OF AMAZONAS
STATE OF PARÁ
STATE OF MARANHÃO
Brazil
STATE OF ACRE
Peru
Lima
STATE OF RONDÔNIA
STATE OF PIAUÍ
STATE OF TOCANTINS
STATE OF MATO GROSSO
STATE OF BAHIA
STATE OF GOIÁS
Bolivia
STATE OF MINAS GERAIS
STATE OF MATO GROSSO DO SUL
STATE OF SÃO PAULO
STATE OF RIO DE JANEIRO
Paraguay
Asunción
São Paulo
STATE OF PARANÁ
Curitiba
Chile
STATE OF SANTA CATARINA
STATE OF RIO GRANDE DO SUL
Uruguay
Santiago
Buenos Aires
Argentina
Montevideo

Putaendo
San Felipe
60
Quillota
Los Andes
57
Viña del Mar
Valparaíso
5
68
Estación Costera de Investigaciones...
Santiago
San Antonio
Maipú
Melipilla
78
Puente Alto
Litueche
Rancagua
5
66
Pichilemu
Rengo
Cáhuil
66
San Fernando
90
Santa Cruz

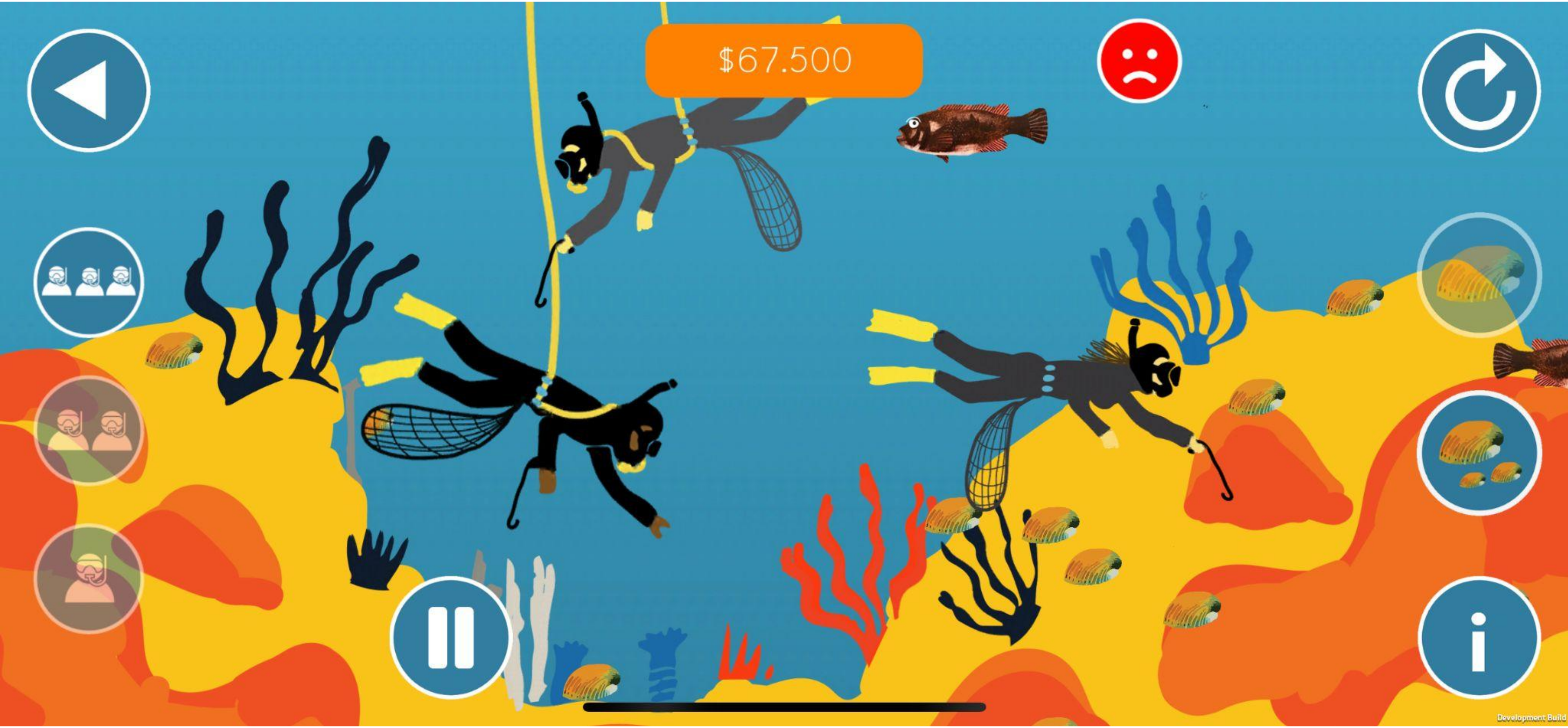




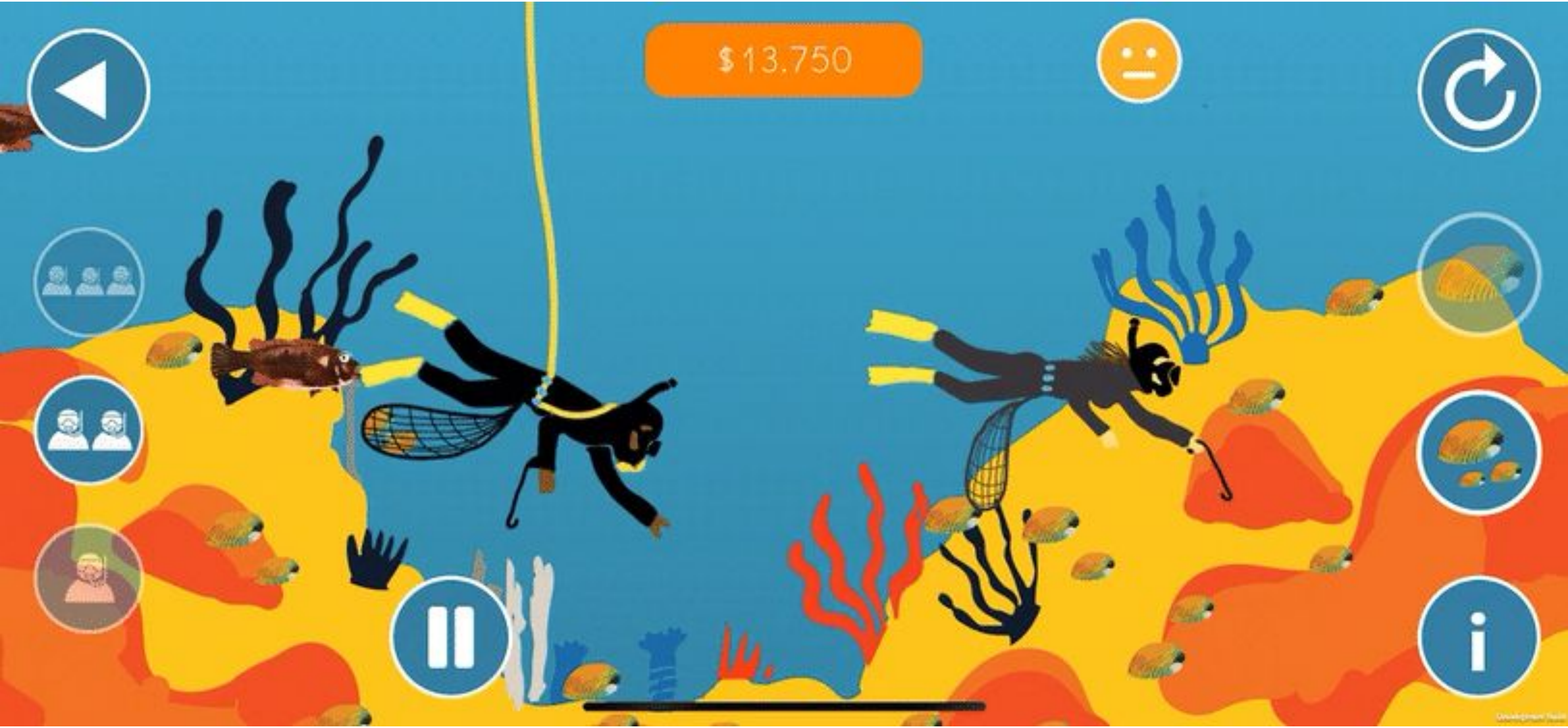

EXPLORA CHILE ES MAR
Comenzar
Acerca de
Esta app permite explorar el Mar de Chile y la influencia de los humanos a través de experiencias de realidad mixta como realidad aumentada (RA) y realidad virtual (RV)
Créditos
Contacto
Esta app fue creada por
¡Hola amigas y amigos! ¡Soy el famoso Loco, bienvenidos a mi mundo!
Omitir
Siguiente


Intro: Observemos la reserva
RV360: El efecto de la pesca en el mar
Juego pesca loco: Pescar sin sobre explotar
Larvas loco: Las áreas protegidas exportan larvas
Juego trama trófica: Los insospechados efectos de la pesca
RV360 interior AMP: Cuidemos este paraíso
Selecciona una actividad


Trama trófica
Humano
Vieja
Loco
Erizo Rojo
Alga
Caracol Negro
Las flechas indican quién se come a quién en el ecosistema
Volver

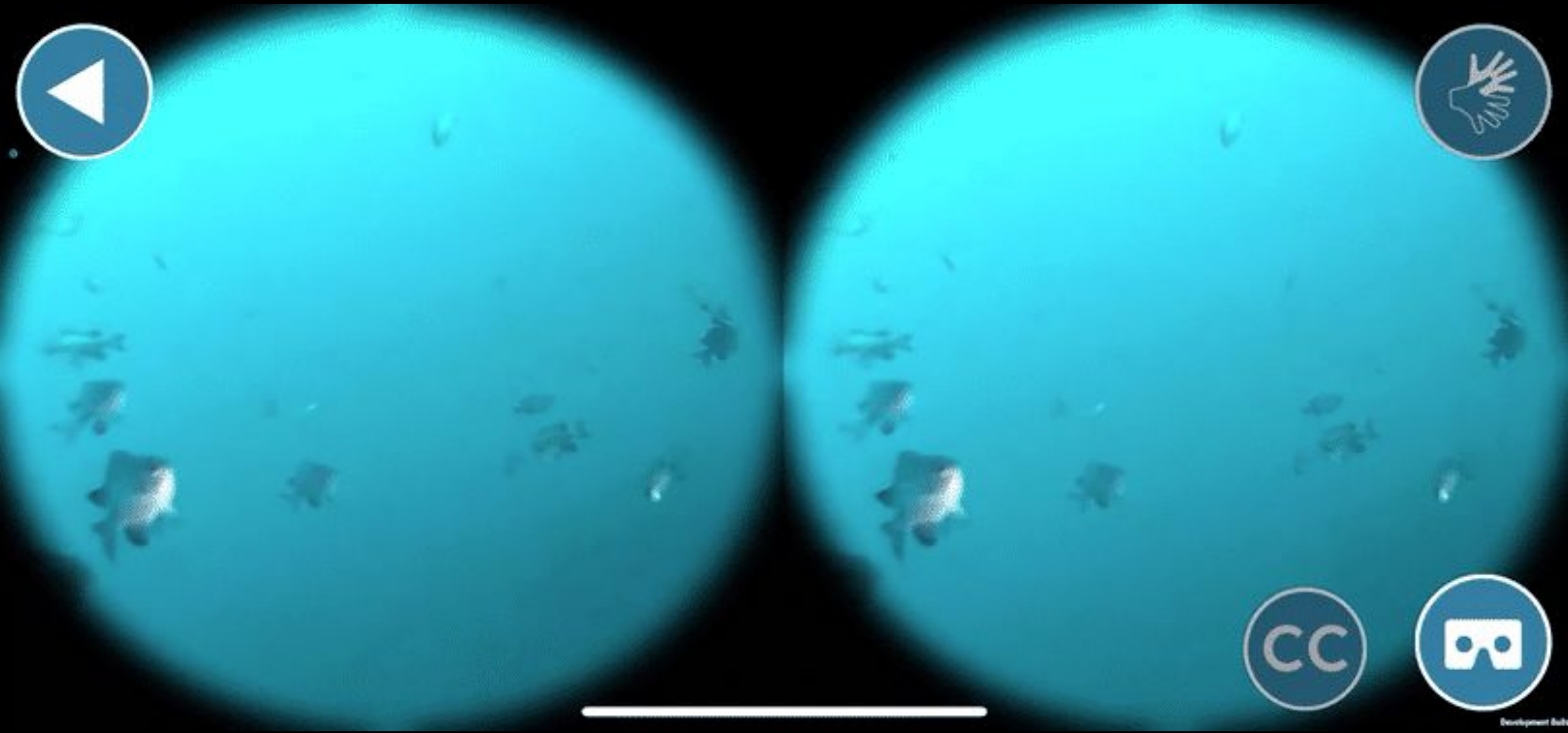


$67.500
Development Build


$13.750


CC


CC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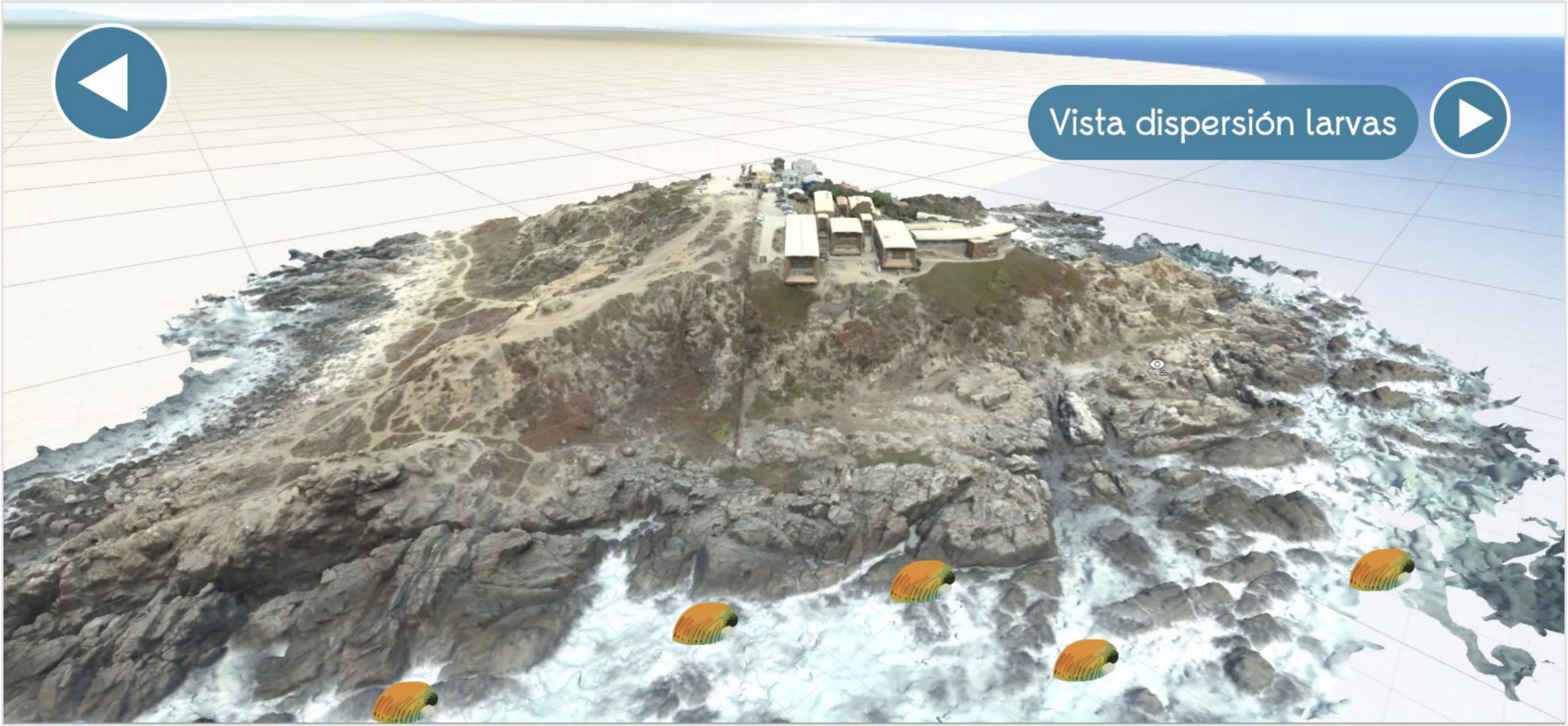
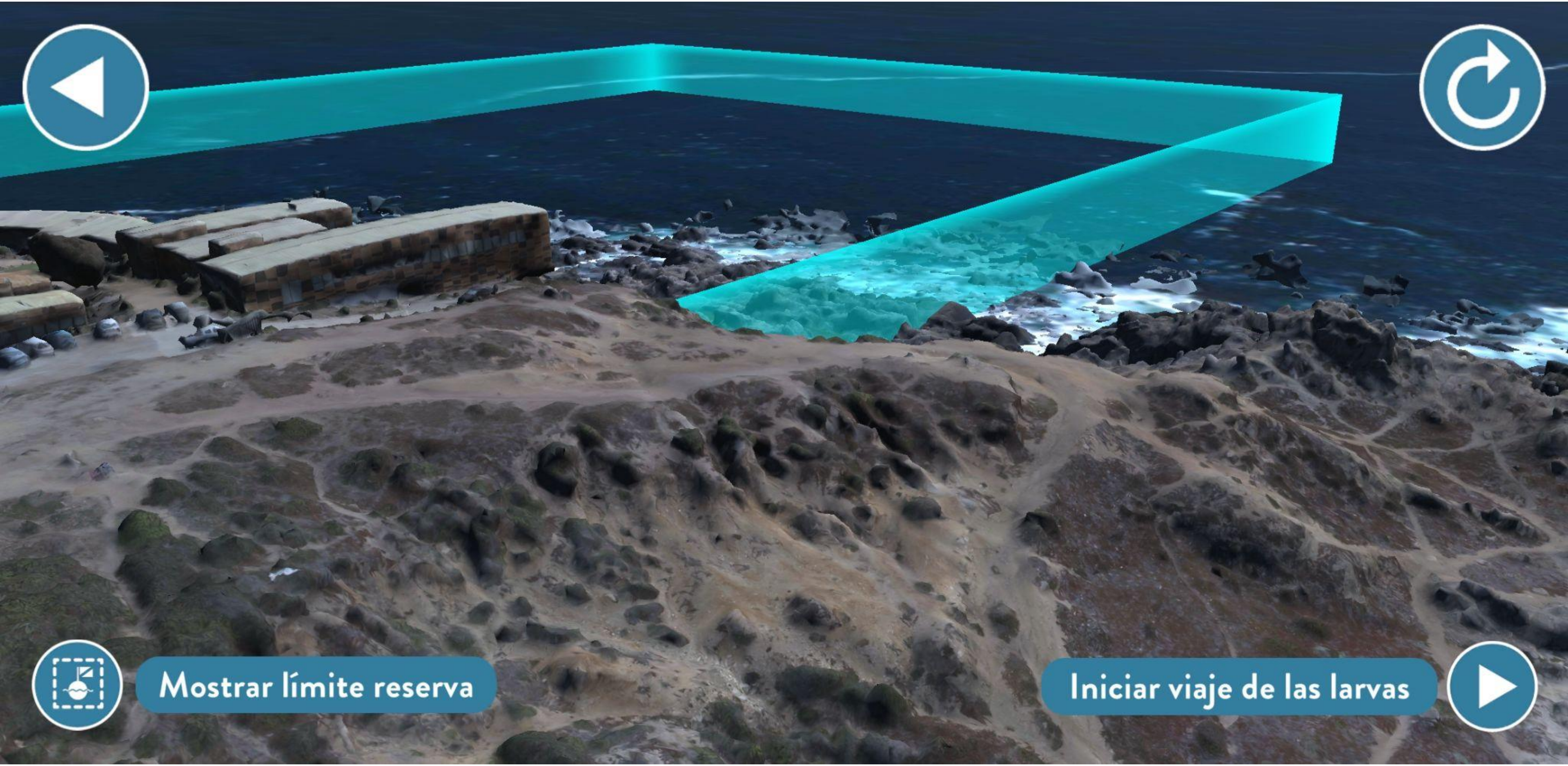
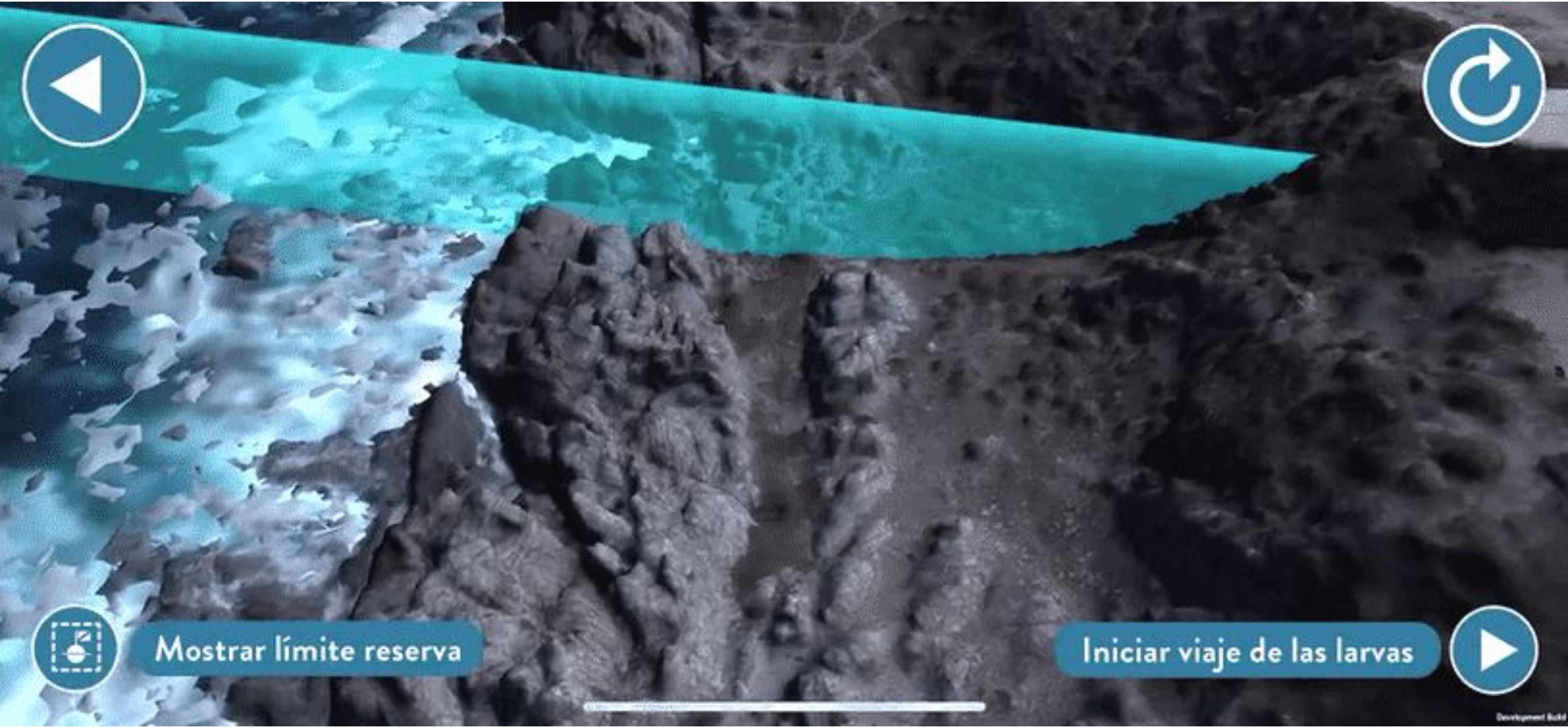

Vista dispersión larvas


Mostrar límite reserva
Iniciar viaje de las larvas


Mostrar límite reserva
Iniciar viaje de las larvas

TRANSFERRING XR DESIGN PRINCIPLES ACROSS THE PACIFIC

WHAT WORKS

THEORY:

ACTIVITY THEORY
DESIGN-BASED RESEARCH
MOBILE LEARNING
HEUTAGOGY
ECOLOGICAL LITERACY

CLAUDIO AGUAYO

9. ACTIVITY THEORY AND ONLINE COMMUNITY EDUCATION FOR SUSTAINABILITY

When Systems Meet Reality

INTRODUCTION

Community Education for Sustainability (EfS) using Information and Communication Technology (ICT) tools and affordances (i.e., possibilities) bring together learning processes occurring within different interconnected dimensions in complex and unpredictable ways. Such complexity calls for the adoption of a systems thinking approach, where the focus is on the existing relationships between the different components composing the learning system.

By adopting a systems thinking approach, the design and implementation of ICT-based online learning systems can account for the ever-changing dynamic complexity that unfolds in multidimensional learning contexts. In this view, learning emerges when learning actors come together in a shared action, or inter-action, which is at the basis of social learning in community EfS using ICT tools. Here the learning process is regarded as an integral outcome of the whole learning system, as properties of systems can only be found as part of the 'whole' and not within its individual 'parts' or components. In this scenario, the role of online learning systems is to act as a facilitator of the learning process by actively promoting meaningful and culturally responsive interaction with community members that can lead to engagement in

(Aguayo, 2016)

Int Rev Educ
DOI 10.1007/s11159-017-9685-7

CrossMark

ORIGINAL PAPER

Promoting community socio-ecological sustainability through technology: A case study from Chile

Claudio Aguayo[1] · Chris Eames[2]

Abstract The importance of community learning in effecting social change towards ecological sustainability has been recognised for some time. More recently, the use of Information and Communication Technology (ICT) tools to promote socio-ecological sustainability has been shown to have potential in community education for sustainable development (ESD). The effective design and use of technology for community learning implies an understanding of a range of cross-dimensional factors including: socio-cultural characteristics and needs of the target

(Aguayo & Eames, 2017)

Australasian Journal of Educational Technology, 2017, 33(6).

AJET ASCILITE

Key themes in mobile learning: Prospects for learner-generated learning through AR and VR

Claudio Aguayo, Thomas Cochrane, Vickel Narayan
Auckland University of Technology

This paper summarises the findings from a literature review in mobile learning, developed as part of a 2-year six-institution project in New Zealand. Through the development of a key themes codebook, we address selected key themes with respect to their relevance to learner-generated learning through emerging technologies, with attention to mobile augmented reality and mobile virtual reality. We see that these two current mobile learning affordances, complemented though relevant approaches to research and practice in mobile learning such as design-based research and connected social learning, are critical to reconceptualise learning through mobile devices. We conclude that mobile learning still requires the theories, methodologies, and practices of its own as a field. We also see a need for mobile learning to be conceptualised around ever-changing learning affordances and educational settings, rather than focusing on static structures such as content-delivery approaches, while embedding it within the scholarship of technology enhanced learning.

Introduction

Cook and Santos (2016) argue for the emergence of three aspects of mobile learning: the integration with social media for connecting learners and work-based practice, the use of design research to guide mobile learning implementation, and learner-generated content and contexts in learning. Mobile learning (re)conceptualised around what learners can do and create through mobile affordances (the range of

(Aguayo, Cochrane & Narayan, 2017)

USING MOBILE LEARNING IN FREE-CHOICE EDUCATIONAL SETTINGS TO ENHANCE ECOLOGICAL LITERACY

Claudio Aguayo
Auckland University of Technology
New Zealand

CHRIS EAMES
The University of Waikato
New Zealand

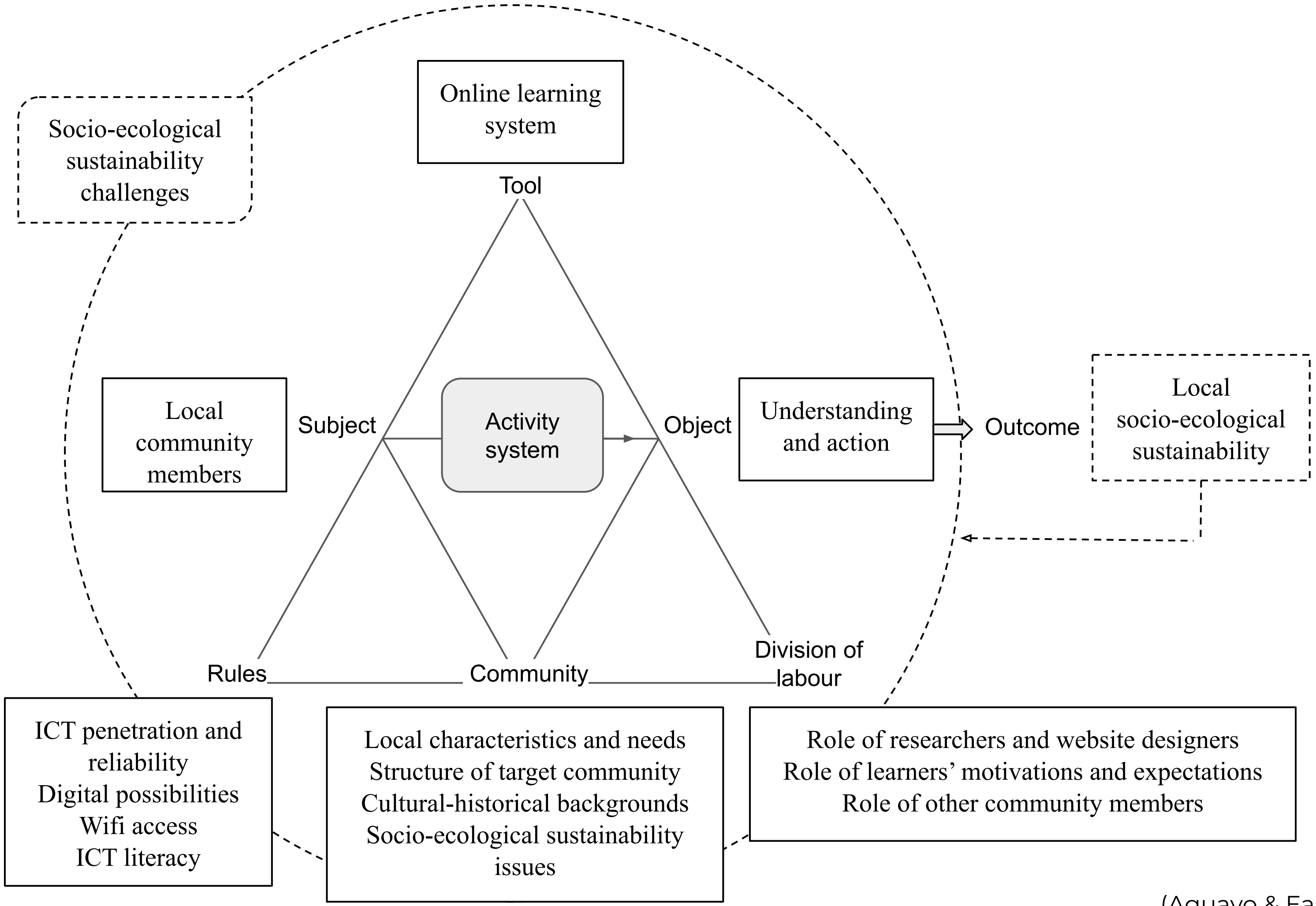
Abstract

This article presents the case for using mobile technologies to facilitate the integration of classroom and outside-of-classroom learning experiences designed to enhance the ecological literacy of primary school students and their parents. There is growing evidence supporting the transformative potential of mobile learning technologies and tools within education settings to deliver meaningful learning experiences. We argue here that this potential could extend to integrating learning between the classroom and education outside the classroom (EOTC). We further argue that this mobile learning potential can mediate learning between students and their parents, visitors and educators at free-choice learning settings. We situate our argument within learning to enhance ecological literacy and call for studies that can consider the possibilities offered by mobile technology and related pedagogical frameworks, the reinforcement of learning experiences post a visit to a free-choice setting, and the integration with hands-on and non-technology mediated learning instances. Here we present some key theoretical considerations as a prelude to a study being funded by the Teaching and Learning Research Initiative to examine these possibilities.

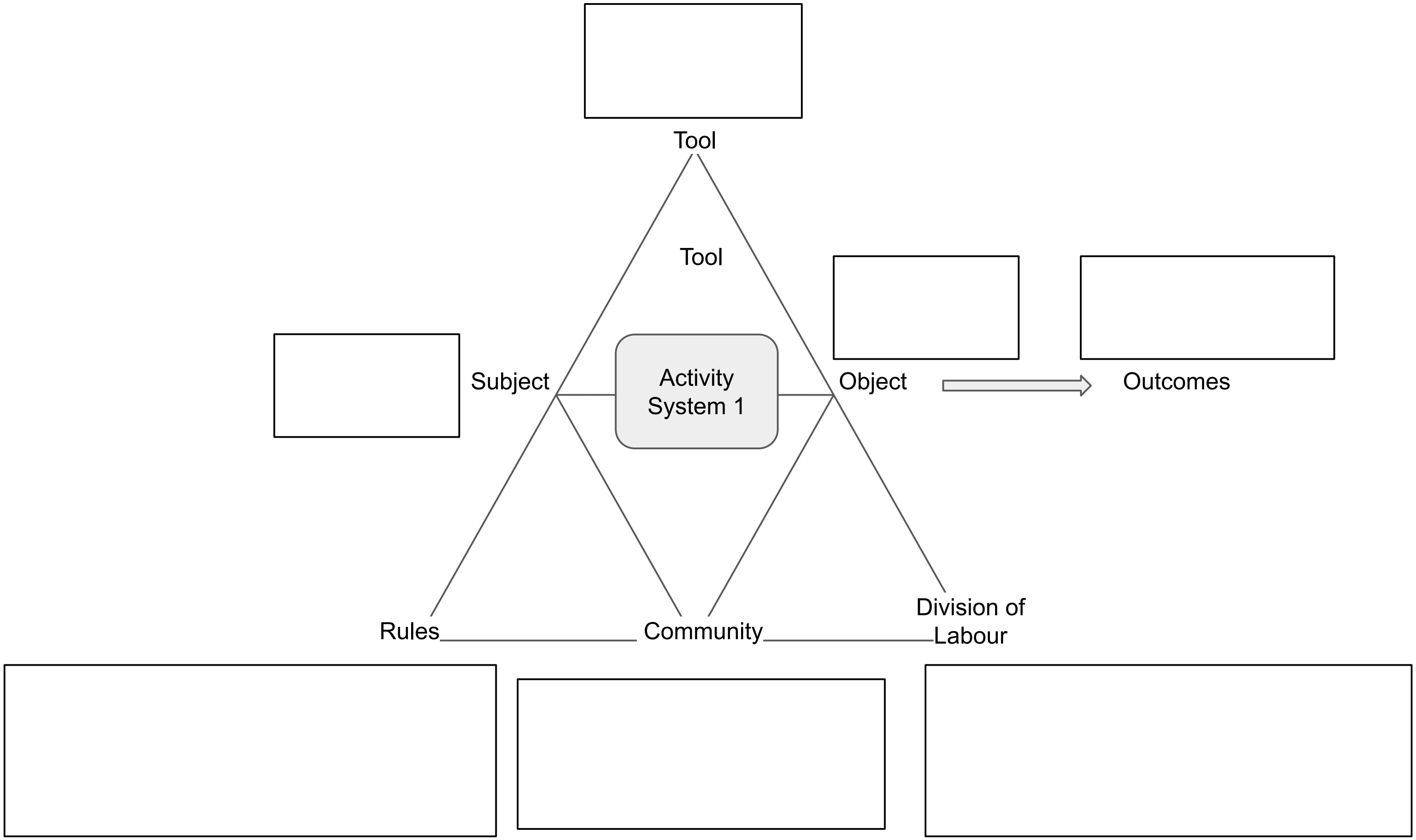
Keywords

Mobile learning; marine conservation; free-choice learning; EOTC; ecological literacy; environmental education; sustainability education; technology-enhanced learning

(Aguayo & Eames, 2017)

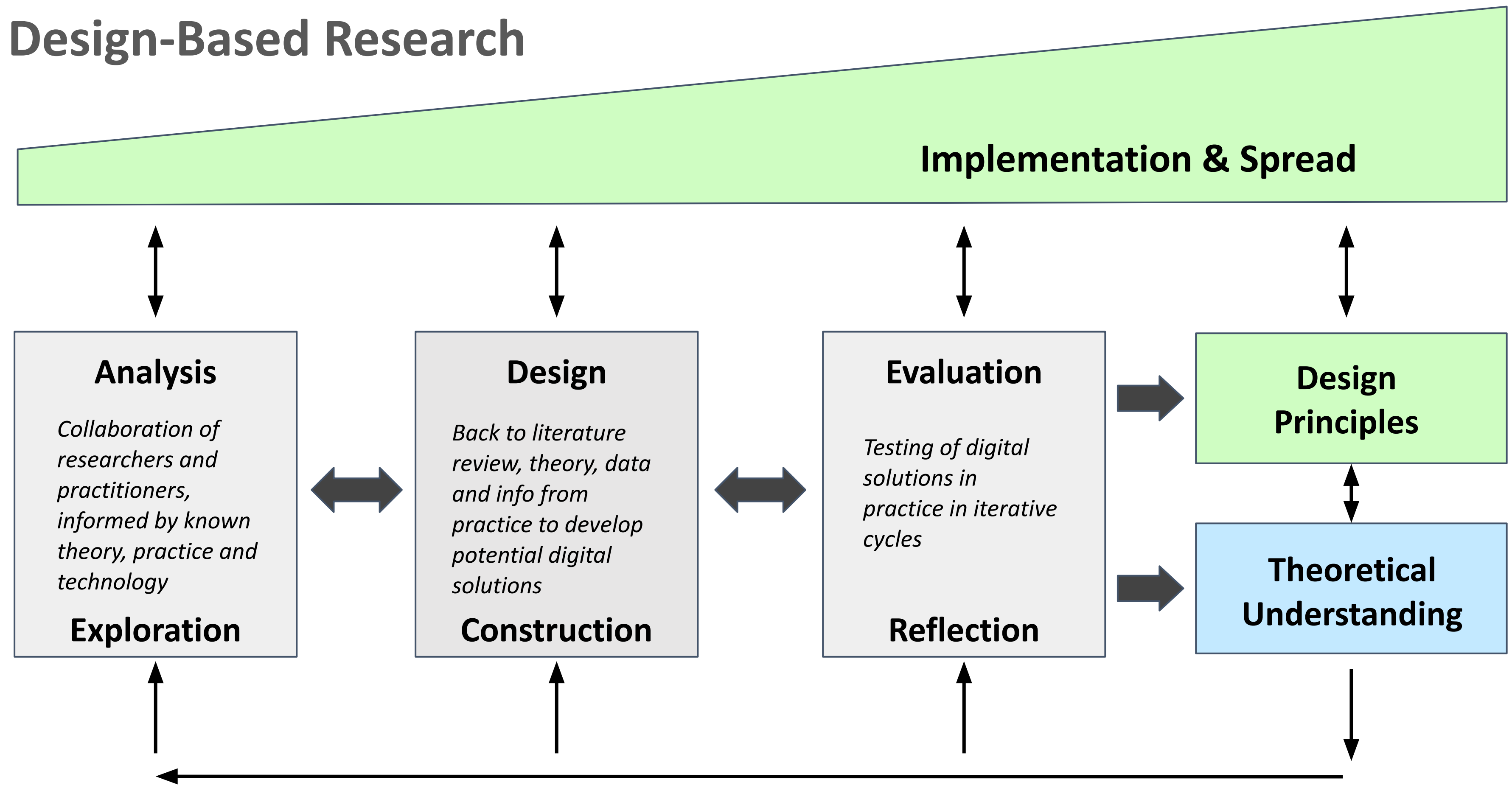


(Aguayo & Eames, 2017)



Tool
Tool
Subject
Activity System 1
Object
Outcomes
Rules
Community
Division of Labour

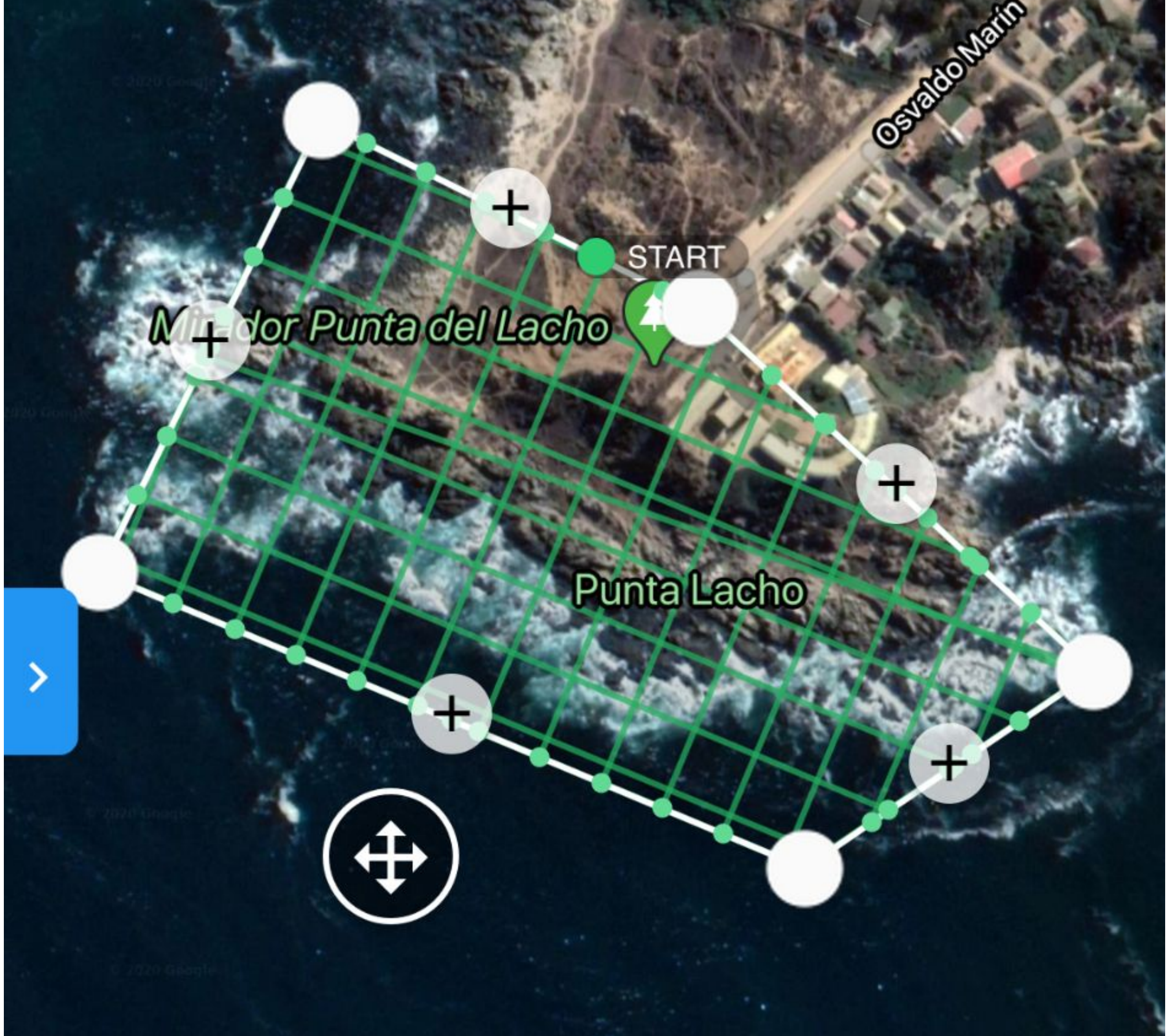

CC


Design-Based Research
Implementation & Spread
Analysis
Collaboration of researchers and practitioners, informed by known theory, practice and technology
Exploration
Design
Back to literature review, theory, data and info from practice to develop potential digital solutions
Construction
Evaluation
Testing of digital solutions in practice in iterative cycles
Reflection
Design Principles
Theoretical Understanding

ACADEMIC EXCHANGE

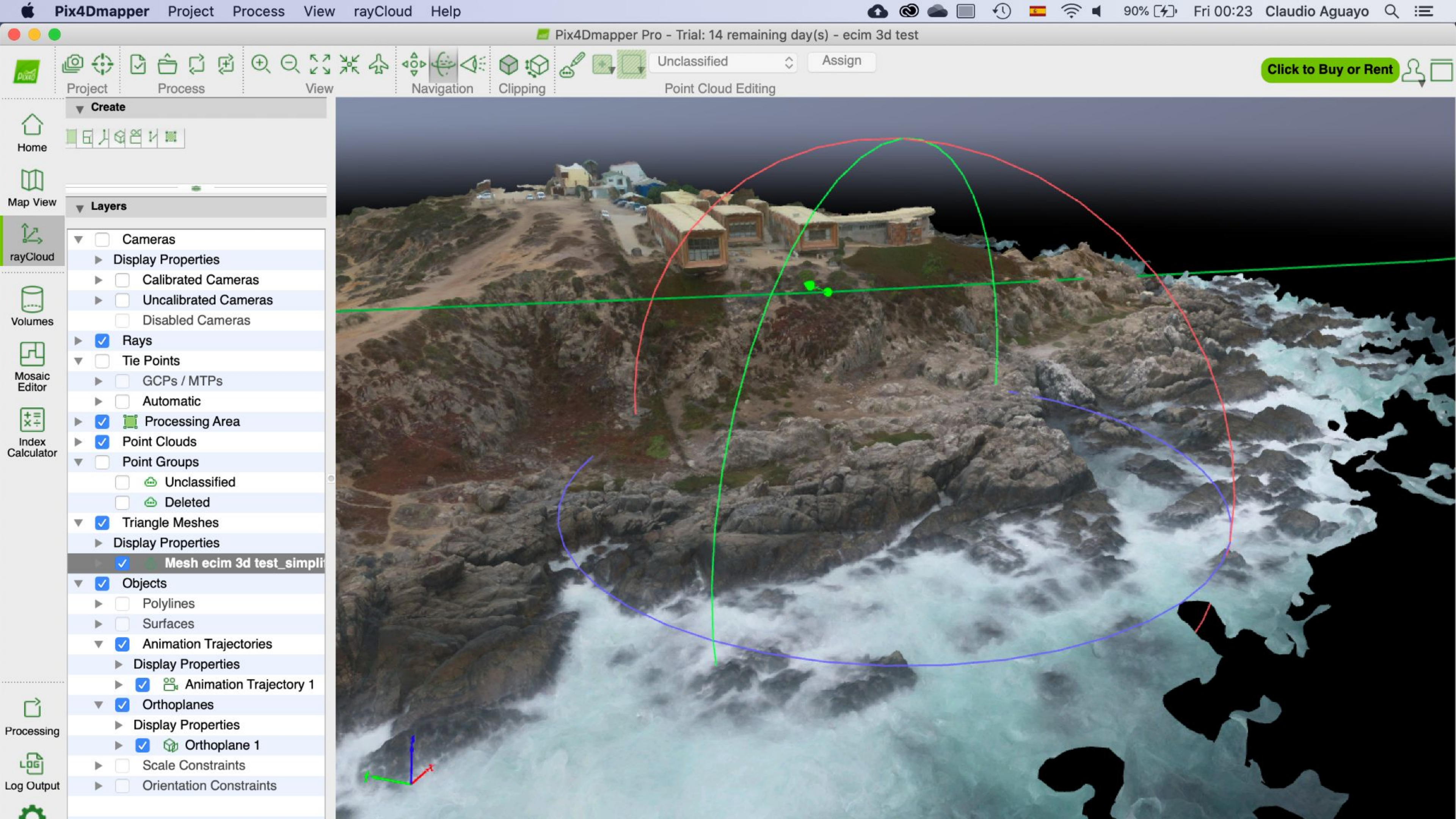
2018

2019



Osvaldo Marín
START
Mirador Punta del Lacho
Punta Lacho


Marín


Pix4Dmapper
Project
Process
View
rayCloud
Help
90%
Fri 00:23
Claudio Aguayo
Pix4Dmapper Pro - Trial: 14 remaining day(s) - ecim 3d test
Project
Process
View
Navigation
Clipping
Unclassified
Assign
Point Cloud Editing
Click to Buy or Rent
Home
Map View
rayCloud
Volumes
Mosaic Editor
Index Calculator
Processing
Log Output
Create
Layers
Cameras
Display Properties
Calibrated Cameras
Uncalibrated Cameras
Disabled Cameras
Rays
Tie Points
GCPs / MTPs
Automatic
Processing Area
Point Clouds
Point Groups
Unclassified
Deleted
Triangle Meshes
Display Properties
Mesh ecim 3d test_simplif
Objects
Polylines
Surfaces
Animation Trajectories
Display Properties
Animation Trajectory 1
Orthoplanes
Display Properties
Orthoplane 1
Scale Constraints
Orientation Constraints

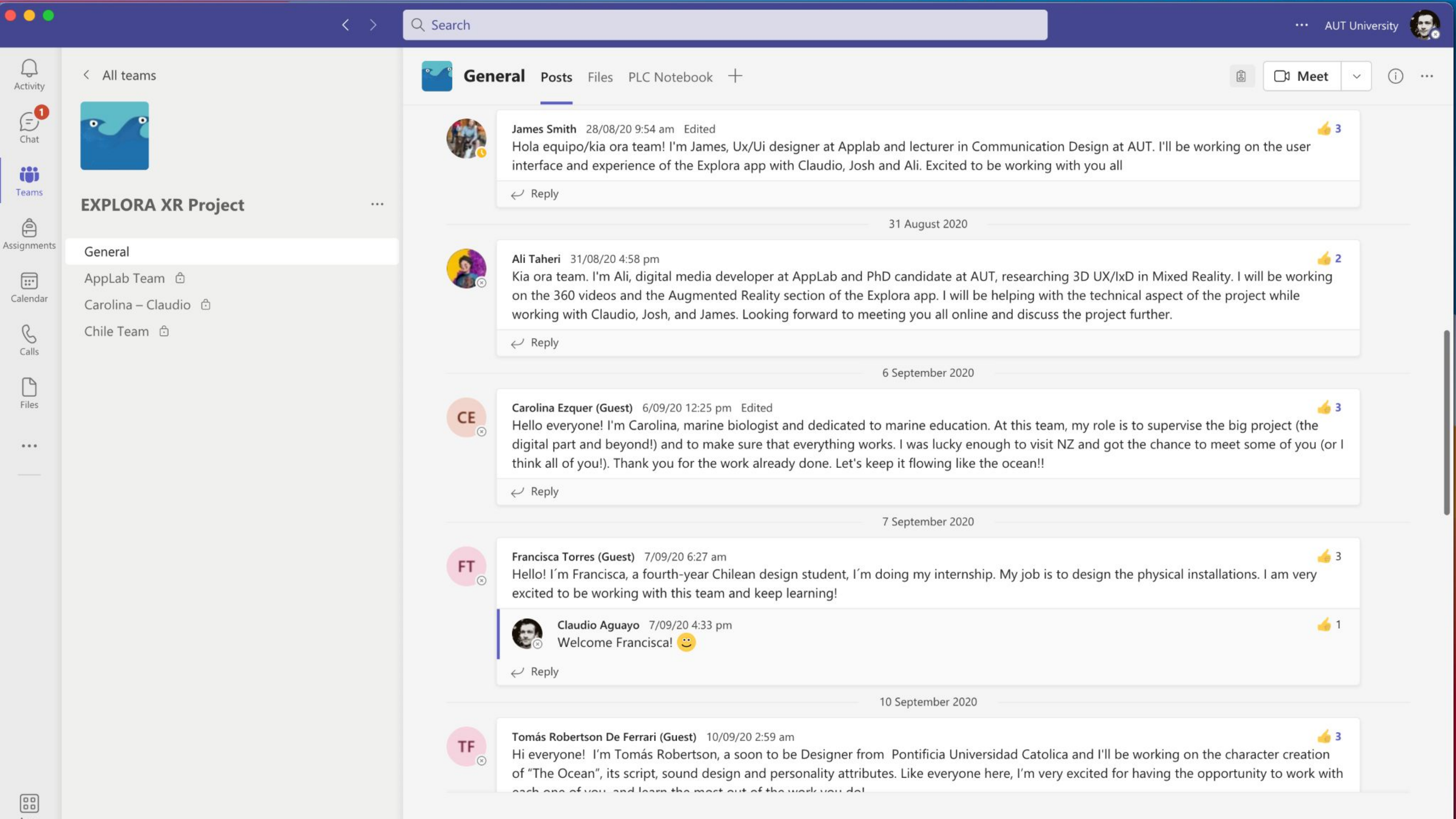

AUT
INDUS
-LEAD
FACIL

1440


NEW ZEALAND
MARINE STUDIES CENTRE
UNIVERSITY
OTAGO
NEW ZEALAND


GOAT ISLAND
MARINE DISCOVERY CENTRE
THE UNIVERSITY OF AUCKLAND
NEW ZEALAND

ONLINE COMMUNICATION
(COVID-19)



Search
AUT University
Activity
Chat
Teams
Assignments
Calendar
Calls
Files
All teams
EXPLORA XR Project
General
AppLab Team
Carolina – Claudio
Chile Team
General
Posts
Files
PLC Notebook
Meet
James Smith 28/08/20 9:54 am Edited
3
Hola equipo/kia ora team! I'm James, Ux/Ui designer at Applab and lecturer in Communication Design at AUT. I'll be working on the user interface and experience of the Explora app with Claudio, Josh and Ali. Excited to be working with you all
Reply
31 August 2020
Ali Taheri 31/08/20 4:58 pm
2
Kia ora team. I'm Ali, digital media developer at AppLab and PhD candidate at AUT, researching 3D UX/IxD in Mixed Reality. I will be working on the 360 videos and the Augmented Reality section of the Explora app. I will be helping with the technical aspect of the project while working with Claudio, Josh, and James. Looking forward to meeting you all online and discuss the project further.
Reply
6 September 2020
CE
Carolina Ezquer (Guest) 6/09/20 12:25 pm Edited
3
Hello everyone! I'm Carolina, marine biologist and dedicated to marine education. At this team, my role is to supervise the big project (the digital part and beyond!) and to make sure that everything works. I was lucky enough to visit NZ and got the chance to meet some of you (or I think all of you!). Thank you for the work already done. Let's keep it flowing like the ocean!!
Reply
7 September 2020
FT
Francisca Torres (Guest) 7/09/20 6:27 am
3
Hello! I´m Francisca, a fourth-year Chilean design student, I´m doing my internship. My job is to design the physical installations. I am very excited to be working with this team and keep learning!
Claudio Aguayo 7/09/20 4:33 pm
1
Welcome Francisca!
Reply
10 September 2020
TF
Tomás Robertson De Ferrari (Guest) 10/09/20 2:59 am
3
Hi everyone! I'm Tomás Robertson, a soon to be Designer from Pontificia Universidad Catolica and I'll be working on the character creation of "The Ocean", its script, sound design and personality attributes. Like everyone here, I'm very excited for having the opportunity to work with

Chat

Me to Everyone 9:09 AM

https://play.google.com/store/apps/details?id=com.AppLab.ExploraChileEsMar

Me to Everyone 9:24 AM

Las escucho

Sergio Navarrete to Everyone 9:55 AM

https://lascrucesem.cl/

Who can see your messages?

To: Everyone File ···

THE FRAMEWORK

TEACHING & LEARNING RESEARCH INITIATIVE
NĀU I WHATU TE KĀKAHU, HE TĀNIKO TAKU

Designing mobile learning with education outside the classroom to enhance marine ecological literacy

Chris Eames and Claudio Aguayo

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A Framework for Mixed Reality Free-Choice, Self-Determined Learning

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In this article, we present a theoretical framework for mixed reality (MR/XR) self-determined learning to enhance ecological literacy in free-choice educational settings. The framework emerged from a research study in New Zealand which aimed to explore how learning experiences which incorporate mobile technologies within free-choice learning settings can be designed to enhance learner development of marine ecological literacy. An understanding of how mobile technology can be integrated into the teaching and learning of sustainability education that

THANK YOU

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