

UMARG

Using Mobile Augmented Reality Games to develop key competencies through learning about sustainable development

Module 1 (Part 2)

How to design, develop and incorporate Mobile Augmented Reality Games in teachers' activities to increase students' digital and civic key competencies

**Good practices/Case studies & AR Platforms
CARDET**



Outline

- Introduction – MARG in education
- Case studies – Good examples
- AR educational applications
- AR platforms
- Taleblazer
- UMARG games





- New teaching methodologies: mobile devices, Augmented Reality (AR), Game-based learning
- The combination of these three elements is considered highly innovative
- It allows learning to move beyond traditional classroom environments to nature spaces that students can physically explore.

Mobile Augmented Reality Games in education

- Encourage interactivity and engagement
- Combine learning and ICT competences
- Provide personalized learning
- Visualize complicated concepts
- Inspire empathy
- Promote communication and collaboration
- Improve learning outcomes

MARG can be used for:

- Provision of feedback
- Storytelling
- Book presentations
- Enrichment of tasks
- Content creation
- Playing
- Reading



learning
performance



student
engagement



motivation
to learn





Good practices/ case studies of MARG

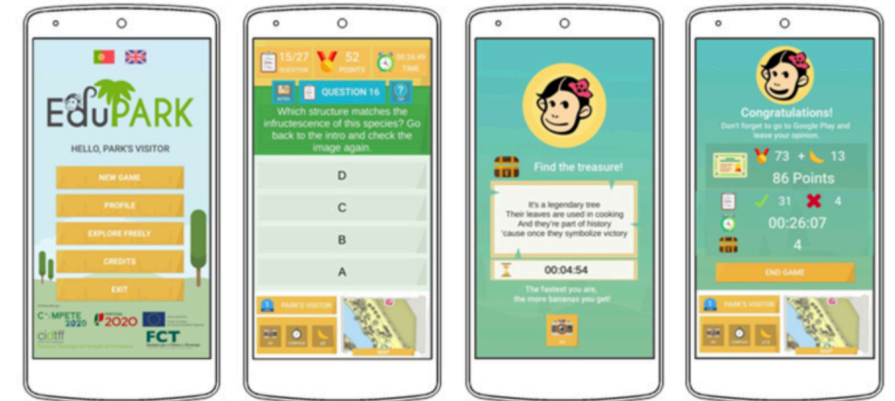


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EduPARK App (Pombo & Marques, 2020)

- EduPARK was developed with the aim of **supporting social constructivism** approaches to teaching in a game-based approach
- Interdisciplinary approach: Biology and History
- 924 students
- Results revealed **high educational value scores**, especially among teachers and students of 2nd and 3rd Cycles of Basic Education (83.0 for both).
- Motivation and engagement



EcoMOBILE (Kamarainen et al., 2013)

- Situated learning theory
- Subject: Biology (ecology)
- Understand and interpret water quality measurements
- 6th grade students
- Students navigated the pond environment using mobile wireless devices to observe virtual media and information overlaid on the physical pond and collect water quality measurements
- **The AR app promoted students' interactions and deeper understanding**



Mad City Mystery (Squire & Jan, 2015)

- Inquiry-based learning
- Subject: Biology (ecology)
- Investigate whether a death caused by a murder, suicide, or the combination of several interacting **toxic chemicals**.
- Students aged 9-16
- Collection of data through multimedia resources (interviews)
- Results: engaging students in **meaningful scientific argumentation**. Players were required to **develop and argue scientific explanations**.

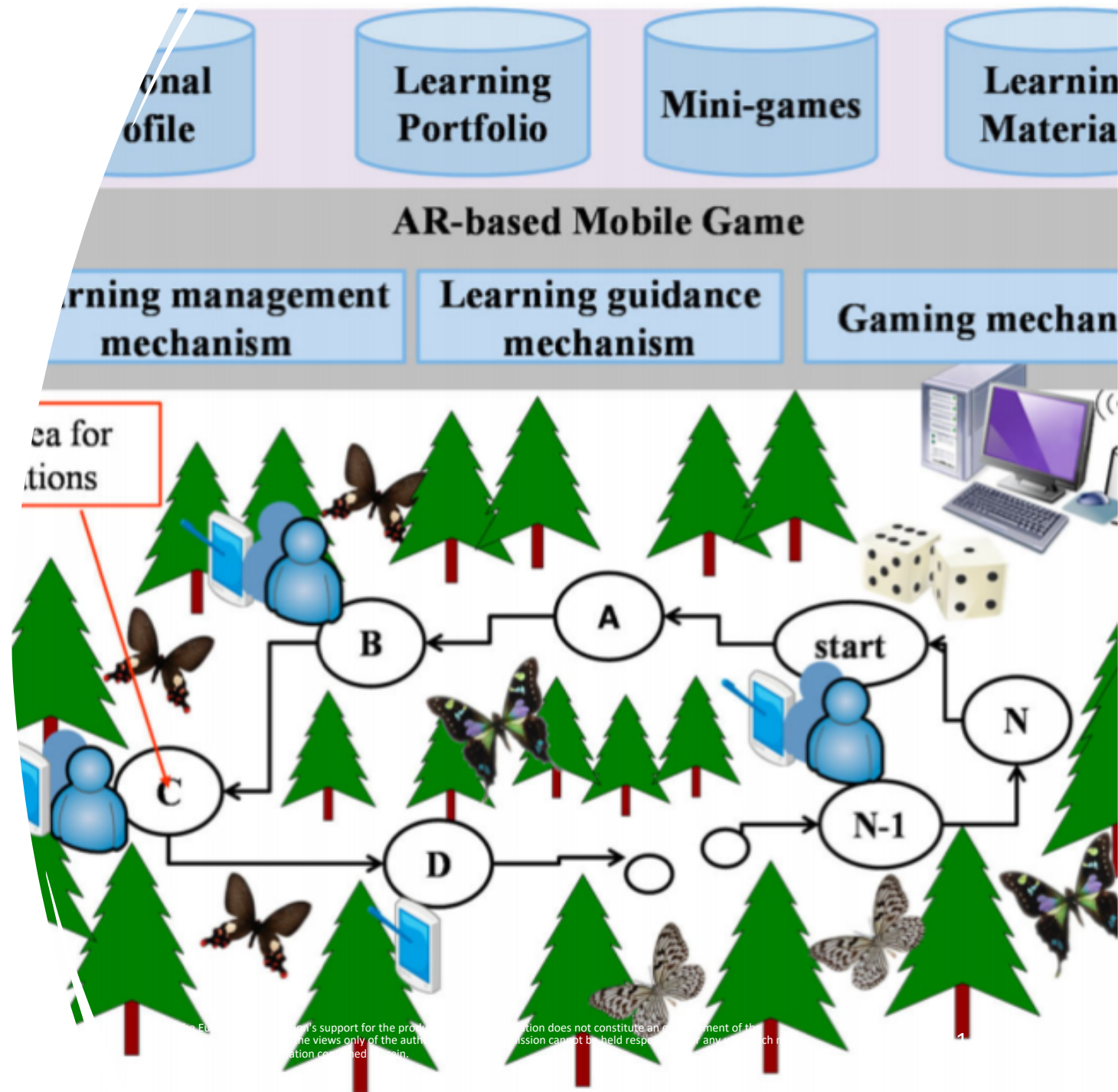


Environmental Detectives (Klopfer & Squire, 2019)

- Inquiry-based learning
- Subject: Biology (ecology)
- High school and university students
- They led the role of Environmental engineers to investigate the **spill of the toxin**, a carcinogenic degreasing agent, commonly found in machine shops, cafeterias, and hospitals
- The Location-aware Pocket PC was used to sample chemical concentrations in the groundwater depending on user's location
- **Participants were highly engaged and motivated in the process**

Ecology AR game (Hwang et al., 2016)

- Inquiry-based approach
- Subject: Biology (Ecology)
- 5th grade students
- **AR-based mobile game** (incorporates game features) and **AR-based mobile learning approach** (completion of tasks)
- The results showed that an **AR-based gaming approach** can improve both students' learning attitudes and performance more than an AR-based mobile learning approach



Students' immersion and learning outcomes in location-based AR settings (Georgiou & Kyza, 2018)

- Inquiry-based learning
- Subject: Environmental Science
- 10th graders students
- The aim was to investigate whether the impact of immersion on learning in location-based AR settings influenced by student motivation.
- Results: **Immersion** was positively predicted by domain-specific motivation and cognitive motivation.
- **Conceptual learning gains were positively related to the level of immersion that students achieved.**



Adventure in Museum (Viinikkala et al. 2014)

- Subject: History
- Cultural Heritage site: Outdoor museum environment (Turku, Finland)
- Guided tour for tourists
- Explore how people lived in the 19th century in this famous city
- The background story support visitors in solving a series of tasks - PBL
- Evaluation of the app (features and functionality)
- **The feedback about the app was generally very good**



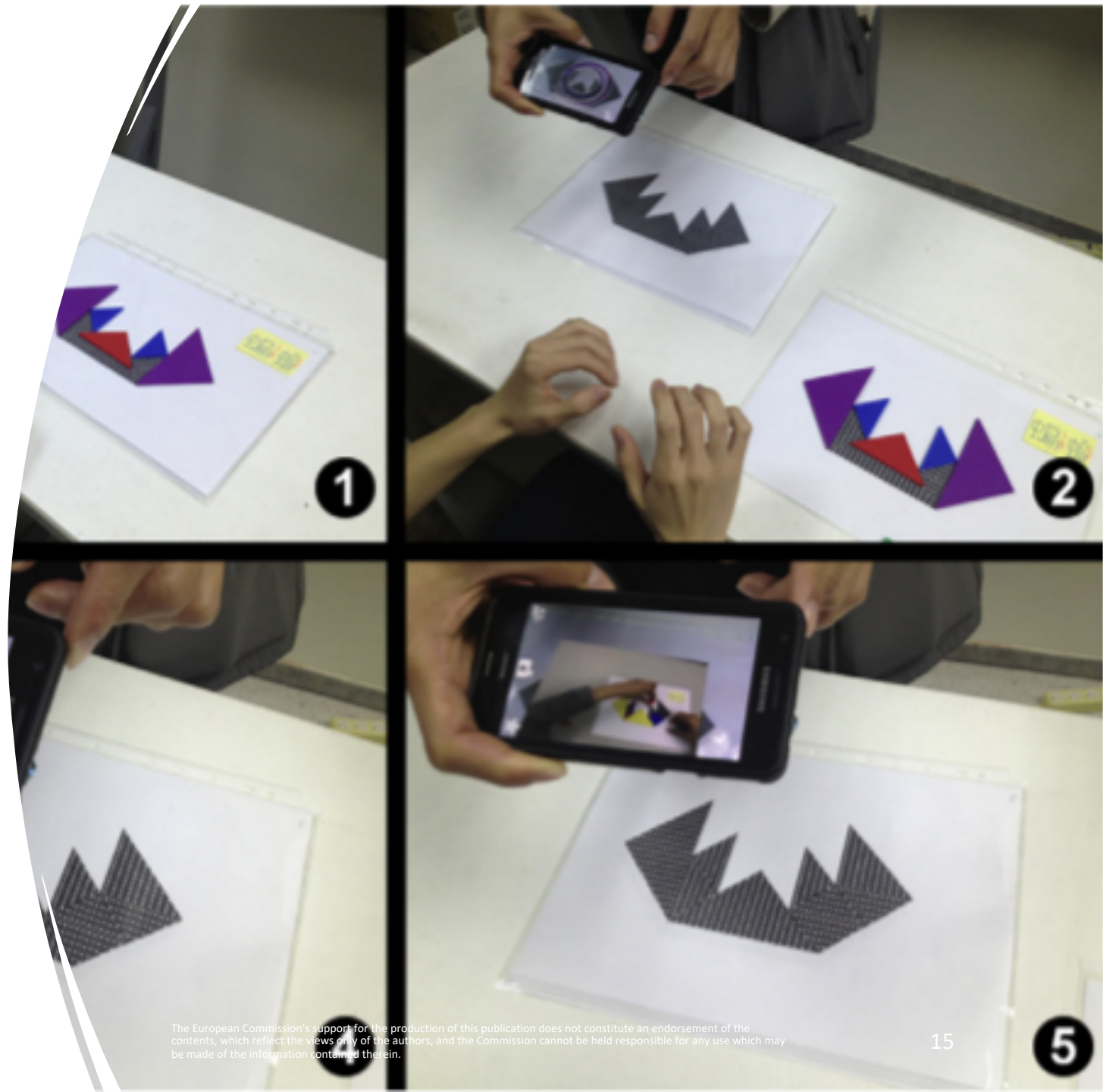
Learning English with Augmented reality (Hsu, 2017)

- Subject: English as a second language
- Two AR educational games:
 - **Self-directed learning**
 - **Task-based learning**
- 3rd grade students
- Both had similar and **high learning effectiveness**
- **The students using the self-directed system revealed higher flow experience**



AR in Special Education (Lin et al., 2016)

- Subject: Mathematics (Geometry – Puzzle-based activities)
- 21 elementary SEN students (6-12 years old)
- SEN teachers designed teaching materials and created AR material (videos, animations, data)
- Students were asked to replicate the Chinese tangram puzzles and the square puzzle games using physical blocks
- **Results: Participants' ability to complete the puzzle games by themselves were improved significantly**
- AR technology could enrich **students' learning motivation** as well as their frustration tolerance.



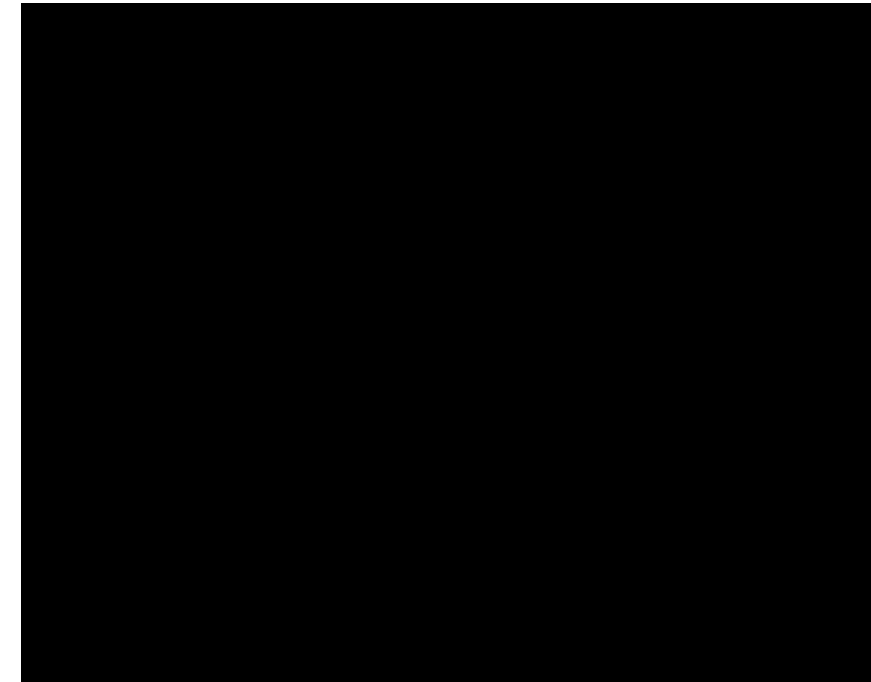
Conclusions...

- Science Education
- Framework: Inquiry-based learning, Problem-based learning, Game-based learning
- Indoor and outdoor activities
- Personalized learning
- Collaboration
- Improvement of learning gains
- Motivation – engagement



Examples of AR applications in education

Application/Website	Description	Mobile operating system
Anatomy 4D (https://play.google.com/store/apps/details?id=com.dagri.d4DAnatomy)	Provides a virtual tour of the human body. Science	Android, iOS
Quiver https://quivervision.com/coloring-packs	Augmented Reality coloring app – Brings the coloring pages to life Art	iOS
CoSpaces edu (https://cospaces.io/edu/key-features.html)	Content creation app – Create 3D objects and animate them with code Science, Mathematics	Android, iOS
Google Expeditions (https://apps.apple.com/us/app/expeditions/id1131711060)	Allows VR trips or Explorations of AR objects (e.g. historical landmarks) All topics /subjects	Android, iOS



Activity on Padlet

How do you envisage the implementation of a MARG in a classroom environment?

You may consider the following:

- Planning
- Classroom orchestration
- Expectations
- Limitations
- Challenges

Choose the 4 most important criteria you should consider before implementing a MARG with students.



Write your answers in Padlet:

<https://padlet.com/nicolettapantela1/mytpuw0g4or28m6w>

*Platforms
for creating
your own
MARG*



Mobile AR platforms (Laine, 2018)

- Even though, a great number of MARG platforms are targeted to developers and people familiar with coding...

Name	Client Type	SDK	Target Tracking	License
ALVAR	Android, iOS, Windows, Linux, Mac	Y (C++, Unity)	Fiducial, image, point cloud	Commercial
ANDAR	Android	Y (Java)	Fiducial, image	Open source
ARCore	Android	Y (Java, C#, C++, Unity, Unreal)	Sensor, object	Commercial (free)
ARIS	iOS	N	Fiducial, image	Open source
ARKit	iOS	Y (Objective-C, Swift, Unity, Unreal)	Sensor, face	Commercial (free)
ARToolkit	Android, iOS, Mac, Linux	Y (C/C++, Java, Unity)	Fiducial, image	Open source
Augment	Android, iOS, web browser	Y (Java, Objective-C, Swift, JavaScript)	Fiducial, sensor	Commercial
Aurasma	Android, iOS	Y	Image	Commercial (free)
Blibbar	Android, iOS	Y (JavaScript)	Image	Commercial (free)
CraftAR	Android, iOS	Y (Java, Objective-C, JavaScript, C#, Unity)	Image	Commercial (free)
DroidAR	Android	Y (Java)	Fiducial, sensor, location	Open source
EasyAR	Android, iOS, Windows, Mac	Y (C/C++, Java, Swift, Objective-C, C#, Unity)	Image, object	Commercial (free)
EON Reality	Android, iOS, smart glasses	Y (C++)	Fiducial, image	Commercial
Hoppala Augmentation	Android, iOS	N	Image, location, object	n/a
Infinity AR	Android, iOS, wearables	n/a	Image	Commercial
Kudan AR SDK	Android, iOS, Windows, Mac	Y (Java, C#, Objective-C, Unity)	Image, object	Commercial (free)
Layar	Android, iOS, Blackberry	Y (Java, Objective-C)	Image	Commercial
Maxst AR SDK	Android, iOS, Windows, Mac	Y (C#, Unity)	Fiducial, image, sensor	Commercial (free)
NyARToolkit	Android, iOS, Mac, Linux, Windows	Y (C/C++, Java, C#, ActionScript, Unity)	Fiducial, image	Open source
Rajawali	Android	Y (Java)	Fiducial, image	Open source
Rox AR SDK	Android, iOS, Windows, Linux	Y (C, C#, Unity)	Object, image	Commercial (free)
ViewAR	Android, iOS, Windows, web browser	Y (HTML, JavaScript, CSS)	Image, object	Commercial
Void AR	Android, iOS, Windows, Mac	Y (C#, Unity)	Image	Commercial (free)
Vuforia SDK	Android, iOS, Windows	Y (C#, JavaScript, C++, Java, Unity)	Fiducial, image, object	Commercial (free)
Wikitude	iOS, Android, smart glasses	Y (Java, Javascript, Objective-C, Unity)	Location, object	Commercial
Xzing	Android, iOS, Windows, web browser	Y (C#, Unity)	Fiducial, face	Commercial (free)

...Here is a list of available and easy to use platforms for creating educational MARG!

Name	Client Type	Cost	Website
1. Actionbound	Android, iOS	Yes (Free/personal account-limited features)	https://en.actionbound.com/
2. PlayVisit	Android, iOS	Yes (Free trial for 30 days/Discounts for education)	https://www.playvisit.com/
3. ARLOOPA	Android, iOS	Yes (free trial/ Education plan)	https://arloopa.com/
4. TaleBlazer	Android, iOS	Free	http://taleblazer.org/

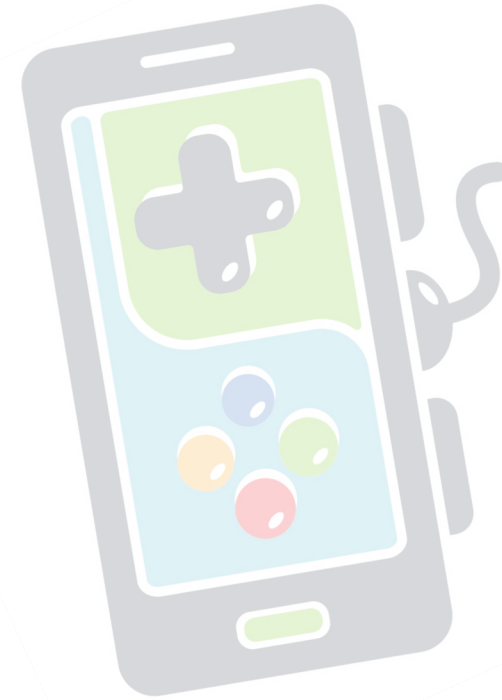
1. Actionbound

Actionbound

<https://en.actionbound.com/>

Features

- ✓ Quiz
- ✓ Missions
- ✓ Tournaments
- ✓ QR codes
- ✓ GPS
- ✓ Guide
- ✓ Maps
- ✓ Rewards
- ✓ Countdown
- ✓ Progress
- ✓ Evaluation
- ✓ Feedback
- ✓ Share



2. PlayVisit



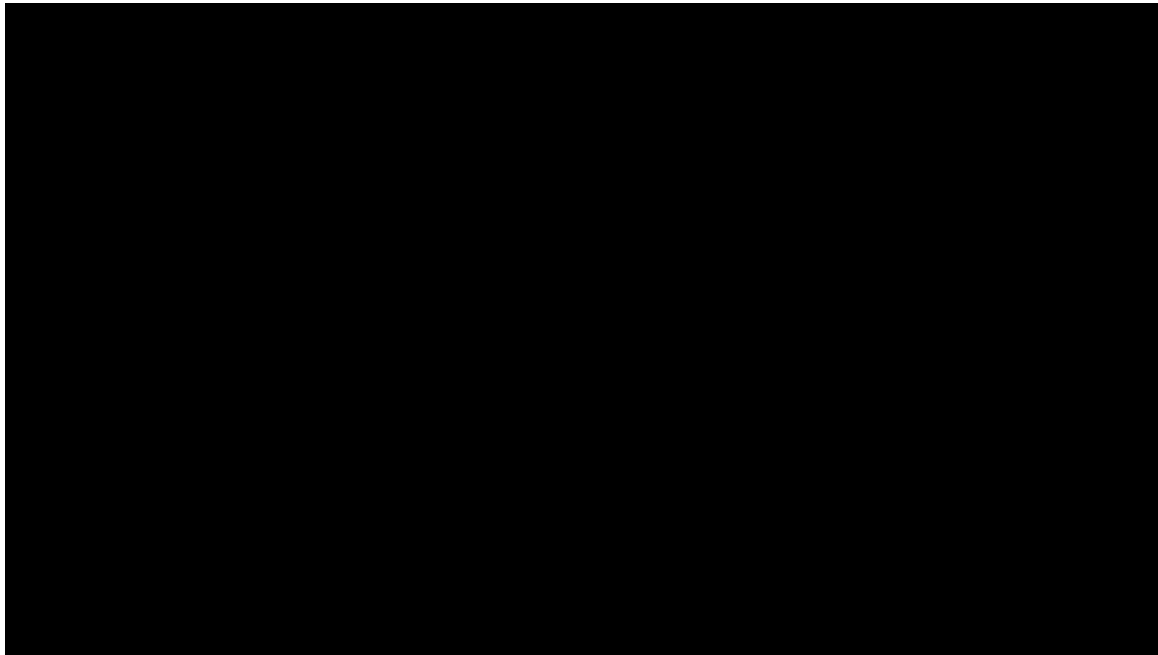
Features

- ✓ Experience templates
- ✓ Add text, multimedia content (image, video, gifs,...)
- ✓ Challenges (Minigames, quizzes and checkins)
- ✓ Performance analysis of the experience
- ✓ Data-based decisions



<https://www.playvisit.com/>

3. ARLOOPA



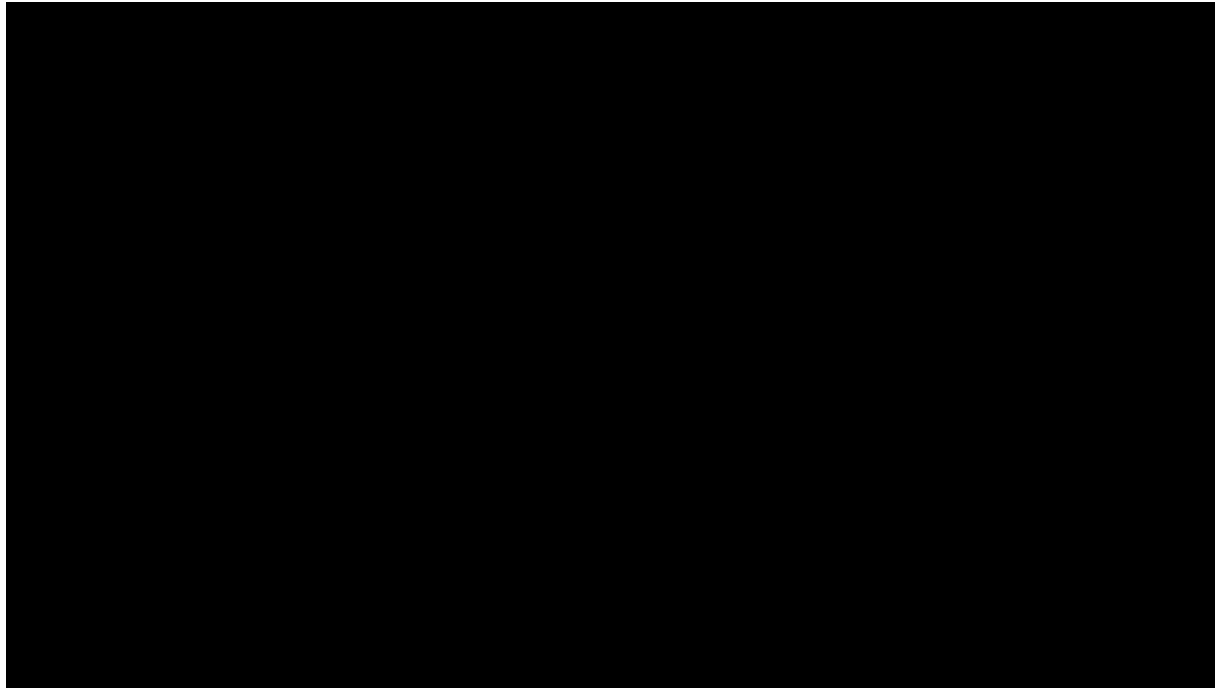
<https://arloopa.com/>

Features:

- ✓ Marker-based, markerless and location-based AR
- ✓ Video, photo, GIF recording.
- ✓ Social sharing.
- ✓ In-app 3D objects library with diverse categories, such as animals, vehicles, educational objects, etc.



4. TaleBlazer (1)



<http://taleblazer.org/>

- ✓ TaleBlazer was used to create MARG in the context of the UMARG project
- ✓ It was developed by MIT STEP lab
- ✓ TaleBlazer is among the most popular platforms for creating educational MARG



TaleBlazer (2)



- **Location-based mobile games:** Players move around real space while the GPS of the device allows them to interact with “nearby” virtual objects in the TaleBlazer game.
- TaleBlazer games can be played on Android and iOS smartphones
- Once the game is downloaded, user does not need an internet connection to play.
- Software components:
 - An online game *Editor* (create/edit/save games)
 - A game *Repository* server (store the games)
 - A multi-player server (maintains a shared game universe for multi player games)
 - Installed mobile application (to play the game / iOS and Android)



TaleBlazer – Limitations (3)

- Location-based building platform only
- Outdoor locations can have weak or poor GPS signals, particularly near tall buildings, open areas of water, and in sparsely populated areas
- Even under best case conditions, GPS positioning is only accurate to about 3 meters.
- Need to keep in mind pedestrian accessibility/safety, etc.

TaleBlazer (4) - Useful resources



A getting started guide and curriculum



http://taleblazer.org/files/curriculum/TaleBlazer_Curriculum.pdf



Documentation:
<http://www.taleblazer.org/files/docs/TaleBlazerDocumentation.pdf>



Introduction to the Taleblazer Editor:
<http://www.taleblazer.org/files/docs/TaleBlazerTutorial1.pdf>

The UMARG games

- ❑ A total of **20 MARG** were developed in the context of the UMARG project using TaleBlazer (5 games per country)
- ❑ The games were based on **learning scenarios** developed by schoolteachers, under the frame of the **Sustainable Development Goals**





SUSTAINABLE DEVELOPMENT GOALS

1 NO POVERTY

2 ZERO HUNGER

3 GOOD HEALTH AND WELL-BEING

4 QUALITY EDUCATION

5 GENDER EQUALITY

6 CLEAN WATER AND SANITATION

7 AFFORDABLE AND CLEAN ENERGY

8 DECENT WORK AND ECONOMIC GROWTH

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

10 REDUCED INEQUALITIES

11 SUSTAINABLE CITIES AND COMMUNITIES

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

13 CLIMATE ACTION

14 LIFE BELOW WATER

15 LIFE ON LAND

16 PEACE, JUSTICE AND STRONG INSTITUTIONS

17 PARTNERSHIPS FOR THE GOALS


SUSTAINABLE DEVELOPMENT GOALS

Indicative examples of the UMARG games

- European Union
- Sustainable waste
- The mysterious extinction of Rhodes species
- Women in Computer history
- Building an ECO School
- Art hunt
- Renew Go
- Sustainable City



Active poll



What is the most important benefit of using MARG in the classroom?

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Join at
slido.com
#583 348

Navigation bar containing: a plus sign icon, a red square icon with a white square inside labeled "Poll", a lock icon, a menu icon, a play/pause icon, a "Show Q&A" button, a gear icon, and a full-screen icon.

Self-directed learning

- ✓ Reading material
- ✓ Scientific articles
- ✓ Useful resources
- ✓ Collaborative activity

<https://drive.google.com/drive/folders/1U2tv4Fba47PmMazXFmER934sRFrCSX4Y?usp=sharing>



Thank you for your attention
www.umarg.eu

