

Europeana Learning Scenario (Museum Educators)

Title

Gamification in Scientific Museum: Lateral Thinking Approach.

(Discovering historical surveying: a cooperative learning by doing activity into gamification approach.)

Author(s)

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Abstract

This Learning Scenario allows participants to learn about historical techniques and survey tools (and a few aspects of topography and cartography) used from the Ancient Age to the end of the 19th century. Using specific strategies belonging to Lateral Thinking, participants interact in cooperative learning approaches and in a “learning by doing” framework. The museum educator introduces them to crucial concepts of Survey and guides them into a short visit of two sections of the Museo Michelangelo. Then, participants are invited to build up a crossword schemata, using museum resources. The game will consist of solving crossword schemata exploring the museum with the crucial support of Europeana resources. The resources are also internal (catalog, guidebook, introduction labels, object labels, video, audio storytelling) and external ones (museum cataloging sheet published on Europeana). Additional useful information can be searched into other historical Science collections (i.e., the Museo Galileo Firenze) available on Europeana. After generative and research activities, participants select and organize the different types of tests and games and linked implementation software (crossword definitions, puzzles, scientific interactive ability test). In the last phase, they select and organize all specific materials (audio, video, tests, photos, storytelling...) and implement them in the game. Due to the pandemic crisis, the game can be also implemented into an online version.

The LS suggests strategies, methods, resources, and web tools that are potentially applicable to any other museum, not only scientific ones.

Keywords

Historical Survey, Cartography, Technical drawing, History of Science, unit of measurement.

Table of summary

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Subject	STEAM framework (Science, Technology, Engineering, Art, Mathematics)
Topic	Survey, Topography, History (since Ancient Age to 19 th century).
Age of participants	Upper secondary and adult Education generally (in this case 2 high school students, 1 museum educator responsible, 1 undergraduate student)

Suitable setting for implementation	<p>The LS is designed to be implemented either within a museum setting or online. The optimal place is the Museum’s educative section/laboratory and auditorium equipped with a video projection apparatus, a PC, a printer, a great table (possibly round or elliptic).</p>
Activity time	<p>8 hours</p>
Online educational material	<p><i>Interactive scientific free laboratory</i> https://phet.colorado.edu/sims/html/balancing-act/latest/balancing-act_it.html</p> <p>Interactive tools to implement remote cooperation activities https://puzzel.org/it/ https://classroom.google.com/ https://meet.google.com/ https://it.padlet.com/</p>
Offline educational material	<p>Post-it notes of different colors, paper (A4, A0), colored felt tip pen, books</p>
Europeana resources used	<p>https://classic.europeana.eu/portal/it/record/2048406/item_6RSU7WYJMRTKV6XJOSGVNLGK62DY3HBF.html?utm_source=new-website&utm_medium=button <i>Max-Planck-Institut für Wissenschaftsgeschichte / Max Planck Institute for the History of Science</i></p> <p>https://www.europeana.eu/it/item/9200369/webclient_DeliveryManager_pid_6346569_custom_att_2_simple_viewer <i>Fondazione Biblioteca Europea di Informazione e Cultura (BEIC)</i></p> <p>https://www.europeana.eu/it/item/287/work_99214 <i>MetsTeca</i></p> <p>https://www.europeana.eu/it/item/287/work_8122 <i>MetsTeca</i></p> <p>https://www.europeana.eu/it/item/287/work_8126 <i>MetsTeca</i></p>

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Integration into the curriculum

This LS overlaps several learning fields. In fact, you can adapt the described strategy to every museum content. In this specific case, the activity deals with each STEAM course i.e. Pure Sciences (Mathematics, Physics), Applied Sciences (Topography, Engineering Statics), Fine Art History. Moreover, there are deep

links to History and High Literacy. Of course, the LS designs a multidisciplinary activity that cannot develop into a static and stand-alone course, but it naturally lives into a curriculum built up in cooperation among three or more courses.

Aim of the educational activity

To increase educational and specific collection knowledge skills in the fields of History of Science and Technology.

To improve curiosity and identity with respect to cultural heritage, namely belonging to History of Science and Technology (in lifelong learning perspective).

Outcome of the educational activity

The outcome is a treasure hunt game. The learning activity is based on a short introduction to the selected museum contents (8-10 objects), individual research concerning these museum contents using Europeana and external resources, cooperative setting up of the individual contents to arrange the gamification, picking up the specific game test using appropriate on-line free software and apps and implementing the contents into the games.

21st century skills

Learning and innovation skills: critical thinking and problem solving, communications and collaboration, creativity and innovation

Digital literacy skills: information literacy, media literacy, Information and Communication Technologies (ICT) literacy

Career and life skills: flexibility and adaptability, initiative and self-direction, social and cross-cultural interaction, productivity and accountability

Problem-solving, critical thinking, ability to cooperate, creativity, computational thinking, self-regulation are more essential than ever before in our quickly changing society. They are the tools to make what has been learned work in real-time, in order to generate new ideas, new theories, new products, and new knowledge.

Activities

Name of activity	Procedure	Time
Museum knowledge	The scientific educator guides the group in Survey and Historical Measurement sections or talks about the following topics:	1 h

How to measure distances, angles, and time? What is light and how does it propagate? How to create and destroy rocks and what are they composed of? What was drawing used for and how to draw? How did our grandparents and great-grandparents do the calculations? A visit to a museum, physically or virtually, can give the answers to these questions, and a visit to Museo Michelangelo is such an example.

This museum collects and exhibits rocks and minerals, scientific tools, didactic models, and technological equipment dated back to 1850 and 2000. The collection contains objects that belonged to three different Caserta schools since 1864. In fact, the most ancient part of the collection comes from Istituto Tecnico “Garibaldi” in Caserta, planned during the Bourbon age and open since 1864.

Topography is a Science that overlaps with Engineering and Mathematics. It studies the forms and features of Earth surfaces into a range of 25 km from the point of observation. Thus, we can have a very good approximation of 3D Earth surface on a 2D surface, i.e. the paper sheet. Surveying is a part of Topography devoted to measure, compute, and draw the Earth’s surface.

Since the Ancient Age, every civilization needed to measure and divide lands for agricultural aims and to compute the consequent taxes for their possession. Surveying is crucially based on Geometry (that means measurement of the Earth). To fix up a point on the Earth surface the better strategy is based on triangulation: then the Mathematics properties and theorems play a crucial role (parallel and perpendicular lines, Thales’s theorem, triangular similitude, proportions, Pythagoras’s theorem, 1st, and 2nd Euclidean theorem). Only after the half of the 17th century, Surveying implemented telescopes into topography instruments, and thus Trigonometry was needed.

In each case, Surveying is devoted to measuring angles and distances, according to direct and indirect methods.

https://youtu.be/XuDy9s4fl_8?t=1251

https://youtu.be/XuDy9s4fl_8?t=1797

The measurement history section of Museo Michelangelo completes the Topography one. It exhibits instruments used from antiquity to 1600 for direct and indirect measures of distance, and angles (and so time, indirectly). They are wooden copies working and created in 2008 because original ones do not exist; they are very rare. These instruments do not have telescopes or microscopes since optics entered the topographical instruments only in the first years of 1700. Today, the involved techniques are largely unknown although quite precise.

This task could take place in a relevant section of the museum that the educator works, or it could be held online through a virtual tour. Museo Michelangelo provides the opportunity for a virtual visit.

<https://musemichelangelo.altervista.org/tour-virtuale/>

	<p>The educator leads the participants to these fundamental concepts in 10 minutes. Then, he/she invites them to explore resources (Europeana and internal ones mainly) to select objects (instruments, apparatus, history, names, dates, etc.). The selected objects will be transformed into “treasures” words or experiences to implement the game. (50 minutes).</p> <p>Specific contents concerning with Museo Michelangelo: https://musemichelangelo.altervista.org/wp-content/uploads/2019/10/GuidaMuseoMichelangelo_2015w.pdf https://musemichelangelo.altervista.org/wp-content/uploads/2019/10/catalogo.pdf</p> <p>Catalogo Generale dei Beni Culturali (set up a query with the following parameters: field: Dove > specific options; (tent menu) Regione: Campania; (province list) Provincia: Caserta; (municipality list) Comune: Caserta; Indirizzo: viale Michelangelo) http://www.catalogo.beniculturali.it/sigecSSU_FE/ricercaGuidata.action?timestamp=1577274831830</p> <p>Multimedia resources on Museo Michelangelo https://izi.travel/it/609c-museo-michelangelo-caserta/it https://www.youtube.com/channel/UCwRaGGyle-3pZYA4fSsxnXQ/featured https://www.youtube.com/watch?v=XuDy9s4fl_8</p> <p>During this activity, participants learn and build up the hard knowledge (contents) of this LS concerning the planned topics.</p>	
<p>Creative process</p>	<p>Using Lateral Thinking strategies, participants generate a lot of ideas to plan and design the game.</p> <p>Lateral thinking offers solutions to solving problems, namely complex and cultural ones. Differing from the logic-deductive method, it uses an indirect and creative approach that at first sight can seem not immediately applied or reasonable. The central idea is that several best solutions may not be outcomes from a step-by-step logic method. The celebrated book “The Use of Lateral Thinking” by De Bono (1967) introduces a new point of view for the perception of creativity, not as "vertical" logic, but as a “lateral” process. Lateral thinking valorizes contribution for all participants to the creative session because each participant must clean its pre-concepts and accept each other as a peer creator.</p> <p>Using Lateral Thinking it is possible to move from one known idea to several unexpected and surprising new ideas. De Bono stated four tools for a correct thinking approach:</p> <ul style="list-style-type: none"> - idea-generating: to break current thinking patterns—routine patterns, searching innovative view to see a usual problem; - focusing: to broaden where to search for new ideas; - converging: to collect, select, and evaluate the idea-generating output; 	<p>1 h</p>

	<p>- implementing: to consider real-world constraints, resources, and support to solve the assigned problem.</p> <p>There are different techniques that allow us to support the four-step: Random entry idea generation, Provocation idea generation, Movement techniques, Challenge, Concept formation, Disproving, Fractionation.</p> <p>According to random entry idea generation technique, the educator invites participants to write one (and only one) word on a single sticky note. The word can represent: the name of an historical object or a scientist or a place linked to an object belonging to the museum collection. Moreover, the generated word can describe an action/phase of the game process (an ability test, a type of test), a tool, etc. It is important that each participant freely expresses the ideas, with no a priori selection (each idea is always a good idea!).</p> <p>It is better to have sticky notes in different colors: the different colors can be offer further creative stimuli. Participants must put each sticky note on a wall (digital or real one), on a blackboard, on a table etc.: in every case, it does not matter where he/she will post the sticky note (center, board, angle of the available surface).</p> <p>At the end of the creative session, the participants will have more elements to arrange and organize treasure words.</p> <p>First of all, they will be invited to cooperate to cluster similar word/action/tools. For example, they will be able to delete two similar words or group them to enforce ideas that are more frequent. Moreover, it will be possible to re-write significant words/sticky notes: for example, red ones for actions that it will be involved into the game, green for key word linked to historical etc. During the clusterization process, while you put the own sticky notes/words on the wall, it is crucial explain to all participants why the word is linked to the others, thus, it will pop up new original and creative ideas and hidden relationship between already well-known words, objects, tools, actions etc.</p> <p>Then, the educator will guide a brainstorming phase to add/delete more ideas / sticky notes generated by the clusterization phase.</p> <p>At the end, it will be evident the central ideas and the roles that they will play in the (cause-effect) phase to build up the hunt treasure game.</p> <p>All the activities linked to Lateral Thinking processes can also be implemented and shared online using Padlet (as virtual digital blackboard/wall) or other similar tools (included in google, for example).</p> <p>This activity offers a significant occasion to improve soft skills in participants/learners.</p>	
<p>Selection process</p>	<p>Selection of contents, materials, and software</p> <p>This phase is devoted to deep thinking about how to arrange and organize the treasure game with respect to tests and the ability involved for the selected potential public.</p>	<p>1 h</p>

For example, we can decide to set up a game for a young public, up to 16 years students and adults.

Then, we need design to set up a crossword schema: the “treasures words” will be the solution to the horizontal and vertical questions.

Due to the pandemic constraints, we must implement an online version of the game. Thus, we need to search online freeware (and possibly open source) apps and software to implement: a crossword, a puzzle, an interactive scientific ability test.

During this phase, we set up the rules of the treasure game, what the players can be or can be not done.

Players will be able to explore Europeana resources using a few suggested keywords and collections. They will also have Museum inner resources (catalogue, guidebook, introduction labels, object labels, video, audio-storytelling) and external ones (museum cataloging sheet published on Europeana).

We will also offer our multimedia content resources: video (our Youtube channel), audio-video storytelling (our section on izi.travel).

Thanks to this activity participants/learners have a significant occasion to enlarge their experience in particular with respect to software appropriated to gamification, museum storytelling, and remote cooperation processes.

<https://www.europeana.eu/it/search?page=2&view=list&query=Measuring%20instruments%20%22xvii%22>

Museo Galileo – Istituto e Museo di Storia della Scienza – Firenze

https://classic.europeana.eu/portal/it/record/2048406/item_6RSU7WYJMRTKV6XJOSGVNLGK62DY3HBF.html?utm_source=new-website&utm_medium=button

Max-Planck-Institut für Wissenschaftsgeschichte / Max Planck Institute for the History of Science

https://www.europeana.eu/it/item/9200369/webclient_DeliveryManager_pid_6346569_custom_att_2_simple_viewer

Fondazione Biblioteca Europea di Informazione e Cultura (BEIC)

https://www.europeana.eu/it/item/287/work_99214

MetsTeca

https://www.europeana.eu/it/item/287/work_8122

MetsTeca

https://www.europeana.eu/it/item/287/work_8126

MetsTeca

Multimedia resources on Museo Michelangelo

	<p>https://izi.travel/it/609c-museo-michelangelo-caserta/it</p> <p>https://www.youtube.com/channel/UCwRaGGyle-3pZYA4fSsxnXQ/featured</p> <p>https://www.youtube.com/watch?v=XuDy9s4fl_8</p>	
Implementation	<p>Implementation of the game (crossword, puzzle game, storytelling, interactive scientific laboratory for the ability test, virtual tour)</p> <p>Using appropriate software/apps for “treasure words”, participants must arrange all selected contents into the crossword schemata and create and write the linked (horizontal and vertical) definitions.</p> <p>A few definitions of the crossword game can be answers derived from the ability test: a scientific experiment, a storytelling audio, a photo-puzzle game, as in our implementation.</p> <p>At the planned tools (crossword, puzzle game, audio storytelling, scientific ability test etc.) will be set into different space of the museum or in the same room, as you prefer. In our case, we built up a museum virtual tour specifically devoted to the treasure game (and then different by the official one). In the virtual tour space, we posted the tools as hotspot buttons. If it is necessary, you can put some hints to help gamers. : in the real museum as labels, in virtual tour museum as information label or hotspot.</p> <p>During the implementation phase, each participant must check for mistakes, errors, bugs that eventually occurred.</p> <p>Thus, participants/learners can experiment and increase their informatics skills.</p> <p>Interactive scientific laboratory on-line for the ability test</p> <p>https://phet.colorado.edu/sims/html/balancing-act/latest/balancing-act_it.html</p> <p>Interactive tools to implement remote cooperation activities</p> <p>https://puzel.org/it/</p> <p>https://classroom.google.com/</p> <p>https://meet.google.com/</p> <p>https://it.padlet.com/</p>	4 h
Evaluation	<p>The participants /learners will be invited to participate in a focus group to evaluate results and players’ comments, after a gaming phase.</p>	1 h

The outcome of this task will allow us to reorganize the game, if it is necessary, or to implement changes and improvements.

Participants' feedback

We collect participants' feedback using two strategies: a detailed anonymous webform (with a questionnaire based on closed, either quantitative or defined answers, https://docs.google.com/forms/d/e/1FAIpQLScwrZ0AA6mQ0BvuYY9kwfjOY7NPO9s6q7AsRm0Cvfh-v0y_hQ/viewform) and a brief focus group session (10 min, at the end of the activity).

Educator's remarks

The challenges for each Museum in the following years will reach different publics satisfying specific requirements and educational needs. The gamification offers deep results with respect to participation in the activities and guarantees a high level in learners. Cooperative learning allows us to obtain better results than individual ones, increasing and exploring ideas.

I am proud to contribute to the increasing educational service of Museo Michelangelo, belonging to my high school. I enjoyed experimenting with the power of Lateral Thinking procedures to generate original ideas. Interesting educational activities to improve scientific knowledge into a historical framework. Intriguing experience to test education and ludic into a museum (onsite and using free online resources).

The main difficulty in the online version is concerning setting up all virtual resources and testing them to avoid bugs. It is a work that requires several informatics skills and increases the implementation time.

The activity was implemented in an online interactive version, that is now available on the museum website: "Playing with historical survey: a treasure hunt game into Museo Michelangelo" – www.musemichelangelo.altervista.org.

About the Europeana DSI-4 project

Europeana is Europe's digital platform for cultural heritage, providing free online access to over 53 million digitised items drawn from Europe's museums, archives, libraries and galleries. The Europeana DSI-4 project continues the work of the previous three Europeana Digital Service Infrastructures (DSIs). It is the fourth iteration with a proven record of accomplishment in creating access, interoperability, visibility and use of European cultural heritage in the five target markets outlined: European Citizens, Education, Research, Creative Industries and Cultural Heritage Institutions.

[European Schoolnet](http://EuropeanSchoolnet) (EUN) is the network of 34 European Ministries of Education, based in Brussels. As a not-for-profit organisation, EUN aims to bring innovation in teaching and learning to its key stakeholders: Ministries of Education, schools, teachers, researchers, and industry partners. European Schoolnet's task in the Europeana DSI-4 project is to continue and expand the Europeana Education Community.

Annex