V!RUS
revista do nomads.usp
nomads.usp journal
ISSN 2175- 974X
criação em processo+s
creation in process+es
sem 2 - 11

How to quote this text: Varano, S., 2011. Objective and sensitive map, *V!RUS*, [online] n. 6. Available at: <http://www.nomads.usp.br/virus/virus06/?sec=4&item=5&lang=en> [Accessed 00 Month 0000].

Objective and sensitive map

Sandro Varano

Sandro Varano is Architect and Doctor in Science of Architecture. Professor at the *Ecole Nationale Supérieure d'Architecture de Strasbourg*, Researcher at the *Département Architecture, Morphologie/Morphogénèse Urbaine et Projet* (AMUP) - ENSAS. He also works at MAP-CRAI - FRE n°3315 / CNRS - *Ecole Nationale Supérieure d'Architecture de Nancy*.

Abstract

The aim of this work is to teach the public by facilitating the appropriation and memorization of new knowledge of built cultural heritage. The 3D navigation space proposed, correlates activities of exploration and creation. During his real time movement, the learner is guided and motivated following topographical, cognitive and scripted paths. At the same time, he/she creates his/her own « memory map » that will help to move, build knowledge and memorize. It results in a prototype using the Cheops Pyramid as support of experimentation.

Keywords: Built cultural heritage; strategic path; memory map; learning.

1. Introduction

This work deals with archaeological and architectural restoration. Through the use of existing numerical tools, the objective consists in proposing to non-expert learners, a hypermedia navigation space based on systemic, practical and graphic assumptions, in order to conceive a complete visualization and immersion tool as an aid to understand archaeological and architectural knowledge.

The system presented proposes a 3D navigation mode based on strategic paths dedicated to learning. In our system, the real-time visit of an archeological site or an architectural monument leads to two activities that the learner performs in parallel:

- the exploration of the 3D model
- the creation of the memory map

These activities belong to a real educational project: the exploration based on clues discovery and riddles resolution incites the learner to participate; the creation helps the learner to organize and visualize information. Both processes allow him to structure and construct knowledge.

During the exploration activity, the learner is guided and motivated in sequenced and superimposed routes, while allowing a lot of freedom. This structure in double layers is composed of the topographical path and the cognitive path. During the creation activity, the learner materializes his mental map. The memory map evolves according to the progress of the learner on these paths.

In this research work, we will correlate the creation of the memory map with the kind of narrative proposed during the exploration. In our study, we will choose the Great Pyramid of Giza in Egypt. With the help of Tristan Truchot, we created a prototype of an extract of the scenario to estimate and experiment our work.

We will also see how, using a system of paths optimization and generating scenarios, the processes of creation can join a wider educational frame, allowing collective discovery of built cultural heritage knowledge.

2. Strategic paths

2.1 The topographical path

To be able to structure the movements, we introduce the notion of the topographical path by identifying critical places and secondary places in the path and by putting them in concordance. It is necessary to choose in the studied building the interesting critical places according to the message that we want to communicate to the learner. Each crossing point suggests specific actions that we wish to represent in the topographical path. The crossing points of the path consist of two types of places:

- the information places, defining the information route
- the knowledge places, defining the knowledge route

The data on the information route are reinvested in the knowledge places where the learner transforms the information into knowledge. The knowledge place is a critical point structuring the path in learning sequences. The passage from a sequence to the other one can be linear, reticular, or mixed (Figure 1).

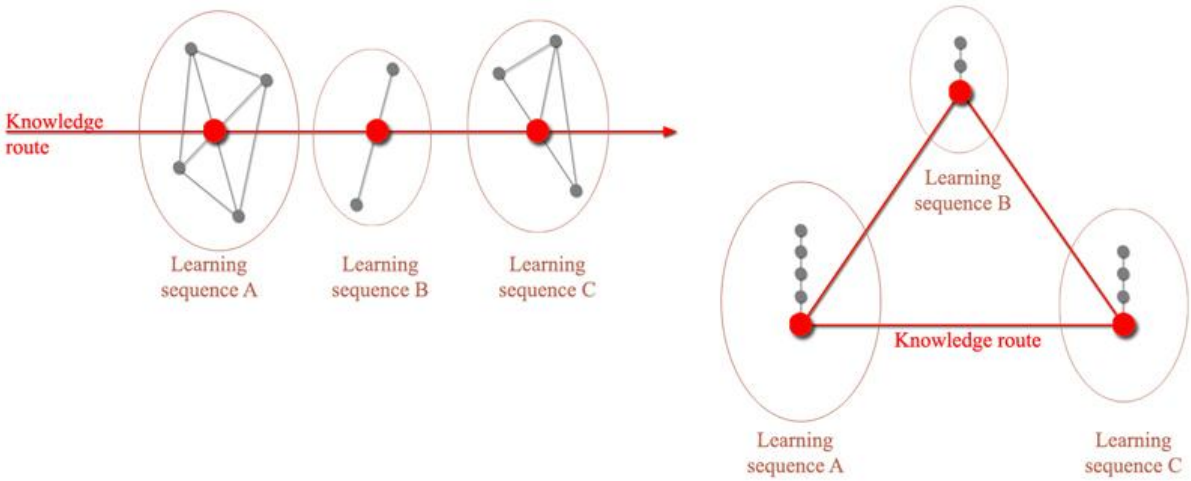

Figure 1. Successive learning sequences of the topographical path.

2.2 The cognitive path

Research and cognitive experiments have shown that the learner must be constantly alerted and motivated to be interested in the studied topic. The acquisition of new knowledge depends on his willingness to achieve the objectives defined at the beginning.

To motivate the learner by avoiding a "cognitive overload" (Jacquinot, 1996), we define a ludic aspect of the path in relation to the diversity of spaces that can be visited and in relation to the possible interactions in these spaces by manipulating multimodal information.

The activities which take place around the interactive multimedia objects have various logics; we can so qualify types of places:

- Places of fabrication/mechanism
- Places of reading/decoding
- Places of travel/transport
- Places of labyrinth/orientation, …

2.3 The scripted path

The work here is to juxtapose the narrative structure of an interactive story with the topographical and cognitive paths.

The semantic approach of the narrative is a paradigmatic and syntagmatic division of the topographical and cognitive paths, and this, in two phases: first, we divide the paths into narrative sequences; then, we connect the sequences in a production of sense.

The knowledge route is a long process of riddles solving. At the beginning of each narrative sequence, the riddle generates cognitive conflicts and initiates a clues research on the information route. The information places deliver useful clues to solving the riddle (Figure 2).

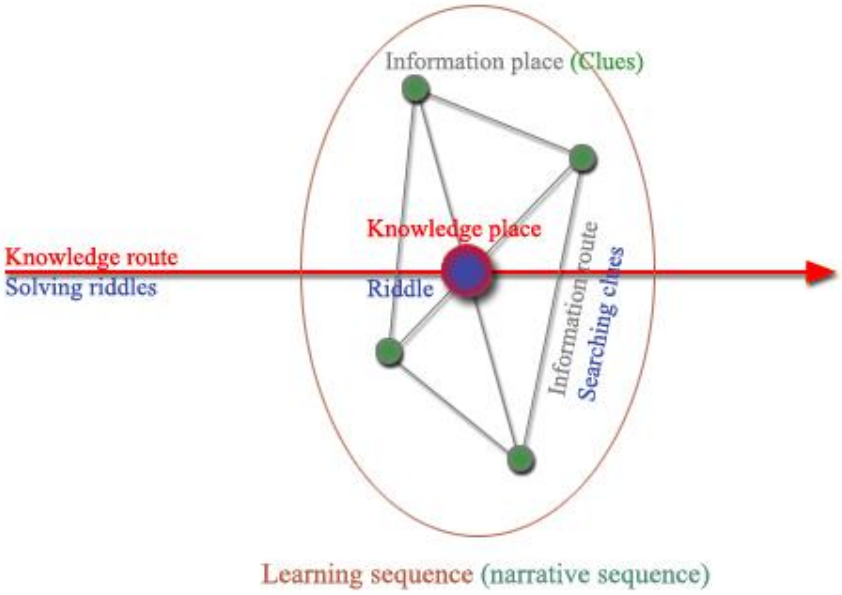

Figure 2. Searching clues and solving riddle in a narrative sequence.

If monument information misses, we can create some extensions of the path in the 3D base model. These spaces voluntarily added, fictitious or depending on the historical context of the building, belong to the information route and hold the clues for solving the riddle at the knowledge place and for moving to the next sequence. The knowledge places would thus be existing spaces in a building to be communicated.

Imagine a path in the Cheops Pyramid in Egypt. The learner moves in real time in the existing spaces in the monument. He can take at any time inserted exterior spaces. By leaving the "King's Chamber", he could go for example to a mummification room of the second empire, to the Louvre Museum in Paris, to an invented virtual space allowing an interaction between the learner and his environment. The transition between the existing spaces and added spaces is possible by crossing portals (Figure 3).

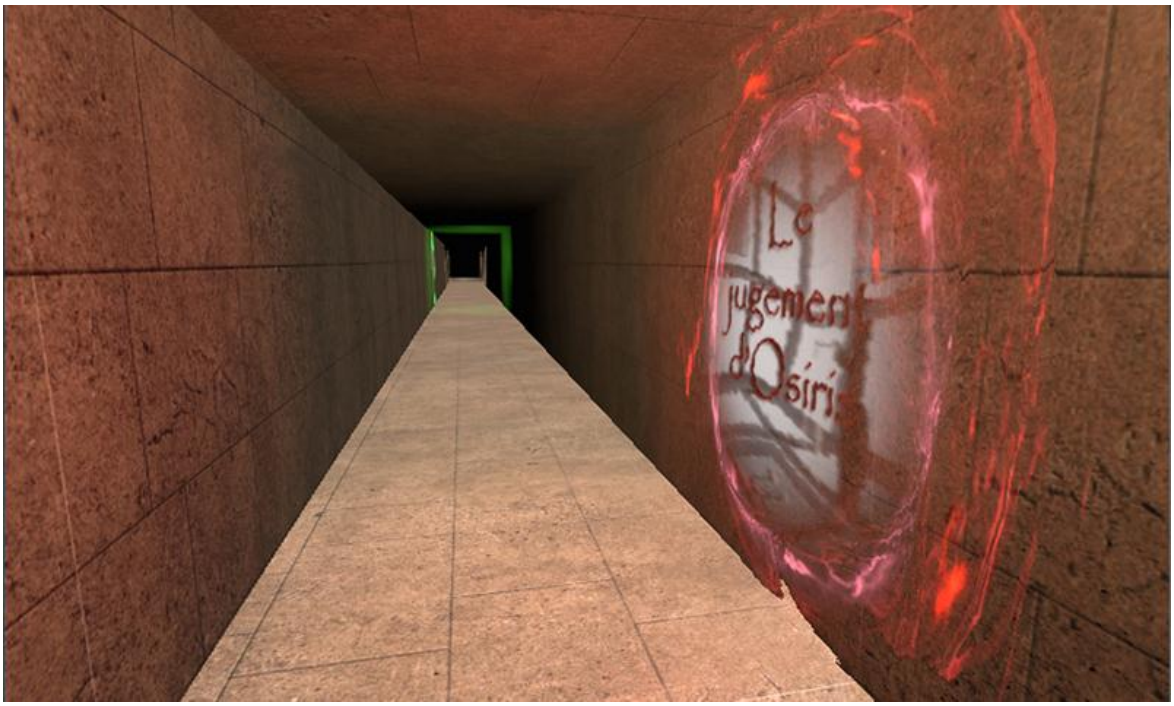

Figure 3. Teleportation portal located in the horizontal corridor.

The successive sequences define a quest. The number of information places in each sequence is defined in relation to the riddle proposed and the number of knowledge places in a quest is defined by the message (religious, structural aspect, etc.) to be taught.

3. A scenario in the Cheops Pyramid: story of a journey into the afterlife

The Great Pyramid contains many mysteries. Its architectural, symbolic or historic complexity, allows us to define several quests. In our study, we approach the Egyptian religion with the pyramid.

The pyramid is the funeral monument allowing the pharaoh to live eternally. The purpose of the quest is to reveal the journey of the pharaoh to reach the afterlife. The learner will discover through the pyramid a considerable universe of symbols and religious practices assuring the rebirth of the deceased.

He will move in the monument with a subjective point of view embodying the soul of the pharaoh Cheops.

The quest possesses three learning sequences (A, B, C) or three knowledge places (figure 4).

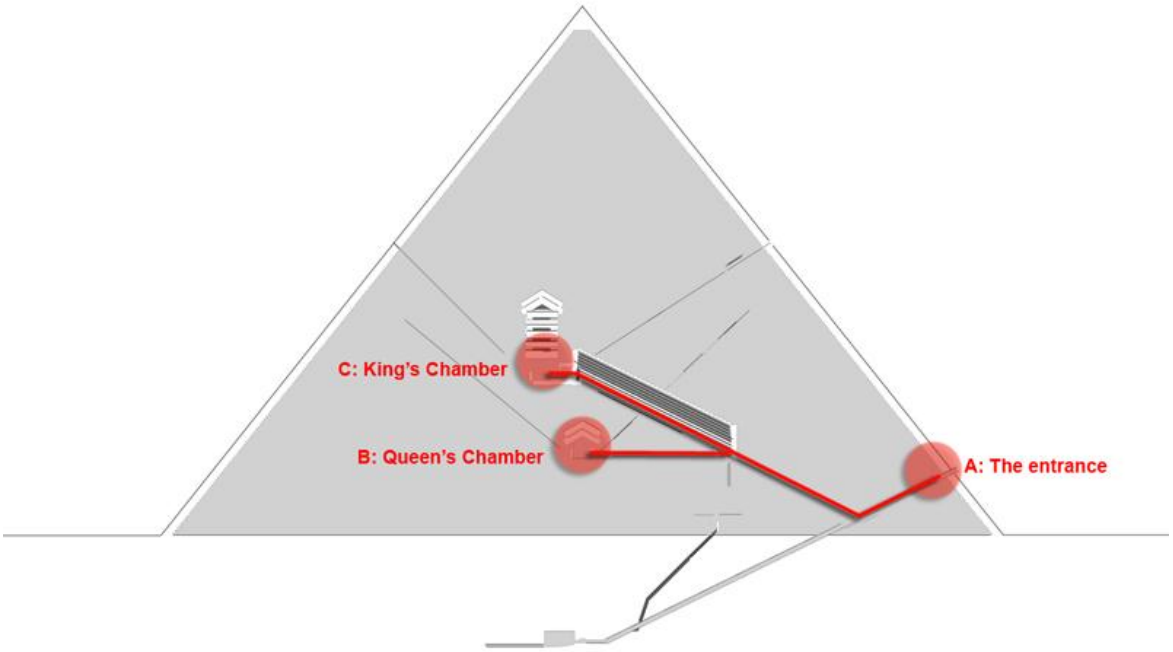

Figure 4. The route of knowledge in the Cheops Pyramid.

A. "The cosmos perceived from the Nile": the sequence possesses a knowledge place: "The entrance", and two information places: "The lines of the priest" and "Blake & Mortimer" (Jacobs, 1955).

B. "A path of obstacles": the sequence possesses a knowledge place: the "Queen's Chamber", and three information places: "The invisible and immaterial entities of human being", "The weighing of the heart" and "A journey by solar bark".

C. "Return to his sarcophagus without mistakes": the sequence possesses a knowledge place: the "King's Chamber" and two information places: "The canopic jars" and "The mummification room".

4. The memory map

During the creation activity, the learner outlines his path. Like a cartographer, he reveals his discoveries in order to establish a journal telling the story of his journey.

4.1 A multimedia notebook

According to David Cohen, multimedia has three components: Audiovisual, Interactivity and Network (Cohen, 1995).

The memory map is a support crossing various graphic and sound representations: it allows the learner to store images, take notes, sketch drawings and play audio or video: multimodal

information found during the 3D exploration or created by the learner. Information contained on the map is manipulated. Actions such as moving, connecting, correcting, removing, etc, maintain an interaction between information and the user.

The memory map is not a closed system with its own data library. Connections are possible with Internet. This concept of network extends the notions of space and distance between consulted information and the learner.

4.2 A locating tool

Outlining a path to explain where we have come from but also where we are going. In this context, a rapid movement system is thus established to navigate between the memory map and the 3D model. This feedback system is possible using sensitive areas. Teleportation provides a transfer between two points of view: an internal or subjective focus on the building and a zero focus around the memory map.

4.3 A memory tool

The memory map transmits messages. Its capacity to produce meanings allows the learner to build his own reasoning. According to Jean Piaget (Piaget, 1936), knowledge results from the interaction between the person and the environment, compared to the constructivist hypothesis: we appropriate knowledge that we build ourselves.

The possible links between the information allow the learner to create associations between elements. This process is similar to the mnemonic method. This activity is a learning process by organizing information and by encouraging memorization.

5. Correlation between the memory map and the strategic paths

Our learning system proposes two different and inseparable activities, it's important to maintain a link between the exploration of the 3D model and creation of the memory map.

A prototype is realized using the *Java* language in order to create the memory map, and the level editor *Unreal Ed 4.0* (with the video game *Unreal Tournament 3*, 2007) in order to create a 3D model of the pyramid. The method consists in using the Internet protocols (*TCP* and *HTTP*) to put in relation the 3D model and the memory map.

Each place allows the realization of a screenshot. It is a page of the memory map as a support of representation. When the learner visits the knowledge place, he initializes automatically the

screenshot illustrating the space where he is (Figure 5). Thus, the number of knowledge place determines the number of pages of the memory map.

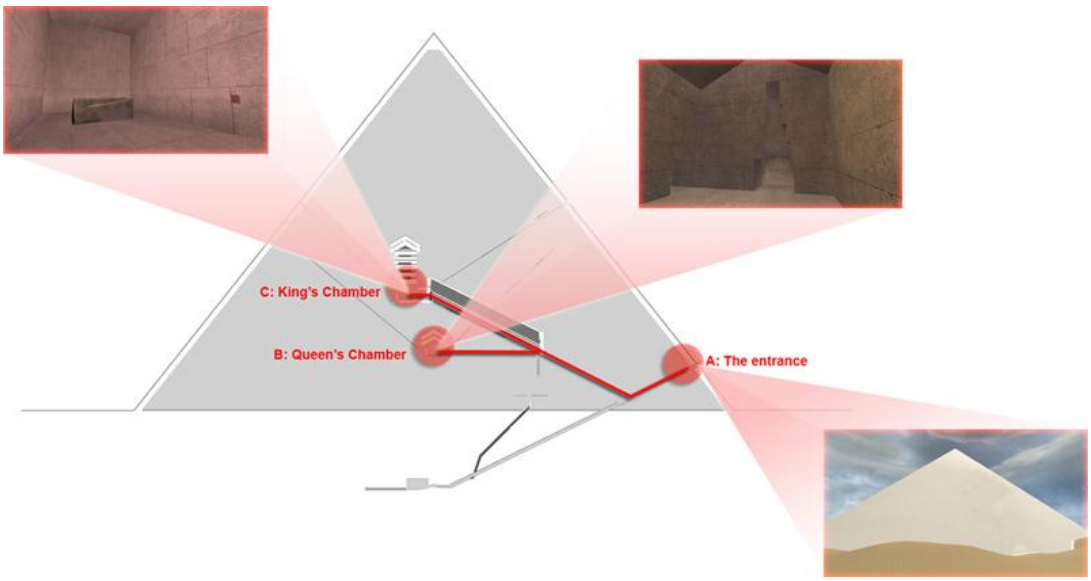

Figure 5. Screenshots in the Cheops Pyramid.

At first, the real-time exploration precedes the creation of the memory map: the memory map of the learner takes shape by successive additions of places materialized during the 3D exploration (Figure 6). A memory page indicates by connectors the number of interactive multimedia objects contained in the corresponding place.

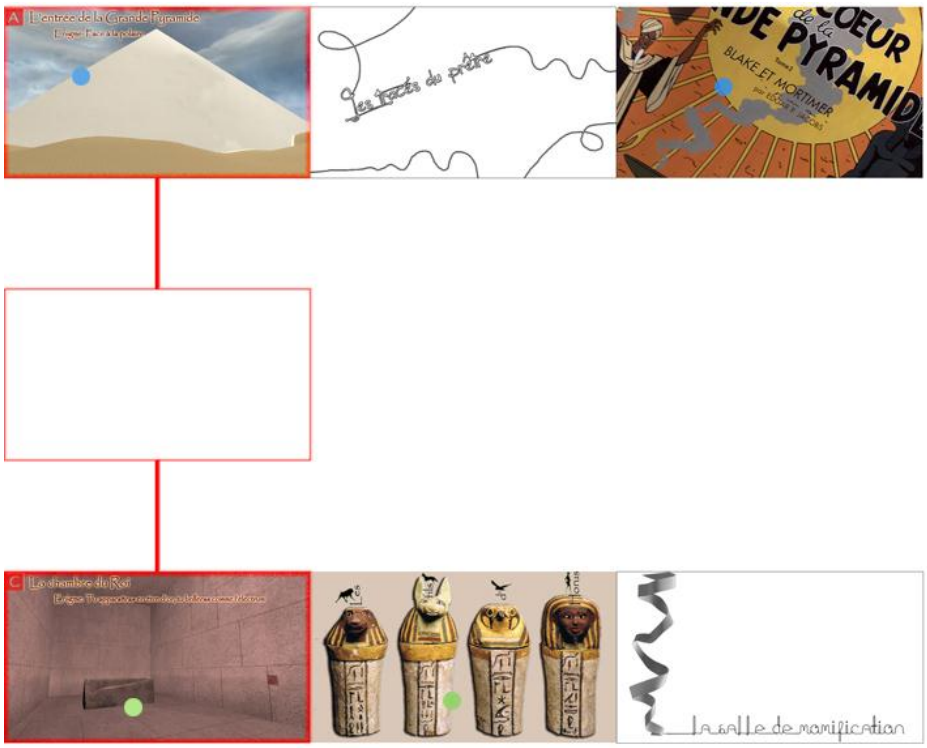

Figure 6. The memory map of the learner taking shape during the 3D exploration.

Then, the learner builds his relation to the spaces using words and images related with the information places: he clicks and transforms information to display on a page; he writes key sentences; he draws details or plans, etc. (Figure 7)

Figure 7. A personalized screenshot: multimedia information recovered on a memory page and personal notes. The information place "The weighing of the heart" is based on the film *Cube* (Natali, 1999).

Two types of links are managed in the system:

- The automatic links connect the information of the same place (2D links on a page) and the various knowledge places (3D links between pages).
- The personalized links created by the learner to connect similar elements.

According to the metaphor of paper folding, the 2D memory map passes to a 3D representation. So, it allows visualizing complex links in 3D.

The dynamics of knowledge construction process is visible through the creation of the memory map; it can assist learner in navigation space and preserve traces of his/her path. The traces visible on the memory map are the result of a creative practice. The traces from this creative practice can be an aesthetic object to contemplate as an artwork (Figure 8).

Figure 8. The path traces.

The memory map allows the learner to organize ideas, to build his own reasoning by taking into account certain rules in a predefined narrative context. The map becomes a travel journal, identical to the stories illustrated in the travels of explorers, themselves in the pursuit of knowledge.

The data and the connections the user chooses to the screenshots, allows him to create his own representation of the world. We refer, on the one hand, to the constructivist hypothesis according to which the learning is an active and constructive process and, on the other hand, to cartography, which has multiple stakes: knowledge, representation, control, action, imagination.

The map is not the exact image of the castle, but rather the learner's representation or perception. The important thing for the user, and for his individual fantasy, is to make sense of what he perceives. From a semio-cognitive point of view, the map establishes the sensitive framework, encouraging the ludic attitude of the user.

Finally, we can observe the combination of different parts of the screen (Figure 9).

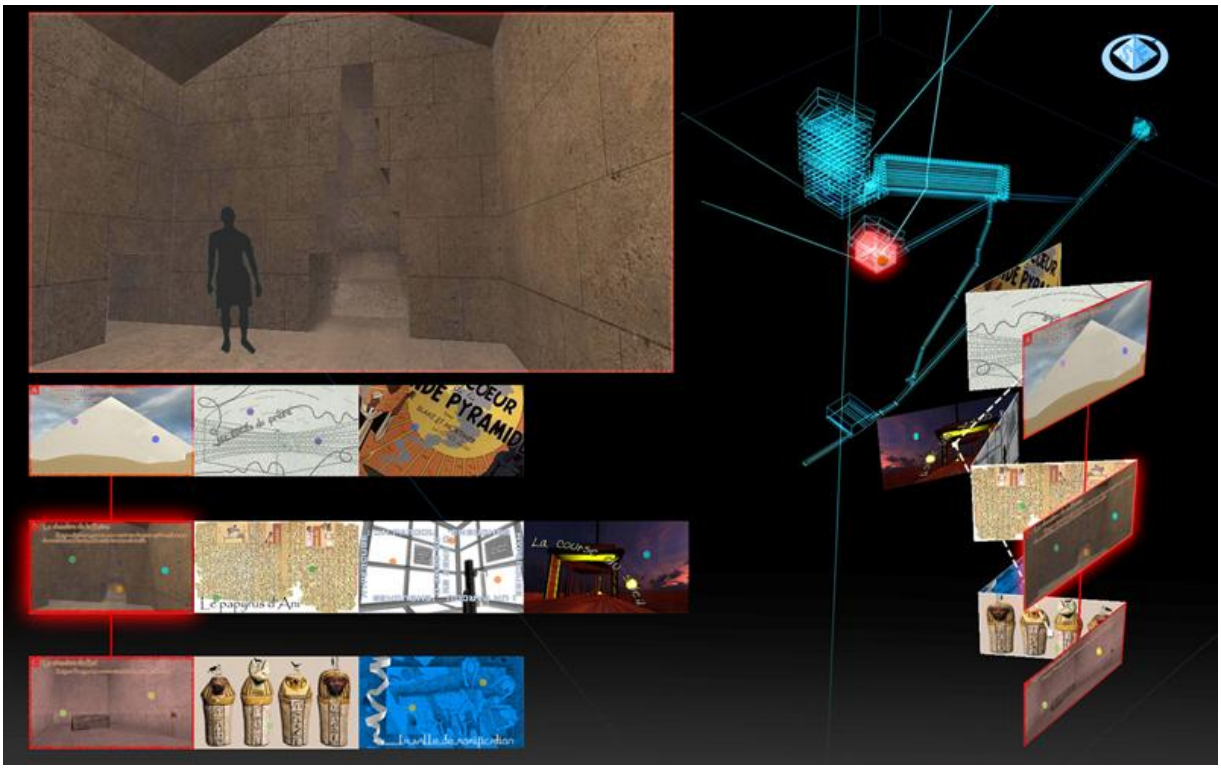

Figure 9. The 3D navigation space on the screen.

6. Collective processes of learning and creation

6.1 Optimization of paths and generation of scenarios

By « optimization », we intend that our topographic and cognitive paths could adapt to learning conditions every time different; learning conditions vary according to learner's profiles and places of use. Ideally, it would be necessary that teaching strategies suggested by teachers, specialists, guides ..., adapt to learning strategies used by learners (students, visitors …).

The configuration of our learning structure is a real asset to optimize paths. Depending on the nature of information and possible actions in each place, on the number of points (distance and speed), and on type of progression between these places (linear, reticular, or mixed; figure 1), we can estimate the mental effort and the duration useful to cross the topographical and cognitive paths. The optimization of paths would be linked to the notions of time and cognitive effort.

In a wider frame, we can realize a system which puts in adequacy the type of optimization with objective of quest.

Imagine a visitor using an interactive device in space museum of a historic building. The user who has a short time, composes his/her path : the first two options concern the type of progression and difficulty level, the third concerns the aspect of the monument which the user

wishes to discover. Then, the system generates a scenario that reflects the options selected: the narrative sequences adapt to learning sequences.

A real optimization of paths combines scripted paths to topographical and cognitive paths.

6.2 The collective nature of processes

Now imagine a learning device in the same historic building. Learning is not limited to the use of interactive device. The device is part of a learning environment combining real path made by visitors (for example a group of students) to the interactive device as a tool mediator.

The group visits the monument, their path is punctuated with remarkable points: for example, 2D bar codes are positioned at certain places and are associated with places or with elements of the place. Each student is free to decode these pictograms with a mobile device (phone …); this has for consequence to store a numerical index recoverable on the interactive device.

At the end of the visit, the interactive device saves the traces of paths from the actions of decoding performed by each student: places and elements decoded of the monument can be knowledge places, information places or interactive multimedia objects associated with fragments of history.The device can then generate a scripted path by taking into account collected data.

Once at school and with the assistance of teacher, the group of students can revisit the monument on network and taking into account the heterogeneous data collected by all students. The multi-learners hypermedia navigation space gives an opportunity for students to review and exchange places and objects of their visit, with interactions and additional information enriching the real path. Instrument mediator between teacher and students is capable of causing such learning situations.

The optimization here combines scripted path, topographical and cognitive paths, and finally real path.

7. Conclusion

Restoring archaeology and architecture, we propose a 3D navigation space based on topographical, cognitive and scripted paths. During the exploration of a 3D model, the learner can create his own memory map facilitating the appropriation and memorization of knowledge.

The exploration and creation activities allow us to elaborate a learning system supervising the navigation of the learner: by managing his movements and by taking into account his cognitive capacities.

We have seen how the creation of the memory map is based on the structure of the topographical, cognitive and scripted paths. The map accompanies the learner's exploration.

On the one hand, the paths manage movements and possible interactions in the spaces; on the other hand, the memory map retains traces as evidence of a creative practice.

By producing meaning and by evoking his limits, the learner tries to master the unknown by his own representation.

To conceive an efficient learning system, this work can lead to a conceptual model of 3D navigation space applicable to all types of buildings.

References

Cohen, D., 1995. Interfactives ou l'écran agi: les métaphores à l'écran. In: *Écrits. Images. Oral et Nouvelles technologies*. Actes du séminaire 1994-1995. Under the responsability of Marie-Claude Vettraino-Soulard. Paris: Université Paris 7-Denis Diderot.

Jacobs, E. P., 1955. Le mystère de la grande pyramide. *Les aventures de Blake et Mortimer*. Tome 2. s.l.: Dargaud, p. 54.

Jacquinot, G., 1996. Les NTIC: écrans du savoir ou écrans au savoir. In: Chevalier, Y. Ateliers 9/1996. *Outils multimédias et stratégies d'apprentissage du FLE*, Cahiers de la Maison de la recherche, tome 1. Lille: Université Charles-de-Gaulle Lille 3.

Piaget, J., 1936. *La naissance de l'intelligence de l'enfant*. Neuchâtel: Delachaux & Niestlé.

Natali, V., 1999. *Cube*. s.l.: Metropolitan FilmExport. [Film]

Unreal Tournament 3, 2007. Epic Games, Midway Games. Available at: <http://www.unrealtournament3.com/>.