Dynamic Maps’ Use in Smart-Cities Learning Contexts

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ABSTRACT

This paper examines the potentialities and characteristics of dynamic maps in relationship with constructivist teaching, by considering maps’ support to four functions: the contents’ learning, the contextualization of Learning Objects, the contextualization of online learning interaction and the knowledge construction. Several algorithms for polymorphic and animated maps’ reconstruction, both bi-dimensional and tridimensional, will be examined and described in detail. Among these algorithms, a further differentiation is made between those concerning proximal, or hierarchical development, and those regarding gravitational developments. In the latter one the positioning of nodes derives from quantitative values, that express their relation’s attractive strength. Conclusions derived from this work are the unavoidable need to implement maps’ dynamic reconstruction algorithms, when the complexity of the disciplinary ontology makes the traditional static approaches unable to provide an effectively usable image of the map.

Keywords: Concept Map, Dynamic Map, Gravitational Reconstruction, Learning Object, Proximal Reconstruction, Reconstruction Algorithms

1. INTRODUCTION

The term “education” includes a complex set of activities, such as the delivery of disciplinary content, the interaction between teachers and students, the assessment of the learners and the quality of the process itself. This set of activities depends on the kind of context in which it is applied (formal, non-formal and informal contexts, actual, distance and blended contexts), on the different cognitive contexts, and on the different learners’ categories. Each of these different contexts influences the choices of organizational and methodological characterization of the learning activity. Even the use of educational tools, and in particular the instruments related to new digital technologies and networks, depends on the differentiation of the didactic activity. We examine, in this regard, the use of concept maps in didactics according to the different ways in which they can be applied.

In the context of the smart cities, the use of graphic maps, and especially of dynamic and three-dimensional maps, is an important issue in order to precisely represent the complexity in all its perspectives (as human relations and resources’ and services’ distribution). In this sense the didactic use of graphic maps has the specific task of helping people to understand and use this model of representation of relational contexts.
2. CONCEPT MAPS AS A STUDY DOCUMENT

The first and most obvious mode is the concept map’s use as a document “in itself”. The concept map has a particular hermeneutic value, related to its characteristic design and label relations. The representation of relations differs significantly from hypertexts to concept maps. Even hypertext navigation is based on relations and their navigation, but in hypertext, the visible part of the relation does not go beyond the “port of entry” (the link) that leads to the document, or to the connected part of a document. In the concept map the relations are entirely visible, as arcs connecting two concept-nodes. This feature makes fully visible the logical path from one concept to another. The concept map represents the relational texture of the discipline as a whole, and its user sees a design composed of nodes and arcs, which effectively shows the structure of the disciplinary context. This structure carries the particular hermeneutic value, because it allows the user to understand, at first sight, the topics and fundamental links of the context. Furthermore, constant use leads to a gradual deepening of the study concept, without losing sight of the general context and the specific position of each concept. This hermeneutic value is linked, obviously, to the degree of detail or depth of the map itself. The more the map is full of nodes and arcs, concepts and relations, the more the study of the map can become significant. By increasing the level of depth, the concept map evolves from context structuring to a kind of knowledge writing. In this way disciplinary content in explicitly structured as a set of relationships that connect specific fields and concepts of the discipline one to the other (Kramer, 1994; Pedroni, 2004). Torma and Nuutila (2004), allow, through a specific software, the use of a structured map to compose sentences in which concepts and relations are clearly separated and automatically integrated.

Among other applications, in a learning environment maps of this kind can provide testing tools which can be applied in “open” and “closed” modalities (La Vecchia & Pedroni, 2007).

These modalities may include:

- Checking the correctness of concept maps provided by the teacher, and the reporting of any errors;
- Creating maps in which the concepts are expressed and graphically designed, but the relations not labeled: the test consists in correctly writing on the map the relation labels, provided on a separate list;
- Reconstruction of maps from a list of concepts and a list of relations.

To be used as an evaluation tool, learners need to know, in advance, how to construct a map: concept maps must not be used for evaluation without previous preparation, since learners may encounter difficulties which are unrelated to their knowledge of the specific discipline.

The ability to manage this type of evaluation and calculate the results through automated software makes them significantly interesting in terms of effectiveness, especially in the e-learning environment, both in their applicability to the process of self evaluation, and in relation to evaluation objectivity.

3. CONCEPT MAPS AS A WAY OF CONTEXTUALIZING LEARNING OBJECTS

The second use of concept map consists in providing support for the archiving and researching of documents. Document sets represented as a sequential list do not capture the context of relationships among the documents. This problem is often the biggest obstacle to the re-usability of Learning Objects in learning
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