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TEACHING CONCEPTUAL MODELLING IN CULTURAL HERITAGE

ENSEÑANDO MODELADO CONCEPTUAL EN PATRIMONIO CULTURAL

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Abstract
Specialists in the Humanities and Social Sciences often construct models of the realities they work with; these models are usually expressed in natural language, such as thesauri, or by similarly informal means. Conceptual modelling, a more formalised approach, has been used in other fields for some time, and we believe that its usage in the cultural heritage field would allow specialists to create better and more powerful models. With this aim, in 2011 we launched an education program on Conceptual Modelling for Cultural Heritage. After five years and numerous experiences, we report here that specialists in cultural heritage with no previous experience in modelling have systematically learnt the necessary techniques and show themselves able to develop rich models. Experience also shows that satisfaction about this approach is very high.

Keywords: Conceptual Modelling. Information Modelling. Education. Teaching. Cultural Heritage.

Resumen

Los especialistas en Humanidades y Ciencias Sociales a menudo construyen modelos de las realidades con las que trabajan; estos modelos se expresan habitualmente en lenguaje natural, como tesauros, u otros vehículos informales. El modelado conceptual, un enfoque más formalizado, ha sido utilizado en otros campos desde hace tiempo, por lo que hipotetizamos que su uso en el campo del patrimonio cultural permitiría a los especialistas crear mejores modelos. Con este objetivo, en 2011 lanzamos un programa educativo sobre modelado conceptual para patrimonio cultural. Tras cinco años y numerosas experiencias, mostramos aquí que los especialistas en patrimonio cultural sin previa exposición al modelado aprenden las técnicas necesarias de forma habitual y se muestran capaces de desarrollar modelos muy expresivos. La experiencia también nos ha mostrado que la satisfacción acerca del enfoque es muy alta.

Palabras clave: Modelado conceptual. Modelado de información. Educación. Docencia. Patrimonio cultural.

1. MOTIVATION AND CONTEXT

Over the years, we have observed that archaeologists, historians, anthropologists, architects and other specialists working on cultural heritage often develop complex information models about the reality they study (González-Pérez, 2002; 2012: 396-401). However, these models are usually highly informal and expressed in natural language or very loose formalisms; it is the case of, for instance, Harris matrices (Harris *et al*., 1993) in Archaeology or lexical thesauri, in most areas of the Digital Humanities. Simple modelling needs may be satisfied by approaches like these, but the ever-increasing challenges of today's interdisciplinary research projects and large-scale collaborations often mean that very complex portions of reality are to be modelled; in these situations, cultural heritage specialists need to collect, transform and manage information of such a complexity that more advanced technologies are necessary. Furthermore, models are sometimes required to be put in a machine-readable format so that they can be automatically (or semi-automatically) processed and manipulated.

Conceptual modelling has been used in software engineering and related disciplines to develop models of highly complex portions of reality with great success (Pastor and Molina, 2007), even in the particular domain of cultural heritage (González-Pérez and Parcero-Oubiña, 2011: 234-244; CIDOC, 2011). Also, conceptual modelling opens the door to a range of machine-processable modelled information through approaches such as Model-Driven Engineering (OMG, 2003).

Developing a conceptual model helps us understand the portion of reality we are dealing with by removing the unnecessary detail and allowing us to focus on what is relevant at each moment. Thus, we can explore complex realities more easily through simpler and more manageable models. In addition, conceptual modelling helps us communicate our understanding of a portion of reality, especially when people of different disciplines and backgrounds are involved, by creating a common shared ontological space where meaningful discussion can take place.

Unfortunately, conceptual modelling has been historically appropriated by software engineers, despite the fact that the connection between the two of them is more accidental than essential. We believe that any cultural heritage professional should be capable of creating their own conceptual models if given a good enough modelling language and the necessary training, and with this premise in mind the ConML (Incipit, 2015a) conceptual modelling language was developed.

ConML is a conceptual modelling language, an artificial language designed to express and communicate conceptual models. It consists of a lexicon, or collection of basic building blocks, plus a set of syntactic rules that determine how instances of these building blocks may be combined to produce expressions. The basic building blocks in ConML are those of *class* (a category of things that is relevant to the model, such as *Book* or *Place*), *attribute* (a property of a class, such as *Title* or *Altitude*), *association* (a relationship between classes, such as *Was Written By*) and *object* (an instance of a class with specific values for its attributes and links for its associations).

Also, ConML incorporates a graphical notation so that models created with ConML can be visualised on paper or screen. Figure 1 depicts a sample ConML model involving books, their authors and the relationship between them.

Figure 1. Sample ConML model representing the *Book* and *Person* classes, each with some attributes (such as *Title* or *Profession*), and connected by an association *WasWrittenBy*.

ConML was designed to be affordable to non-experts in information technologies, and to specifically address modelling needs that are rarely considered in natural sciences but are however crucial in the Humanities and Social Sciences, such as subjectivity, temporality or vagueness (González-Pérez, 2013: 1-6). Also, ConML is oriented towards the creation of people-oriented *conceptual* models rather than computer-oriented implementation models like other approaches such as UML (OMG, 2006) or Linked Open Data (Isaksen *et al*., 2010) do, by removing computing-related artefacts that are not relevant during conceptual modelling. Still, ConML is capable of generating fully-formalised models that can be processed by a computer very much like UML or Linked Open Data approaches. ConML has been used in-house to design the Cultural Heritage Abstract Reference Model (CHARM) (Incipit, 2015b; Gonzalez-Perez *et al*., 2012: 190-201), and is increasingly used by external independent parties as well (Parthenios, 2012; Blanco-Rotea, 2015). A complete description of ConML is beyond the scope of this work, but can be found in Incipit's work (2015a).

The following sections describe our experiences using ConML as an infrastructure to teach conceptual modelling to cultural heritage specialists.

2. TEACHING APPROACH

Given the success that we observed in our own use of ConML, we soon decided to teach others to use it, and in 2010 started designing an education program on conceptual modelling and cultural heritage through our Postgraduate School. The underpinning hypothesis was that *it is possible for cultural heritage specialists with no previous exposure to software or knowledge technologies to acquire operational skills in conceptual modelling in just one week*.

A course structure and contents were designed for this education program. It was assumed that students would have no experience in information or knowledge technologies, and contents were organised so that the course could be equally offered online or through conventional a classroom. Activities would consist of lectures, individual assignments that are to be solved by the students within each lecture, and a mini-project to be carried out through the course by each student in a topic of their particular interest. The course was targeted and advertised to cultural heritage specialists including archaeologists, anthropologists, architects, historians, art historians, geographers and cultural resource managers.

The first edition of the course took place in Santiago de Compostela (Spain) in May 2011 over 5 days, taking 30 hours of contact teaching to cover basic object-oriented modelling aspects such as the concepts of object, class, attribute, association and generalisation, as well as more advanced topics such as the modelling of vagueness, modularity and model refactoring. This edition gathered 19 students with backgrounds in architecture, geography and archaeology. A similar course took place in 2012. Also in 2012, slightly customised versions of the course were taught in Vitoria-Gasteiz (Spain) and Olavarría (Argentina).

In 2014 and 2015, the course was taught as part of a Master's degree in Archaeology in collaboration with the University of Santiago de Compostela. Additional contents were introduced in newer editions of the course, such as modelling patterns, modelling methodology, or the modelling of soft issues such as temporality or subjectivity. All editions so far have been taught in a class rather than online, although we are carrying out an online edition (not reported here) at the time of writing. Table 1 below summarises the course editions so far:

Edition	Place	Dates	Number of students
1	Santiago de Compostela, Spain	May 2011	19
2	Santiago de Compostela, Spain	April 2012	10
3	Vitoria-Gasteiz, Spain	June 2012	12
4	Olavarría, Argentina	August 2012	9
5	Santiago de Compostela, Spain	February-April 2014	8
6	Santiago de Compostela, Spain	February-April 2015	10
Total			68

Table 1. Course editions.

3. OUTCOMES

For every course edition, students were evaluated through three instruments: ongoing participation and in-class exercises, a mini-project they had to develop and present during the course, and a final quiz or larger project, usually weighing 10/35/55, respectively. Scores were given on a scale from 0 to 10, with the pass at 5. Table 2 and figure 2 below show the minimum, average and maximum scores achieved by students for each course edition.

Edition	Minimum	Average	Maximum
1	4	6,6	9
2	5	7,1	9
3	5	7,9	10
4	6	7,0	8
5	5	7,3	10
6	6	7,3	8
Overall	4	7,1	10

Table 2. Minimum, average and maximum scores achieved by students for each course edition.

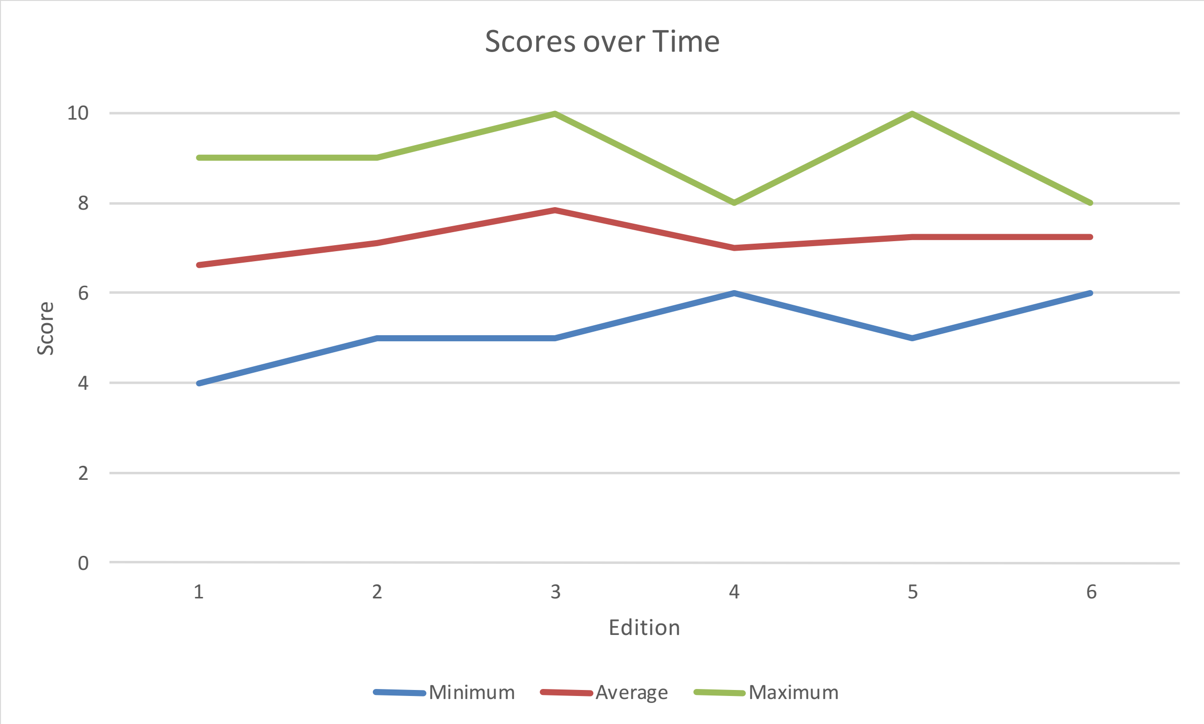

Figure 2. Minimum, average and maximum scores achieved by students for each course edition.

In addition, on the last day of every course, an evaluation questionnaire was distributed to students so feedback about the course could be obtained. The questionnaire contained the following statements about the course:

- Contents are interesting.
- Contents have a high academic standard.
- Explanations are clear and sufficient.
- Communication from teachers is good.
- Visual support (whiteboard, projection) is properly used.
- The pace of the course is suitable.
- The duration of classes and breaks is adequate.
- Theory is adequately illustrated by examples and applications.
- The exercises are appropriate to understand the theory and acquire the target skills.
- The exercises are adequate in number and difficulty level.
- Teachers provide good orientation, guidance and supervision.
- Assessment mechanisms are appropriate and fair.
- The course is about what I expected.

Students were asked to mark on a 4-point Likert scale whether they strongly agreed (4), agreed (3), disagreed (2) or strongly disagreed (1) with each statement. Table 3 and Figure 3 below show the minimum, average and maximum scores for each statement across course editions.

Statement	Minimum	Average	Maximum
1	2	3,5	4
2	2	3,5	4
3	2	3,5	4
4	1	3,7	4
5	2	3,5	4
6	2	3,4	4
7	2	3,2	4
8	2	3,3	4
9	2	3,3	4
10	2	3,4	4
11	1	3,4	4
12	2	3,2	4
13	1	2,7	4

Table 3. Minimum, average and maximum scores for each evaluation statement across course editions. Scores are given as a 4-point Likert scale.

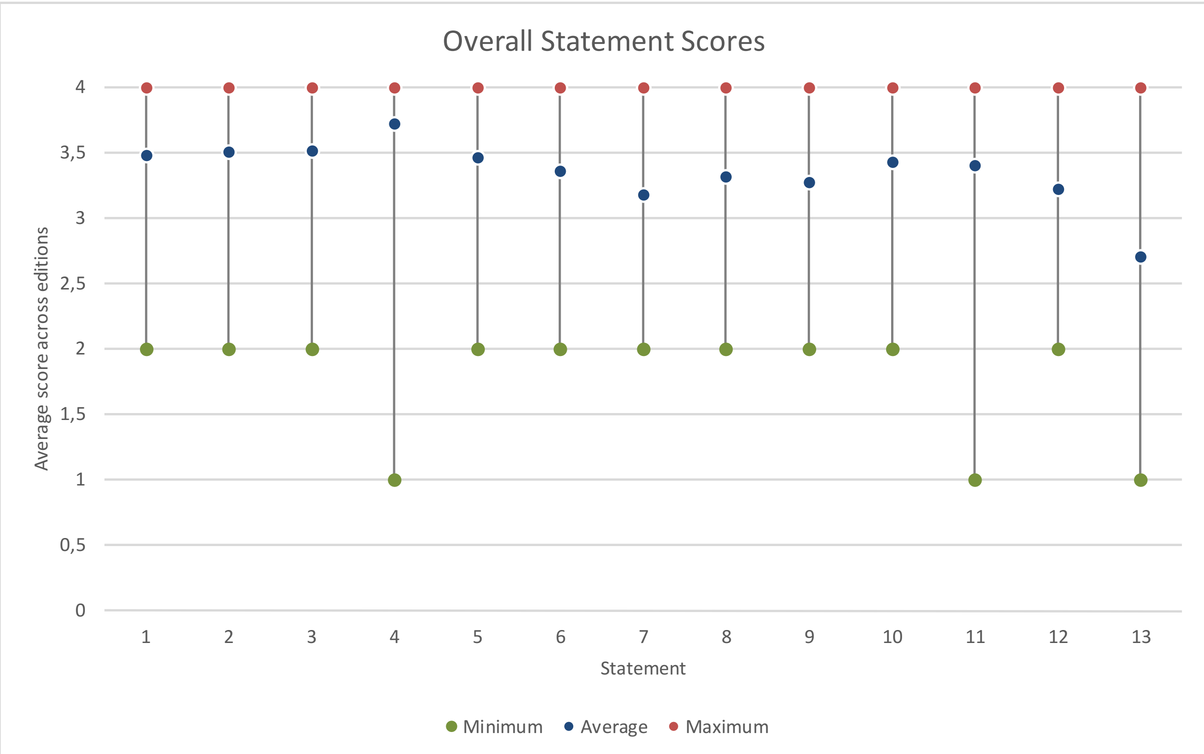

Figure 3. Minimum, average and maximum scores for each evaluation statement across course editions. Scores are given as a 4-point Likert scale.

Finally, and for all editions, a call was made to students on the last day of the course to keep us informed if they applied the skills they had acquired during the course to their projects or future work. So far, we have collected evidence of 11 students doing this out of 68 (16%).

4. DISCUSSION AND CONCLUSION

Academic results over the six editions of the course so far show that, in general, students successfully acquire the intended modelling skills. Only 1 student out of 68 (1.5%) ever failed the course, average scores are stable above 7, and most editions yield students hitting top scores of or above 9. This clearly supports the hypothesis that, in fact, it is possible for cultural heritage specialists with no previous exposure to software or knowledge technologies to acquire operational skills in conceptual modelling in just one week.

In addition, the course seems to be very well received by students, who systematically evaluated it above 3 (*agree*) for all evaluation statements, with the exception of statement 13 (*The course is about what I expected*). It is indeed difficult to adequately convey what the course is about to potential students, given the large disciplinary differences between their backgrounds before the course is taken and the contents of the course. This is an area on which we are working in order to improve up-front information for students in future editions of the course. Also, it is remarkable that students' satisfaction rates so high while having elected the course, to a large extent, unaware of what kind of contents it would involve.

Another area of improvement is that of the actual incorporation of the acquired skills to the repertoire of practices that are deployed by cultural heritage professionals at work. We trust that the course *helps organising minds* when dealing with information, as one student wrote on the feedback questionnaire, and that this is of great value for any course and for us. However, specific tools and techniques are needed to facilitate adoption and productive application, not only for the sake of individuals, but also for the benefit of working groups and interdisciplinary teams that are becoming more and more prevalent in the Digital Humanities.

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