

COURSEWARE RE USE OR COURSEWARE TO REUSE?

José Carlos Teixeira^{*}, César Páris[†], Joaquim Madeira^{*}, J. Brisson Lopes[‡]

^{*} Dep. Matemática – Fac. Ciências e Tecnologia da Univ. Coimbra - Portugal

[†] Centro de Computação Gráfica – Coimbra - Portugal

[‡] Instituto Superior Técnico – Lisboa – Portugal

teixeira@ceg.uc.pt; cparis@ceg.uc.pt; jmadeira@mat.uc.pt; brisson@ist.utl.pt

1. Introduction

Teaching and training scenarios have changed over the years. This does not come as a surprise, but one must study what are the corresponding implications in current teaching and learning methods and processes.

There are three major differences. First, starter learners are more receptive to learning if they are able to visualize different objects, models and concepts — they are growing up in a TV and computer world —, and by actively manipulating them — (learning is thus a hands-on process, which stimulates the curiosity of learners and their interest in acquiring additional knowledge. Furthermore, there has been a huge advance in technological support (computers and networks), and, finally, learning is no more confined to the first 25 years of life, but has turned into a lifelong process.

Today's learning scenarios extend beyond the traditional classrooms: students can access courseware materials from home and teachers feel the need to use new media in their classes. Both scenarios require multimedia material and add interactivity to the traditional chalk and board scenario.

In this position paper we want to open the discussion about the main issues that must be addressed to enable courseware reuse and the feasibility of possible solutions, based on some experiences we already have

2. Production of Courseware Material

Multimedia courseware production is not a one-person job, but requires large teams of persons with different skills and expertise, and is very time and resource consuming. There are two ways of lowering costs: increase the number of people using each course, or make use of the material in different contexts, that is, reuse it.

The best way of guaranteeing that the courseware produced fits its author's idea is that he/she will produce it all. In fact, no deviations will be made concerning the focus and original design, and the

author will always be up to date with the current state of production. With some tools to keep track of the courseware produced he/she will easily maintain and validate it. However, one can immediately perceive the drawbacks of this option: time constrains, tools and methods used might not be the best, but always the ones that the author can access. The best option will be then to have separate teams, according to specific functions.

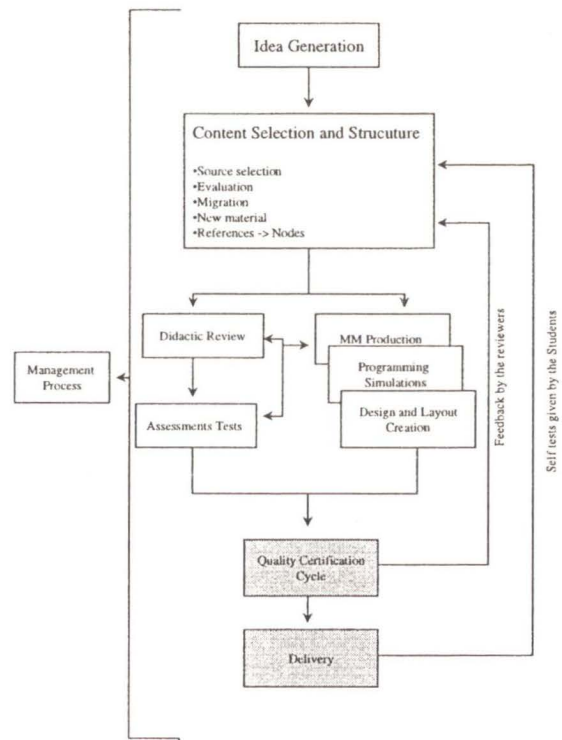


Figure 1. The courseware production process.

As depicted in the above diagram, the same person can perform different functions. For example a teacher, or a group of teachers, can generate one idea, put it on paper and take the responsibility of the didactic and assessment aspects, leaving the most technical aspects - MM Production,

Programming Simulation and Design, as well as Layout Design - to experts in those fields. Of course the authors and the members of the production team will have to interact, and that can be done in real time or in deferred time. This last option could be very helpful if thinking globally, i.e., if a scenario is planned where authors are scattered throughout the world and the production team fixed in one specific place.

The drawback of this scenario is that there are many extra variables that are input into the process. There is now the need for a Management Process ensuring that there is a correct workflow. Furthermore, since the authors are not always directly involved in the production, there must be control mechanisms allowing them to validate the successive production steps. Nevertheless, at the end of the process there should also be a Quality Certification Cycle, which guarantees that the material to be released is still valid.

Although this additional production structure, is associated with an increase in overall costs, it will now be possible to generate high-quality courseware with short-production cycles - two key factors when it comes to courseware production. One way to lower production costs without affecting the structure that produces them, could be the re-use of material already produced. The numbers in the IDEALS project [1], an European project with 13 partners, from industries to universities, from 6 different countries, show that it is possible to lower production costs making re-use of existing courseware.

In that project the conclusions showed that the production time for just one study hour was 164.3 hours [2]. This ratio depends too much on the type of media involved (pictures, video, sound) and the demanded quality. Using templates for some parts of the course the number of hours required to produce one hour of course material was lowered to 91.8 h, with savings of about 44%. That is only the amount of time associated with courseware creation and does not include the time consumed by management tasks.

More important than the above is the possibility to further reduce the production time of course materials by re-using previously developed material. This allows saving about 27 working hours per one hour of courseware. However, it was obvious to all partners involved in the field tests, that re-using implied almost always additional adaptation times which were strongly related to the complexity of the material being re-used. The average time for this was about 6.0 hours per one hour of courseware produced [3]. All of those

tasks took more time than expected, mainly because there were no real, effective guidelines.

The numbers presented above just give an idea about the effectiveness that can be achieved by re-using courseware. It is obvious that the results will vary depending on the quality of courseware and the level of re-use that it is planned - just media, or chunks of knowledge.

General-purpose courseware will lower production costs and can be distributed to a larger number of people. On the other hand, knowledge is getting more and more specific today, and courseware must follow this tendency. Besides developing courseware from the scratch, one needs to be able to adapt general-purpose courseware to specific groups.

Note that generic software should be highly modular to ensure its use by large, heterogeneous groups of users, and has to be designed and produced with great pedagogic and didactic care, as well as carefully designed screen layout and user interface. Thus making it easy to use, as well as stimulating, and ensuring its success regarding the learners. The cost associated with ensuring a high-degree of courseware quality is usually offset by the number of learners that can use such generic courseware.

On the other hand, specific courseware can easily incorporate higher-level knowledge units and might be less modular. This reduced degree of modularity and higher specificity usually restrict the number of possible learners, and the usual high design and production costs might not be as easily offset by the actual number of learners.

3. Courseware Reuse

Nowadays we see images being reused (e.g., clipart), but this is not enough. There should be a way for teachers to reuse compact units of knowledge (modules), which focus on a specific subject. It will be necessary to build courses bearing one word in mind: modularity. When content is stored apart from sequence and structure, one can start thinking in reusing the structure itself.

Three hierarchical levels that can be defined when discussing reuse: the most atomic level - pictures, movies; modules -, a collection of atomic entities presented at the same time to a learner, and learning sequences - structures referencing the modules and their relations.

The easiest and obvious thing to do is reusing atomic entities: you just need to replace one picture for another or one movie for the other. There is no secret here: if you have a database

with some indexation you can ease your work. In terms of presentation, maybe you need to do some adjustments/conversions, but in fact this is not a critical issue.

When you want to re-use modules the first problem appears: you must present these modules to an audience. So if you want to re-use them, you must have coherence, and for that the use of templates is inevitable. Having different templates built according to guidelines will make this possible. This factor is indeed the most critical one. There must be tools and processes that can easily map atomic objects into modules according to the template elected.

Finally the learning sequences, i.e., a collection of references to modules and to other learning sequences that together build one knowledge unit. It is important that these learning sequences fully describe all knowledge that has to be presented regarding specific subjects, allowing their re-use in different contexts, without any dependencies to other modules or sequences. Once more, this must be stated in the design guidelines and followed by all authors.

If you are thinking about a book, the modules will be the sub-chapters and the learning sequences will define which and how the sub-chapters constitute one chapter. For the whole book, there is a learning sequence that references other learning sequences (chapters).

Courseware developers must pay close attention in developing an appropriate set of guidelines for courseware design. Those must be as rigid as possible, in order to achieve global coherence for the course material to be produced. Changes to the guidelines will generate new course material that might not be compatible with that which has been previously developed. When this situation happens, probably previous courseware must be re-produced, and then you start wondering if re-use is effective or not.

Based on the many experiences of re-using courseware, and despite the level of re-usability that is in question, it is known that authoring guidelines cannot remain fixed, or at least without significant changes, for a long period. The same is commonly accepted as necessary to produce a good and stable Resource Bank of courseware, which will allow effective cost reduction in Courseware Production. So, what is the answer?

The method of developing a courseware reusable library must take into account that the guidelines might change, and then treat all courseware components as entities that need to be stored and classified in an effective way. The same goes for the learning sequences, modules and presentation

templates. All of what is stored in the Resource Bank can be modified/replaced individually without affecting others.

We can easily foresee teachers having available several course templates, choosing the ones which are most suitable for their specific courses, and, after that, filling in the empty spaces with previously produced modules. If no suitable modules can be found, then they will produce them and make them available.

The courseware developer must structure its course, looking up what he can reuse from the Resource Bank, and create or modify the missing entities, using the guidelines pre-defined. Then the courseware information entities are accessed and integrated inside the presentation template choose and accordingly with the learning strategy to be followed. Courseware modules are integrated, like a jigsaw puzzle, in order to fulfil courseware authors' needs. It is not expected that they create their own courseware just reusing previously produced modules, but rather that they will reorganize it, adapt some parts and create others.

Each information system that is worthwhile has the same problem: it grows unchecked until it is too hard to manage. An approach to support the previous ideas in a community of producers demands that it must be possible to create and maintain a Knowledge Centre.

It must also be ensured that everybody uses compatible technologies, and it must be guaranteed that there are common rules, procedures and standards. The use of databases is inevitable, due to the expected large amounts of information produced. These databases must reflect the following key issues: cross-platform access, modularity, scalability and, of course, different access permissions. Classification and indexing are other important problems that must be addressed.

Multimedia courseware production requires multidisciplinary production teams, while publication requires clear business models. Copyright ownership has to be transferred, but author rights remain with the creators. This shows the need for adequate business models. Furthermore, courseware delivery releases materials that can be copied over and over again with no quality loss because they are in digital format. This issue can only be solved with appropriate and secure copyright marking tools, as well as commonly accepted copyright policies.

4. Conclusion

This position paper raise some thought inspiring main issues that have to be addressed when considering the design and production re-usable courseware modules.

The authors hope that these ideas might contribute to fruitful discussions during the workshop, as well as possible future chances for collaboration between workshop participants.

References

- [1] IDEALS – Integration of DEDICATED for Advanced Training Linked to Small and Medium Enterprises and Institutes of Higher Education, Project Programme EU Telematics Applications Programme, Project nr. ET-1012, 1995, (<http://ideals.zgdv.de>)
- [2] IDEALS, Report on the Restricted Demo Course. IDEALS – project of the EU Telematics Applications Programme, Project nr. ET-1012, 1998, (<http://ideals.zgdv.de>)
- [3] Paaso, J, Computer Based Teaching Technology for Software Engineering Education, Acta Universitatis Ouluensis C123, 1998, Department of Electrical Engineering, Univeristy of Oulu, Finland