Stages of Content Development in Assisted Instruction

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As the use of technologies has a major impact in the development of all fields of activity, the demands for new and up to date curricula for high education raise more and more often in order to keep up with society development. This happens especially for disciplines related to computer sciences where the curricula have to be changed almost completely once a few years. This paper defines the educational content and presents the stages of content creation and the situations that trigger the content development. As curricula have to be changed so often, the paper emphasizes the importance of using educational objects as a better way to recreate and adapt the content and exemplifies the use of such objects on a platform dedicated to students in the first year of the Faculty of Business Administration.
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1 Introduction

According to the Explanatory Dictionary of the Romanian Language [1], the *content* is defined as what fits into a limited space and as all the essential notes of a notion with respect to its scope. The content represents also the ideas basis of a literary or artistic work, the ordered list of the materials inside a magazine or a book.

Educational content represents the totality of knowledge in a particular field of study, which fits into a learning unit. Depending on the target group and on the educational environment it addresses, undergraduate, university or post graduate, both the difficulty degree of educational content and the amount of transmitted information and knowledge vary. The educational content represents the key element of the educational supports and materials used in the learning process.

For the traditional learning with presence on campus, the educational content and, subsequently, the materials that include it, represents a complementary source having the role of supporting the teaching activity carried out by a professor. Through these educational materials that follow the structure of the course taught by the professor, both the students that were absent and the students that had difficulties in understanding the knowledge and the information transmitted by the professor would have the chance to study individually in order to get things clear and to avoid ambiguities.

For the distance learning, the educational content and also the educational materials presenting it represent the basic support of the students opting for this type of study. Beside the educational content of the materials developed for traditional learning, the educational support designed for distance learning must also contain the information and knowledge presented orally by the professor during course and seminar classes of learning with presence on campus.

2 Responsibilities of the instructor

Regardless the form of learning they address, educational contents must have a unitary structure, provide concise information presented in an easy-to-understand form and must be properly scheduled. Educational contents have the role to guide students to learn structurally in the process of knowledge acquirement. When creating contents, wording should be adapted to the level of study they address. The presentation of the content inside an educational material must be done with respect to the learning style of the current target group. This learning style preferred by the students can be determined on the basis of survey questionnaires. Thus,

the creator of educational content must both adapt the materials according to the demands of the target group and consider his personal pedagogical knowledge acquired from his professional training and teaching experience.

[2] defines a taxonomy of competences required by the teaching profession which contains nine classes that address the basic role of the professor to conduct instructive-educative activities with students. Three of these classes address the contents of the instruction process and the role of the instructors with respect to these contents: content analysis from pedagogical point of view, design of instruction and efficient communication.

Considering these three classes, we identify the responsibilities of the instructor regarding the creation and the use of the content in the educational support dedicated to assisted instruction. According to these, the instructor has the responsibility to:

- identify notions and contents to be introduced in the study, either as a requirement from the students or as a result of the analysis conducted by the instructor in order to create a better curricula for a successful instruction process;
- structure and rank new and existing contents in order to keep the logic of transmitting knowledge to the student for the subject they address, regardless the option to include them in new or existing educational materials;
- highlight the key words specific to the instruction field so that students get in contact with the key concepts of the proposed educational content from the very beginning of the study;
- identify intra-disciplinary, interdisciplinary and trans-disciplinary relations in order to create connections with disciplines from other fields studied or not by the students. Thus, collaborative activities with other students and other teachers are encouraged;
- identify supplementary bibliographic materials required to guide the students in the process of searching resources to complete their knowledge in the studied field;
- decide the method to present the contents, as computer applications, short presentation, logical flowcharts, videos etc., depending on how students choose to study.

The role of educational materials based on these requirements is to provide support for the assisted instruction process, for both the instructor and the students. Regardless their utility or coverage, the contents used for creating educational materials by the instructor must be evaluated before they are actually included, during the instruction process and also at the end of the process, by both teachers and students. The feedback received will make the authors continuously improve their educational supports as schedule, contents and mean of presentation, accordingly to learning styles specific to each generation of students.

3 Stages of content creation

The activity of instructors or professors in the educational process is determined by their pedagogical skills, innate or acquired through study. Educational supports are used for optimizing the educational process. Creating educational supports by the teachers involved assumes the completion of stages of content development for training and computer assisted instruction. We propose ten stages for educational content development, from the moment of deciding the creation of content to the moment of disseminating it to the students. These stages are:

E1. Occurrence of a requirement for creating an educational material;

E2. Building the content development working group;

E3. Documentation for creating the educational material:

a. Consulting databases with previously developed educational materials in order to check if such

required material was previously developed;
- **b.** Consulting and testing existing similar educational materials;
- **c.** Consulting documents from the literature;
- **d.** Identifying ways to create the materials requested;

E4. Choosing a collaborative authoring technology;
- **a.** Establishing the requirements that the collaborative authoring technology must fulfill;
- **b.** Identifying existing technologies;
- **c.** Comparative analysis of identified technologies;
- **d.** Choosing the technology that best meets the requirements from ***E4.a***.

E5. Scheduling the activities before creating the required materials;

E6. Assigning tasks to members of the content development working group;

E7. Creating the educational materials using the technology chosen at ***E4.d***:
- **a.** Creating the first version of the educational material;
- **b.** Updating the versions of the materials created in collaboration.

E8. Verifying the content and the functionality of the educational materials;

E9. Publishing educational materials;

E10. Updating published educational materials at different time intervals.

Each assisted instruction process assumes the presence of at least an instructor, of students, computers and of educational materials.

The first development stage of content for assisted instruction is represented by the moment when the teacher or the students acknowledge the importance of using an educational support for the instruction process they are involved in. Once they are aware of its utility, the workgroup of instructors and professors is formed, E2, and the process of documentation for creating the required materials is started. Thus, the literature, the materials created before by the work team and the similar supports developed by other instructors and are consulted in stage E3. Also in this stage, the working group decides if the creation of the support required is possible or not.

If the members of the working group decide that the support is achievable, then the tools on the market that allow quick and collaborative creation of the material are analyzed and the optimum technology is chosen, in stage E4. The working group sets the time intervals required for creating the educational support, E5, and assign tasks to individual members of the team, E6. The actual creation of the educational support, E7, is represented by the creation of the first version of the material by the members of the working group. The chosen technology must allow them to work collaboratively on the educational material to be created, to save intermediary versions and to highlight in each version the contribution of each member of the group.

Before publishing the final educational support in order to make it accessible to students, E9, this must be verified both as content and as functionality, S8.

The educational material developed based on the specified stages must be created so that it allows future partial or full changes, adding new content inside, adapting to new requests of the applicants, E10.

Let $S = \{S_1, S_2, S_3 \dots S_n\}$ the set of students taking part at the instruction process accomplished by the set of instructors $I = \{I_1, I_2, I_3 \dots I_m\}$ belonging to the same educational unit. Then $M = \{M_1, M_2, M_3 \dots M_k\}$ represents the set of educational materials created and used by instructors $I_1, I_2, I_3, \dots I_m$ in the educational process held with the students of all promotions they collaborated with so far.

If an educational material M_j required by the students is not inside the set of educational materials M, $M_j \notin M$, then all the stages from E1 to E10 are run in order to develop the content, Figure 1.

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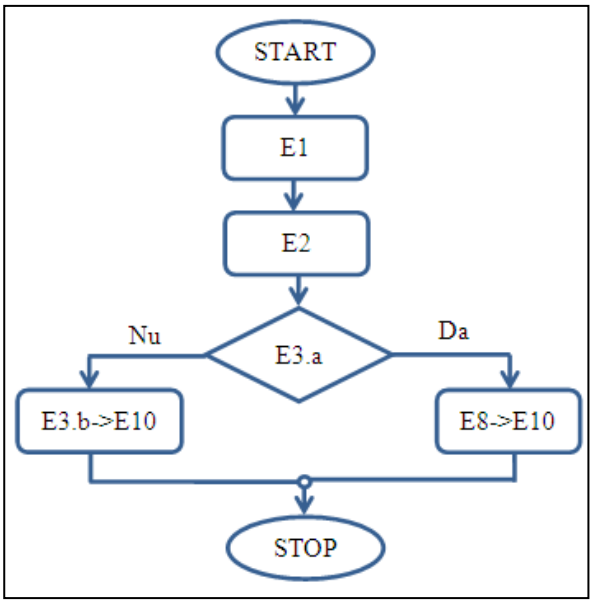

Fig. 1. Flowchart of content development for assisted instruction

Given the case when the material M_j is in the set of materials M, $M_j \in M$ as being previously developed, it is only necessary to check and update its content before publishing it to the students, and thus it is required to get only through stages E1, E2, E3.a, E8, E9 and E10.

During the educational process, the instructor decides which of these materials should be accessible to students at the beginning, during, or at the end of the instruction process and which materials are not required for the instruction of current student promotion.

There are three cases considered to be triggers for stage E1:

- the decision of the instructor $I_i \in I, i = \overline{1,m}$ which, as the result of the instruction assisted by both instructor and computers, and based on his personal experience and skills, acknowledges the utility of an educational support $M_j, j = \overline{1,k}$ to complete the knowledge of the students $S_1, S_2, S_3, \dots S_n$;
- changing the study curricula of a discipline during the instruction process, which determines the instructor $I_i \in I, i = \overline{1,m}$ to opt for the development of educational materials $M_j, j = \overline{1,k}$ in order to provide support to students $S_1, S_2, S_3, \dots S_n$ and to compensate the large amount of information they have to assimilate in the same period of time, initially set;
- the request of one or more students $S_i, i = \overline{1,n}$ to be provided with one or more educational materials $M_j, j = \overline{1,k}$. Such materials are either new materials or materials previously created and found in the set of educational materials M. When students require an educational material, a threshold p must be set in order to determine the decision of the instructor I_i to create the educational support M_j. This threshold p is represented by the minimum number of students requiring the development of the educational material and is expressed as per cent.

$$p \leq \frac{N_S}{N_T} \times 100$$

where:

- p is the threshold that triggers stage E1;
- N_S is the number of students that required and educational support;
- N_T is the total number of students attending the instruction process.

When the percentage of students requesting new materials is lower than the threshold *p*, it is considered to be insignificant and the request not to be relevant. By using the threshold *p*, situations when requests are made by students that didn't take part at the instruction process or didn't approach the study with responsibility are avoided.

If the computed percentage is greater or equal with *p*, then the request should be considered valid and should trigger the stage E1.

In order to successfully reuse the educational supports created following the ten stages proposed for content development, an optimal solution for the computer assisted instruction process is the creation and the use of educational objects.

4 Educational objects

The concept of object is taken from the object oriented programming where it has the role to associate data with operations required for processing. In [3] data specific to objects is defined as structure information described using a set of attributes of the object and operations are defined as actions on the attributes of the objects or on other objects.

The fundamental properties of an object are:

- *identity* – the way an object is uniquely identified;
- *state* – represented by the values of the properties and attributes of the object*;*
- *behavior* – defined by the reaction of the object to external factors or to the interaction with other objects.

The concept of learning object defines a way to create and structure the educational content. In [4] the learning object is define as *a digital or non-digital entity which is used, reused or referred during the educational process assisted by a technology.* Learning objects include multimedia content, instruction content, learning objectives, educational software tools, persons, organizations or events that are referred during the educational process.

In the project *Innovative system for personalized user oriented learning, with applications in project leading* realized by the National Institute for Research and Development in Informatics in partnership with the Bucharest Academy of Economic Studies, the research team built the report *Design of educational objects for e-Learning systems* which presents methodological recommendations for designing and building educational objects.

The techniques identified in [5] for building educational objects for e-Learning systems can be also applied for creating educational objects in assisted instruction collaborative systems. The most frequently used tools and techniques for creating educational objects are text, images, audio-video recordings, synchronous and asynchronous discussions, knowledge assessment tests, internet resources, e-mail, and online libraries.

The text is the most used technique for building educational objects and for transmitting information, Figure 2. Still, using only text in learning objects make students consider the educational material to be difficult and tiring.

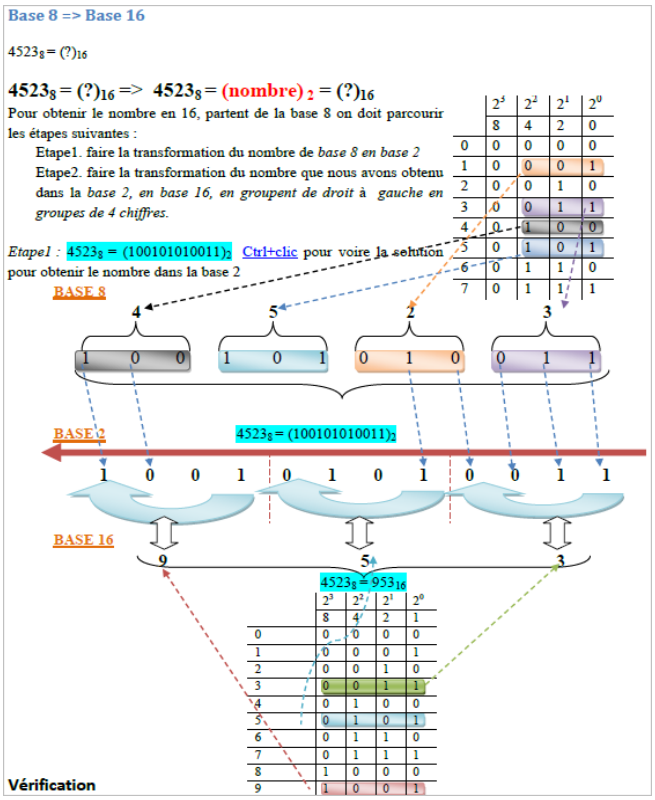

Fig. 2. Using text and graphical representation in the creation of educational objects (*Screen capture from the tutorial Conversions, published on www.info.ase.ro/fr)*

Images and pictures with meaning for the educational content are often used for creating educational objects, figure 3. These may be either screenshots, logical flowcharts or graphical representation, figure 2. Students consider them to be far more suggestive than simple texts displayed on the screen.

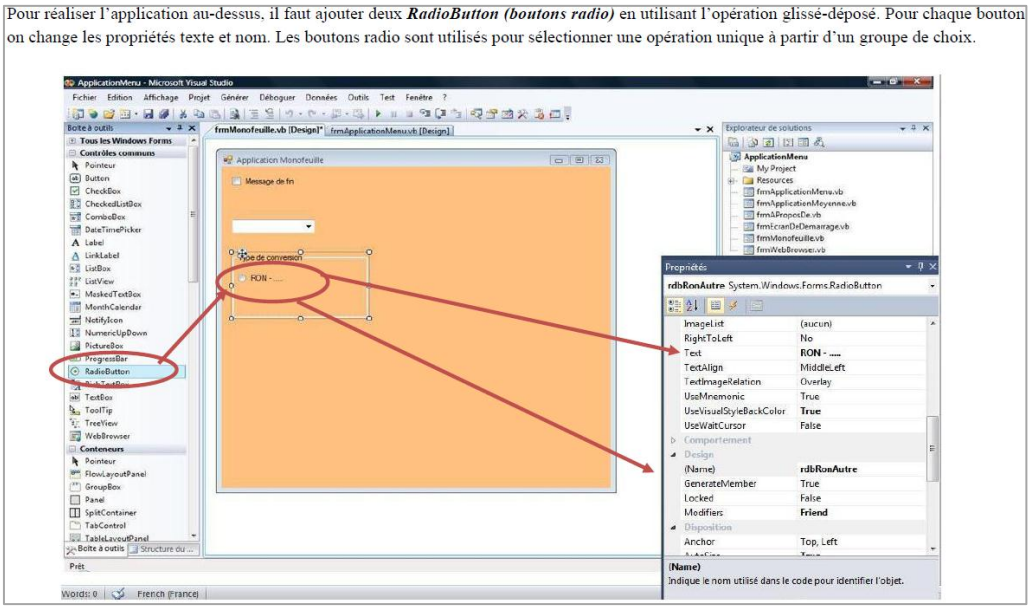

Fig. 3. Using images in creating educational objects
(Screen capture from the tutorial explaining how to create an application using Visual Basic, published on www.info.ase.ro/fr)

When creating learning objects, no matter if the text, images and representations are used individually or combined, a good report must be kept between them. Thus, the student should neither feel that the material is hard to read as a result of excessive use of written text, nor think that the material is not enough documented because of using mainly images and graphical representations.

Another very useful method for creating learning objects is by using audio-video recordings to generate content for educational resources, Fig. 4.

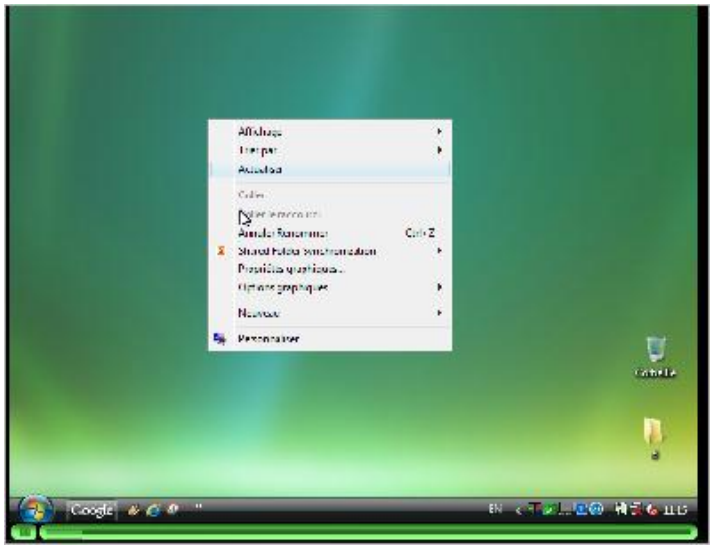

Fig. 4. Using audio-video for creating educational objects

Synchronous discussions through chat or videoconferences may be used for generating educational content from the messages, the questions, the answers and the discussions in real time between the students or between students and instructors.

The result of asynchronous communication achieved through discussion forums or e-mail, Fig. , represents a source of information

for educational content creation, used or referred in a learning object.

Fig. 5. Asynchronous communication through e-mail

Knowledge assessment tests provide the instructor with information about the degree of knowledge acquisition accomplished by the students during the instruction process. These may be considered educational objects too, as the allow students to consolidate their knowledge based on the feedback received from the assessor.

Internet resources from online libraries are often referred in learning objects with the purpose of providing the user with sources that help him clarify uncertain aspects or that constitute supplementary information from the study domain or from related domains.

[5] considers that using learning objects in the instruction process in courses based on knowledge or competences has great advantages for both creators and final users.

The main characteristics of educational objects, identified in [6], are:

- *flexibility*, represented by the possibility to use the object in different contexts;
- *adaptability* which assumes the adaptation in real time to the context;
- *interoperability* represented by the possibility to connect with other systems and contexts.

In [7] the features specific to learning objects are classified in two categories:

- Content features:
  - *Reusability* – the property of an object to be used in different courses, by different groups of students, at different time moments of the instruction process. Creating an object requires the involvement of human, financial and time resources. Because of reusability, throughout the lifetime of the object there will be resources involved for only updating the object.
  - *Content autonomy* – minimization of previous knowledge of the student required to understand the current learning object.
  - *Independence* – pedagogically, it assumes the fact that the same learning object is used in the instruction processes by the instructors regardless their techniques and pedagogical skills and beliefs.
- Auxiliary features:
  - *Accessibility* – provided by object description through metadata.
  - *Compatibility* between learning objects – favors the formation of larger content units by grouping two or more learning objects.
  - *Interoperability* – provides learning objects with the independence from the delivery environment allowing them to be used in different learning environments.

An important evolution in the educational domain is represented by the development of three dimensional learning objects. [8] considers that 3D educational materials, displayed and visualized on devices without special 3D glasses, allows students to view closer to reality the objects they have seen only 2D due to the lack of appropriate

technology used in large scale. 3D content leads to the stimulation of creativity of students and favors the development of imagination. When using 3D educational contents, the educational process become more and more attractive for the new generations of students.

5 Conclusions

Creating a learning process for students, regardless the discipline of study, assumes the presence of an instructor and the use of appropriate educational materials. In order to optimally carry out the educational process, the instructor, having most of the times the role of the professor too, must have pedagogical competencies that represent a minimum professional standard to be fulfilled by a teacher.

In addition to instructor lectures or as substitutes, educational materials must be used as support for courses and seminars. The teacher implied in the assisted instruction process must have the capacity to analyze from the pedagogical perspective the content of all the educational materials included in the study curricula.

As curricula have to be changed more and more often, the proposed stages of content development help the instructors quickly adapt their courses to new demands and to the use of new technologies. The stages we proposed can be used for developing content for the traditional learning with presence on campus, the distance learning, the mixture between traditional and distance learning and also for mobile learning.

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