

Re-using e-teaching materials – Advanced learning blocks approach

Matija Lokar

Institute of mathematics, physics and mechanics and Faculty of mathematics and physics, University of Ljubljana,
Matija.Lokar@fmf.uni-lj.si

Boris Horvat

Institute of mathematics, physics and mechanics and Faculty of mathematics and physics, University of Ljubljana,
Boris.Horvat@fmf.uni-lj.si

Primož Lukšič

Institute of mathematics, physics and mechanics and Faculty of mathematics and physics, University of Ljubljana,
Primož.Luksic@fmf.uni-lj.si

ABSTRACT

A new role of a teacher for the 21st century is here. As stated in numerous papers, this new role means that teachers at all stages of education should be oriented more towards guiding the learner through the learning process. In this process support of information and communication technology (ICT) plays a significant role. More and more e-resources are available to be used at the learning process. But analyzing these resources we often find that their authors do not use all of the opportunities offered by new technologies. One of their most significant drawback is the fact that authors too often forgot (or neglect the fact) these resources are meant to be "delivered" to the learners through teachers. Namely all too often e-resources are monolithic blocks (or at least their main part is). This demands that the educator takes them as a whole, precisely in the order they were written in. Is that really necessary? Do all educators need the same form of resources, do they want to use them in the same order, and do they want their learners to see the same examples, do the same tasks? Why not use the possibilities that new technologies offer and at the very least give the educator the chance to adapt the materials to their own and their learner's needs. Recent studies have shown that teachers need e-learning content that they can easily adapt and reuse for their own purposes. This means that lessons should be made out of small learning blocks or, as they are called, "knowledge objects" / "learning blocks".

A new concept of how to create really useful e-learning content was evolved in Slovenia; namely, by "putting the teacher back into the game". The selection of proper technologies and tools for managing e-learning content and the establishment of a user-friendly and easy-to-use environment for creating and modifying e-learning content, are essential to ensure basic support and popularization of e-learning.

In this paper, we will present new ideas with proofs of concepts of "modular, really interactive e-content" build by using open-source solutions and open standards. You can see some preliminary results at <http://www.nauk.si>. The examples are mostly meant for primary and secondary school teachers. But as these materials are mostly developed as "a proof of a concept" we think the presentation of the ideas can be valuable for the participants of this conference, too.

Keywords:

e-learning content, educational content preparation, knowledge extraction, ICT in learning

INTRODUCTION

The educators preparing themselves for leading a particular educational process perform different procedures. In this preparation it is considered who are learners to be educated, which possible learning methods are to be used and of course, which teaching materials are to be used. The teachers' manual published on the web pages of the Institute for Interactive Media and Learning at University of Technology Sydney (IML 2009) mentions a good teacher as the one s/he uses the teaching materials in the way that is most appropriate for the students being taught at the moment. So one of the important steps in preparation is to make a sound decision what teaching materials are to be used and what method is best suited for the classroom which is currently being taught. Part of teachers' preparation is therefore the review and the selection of teaching materials as well as deciding which technologies are to be used. Two quotes from the manual mentioned above (IML 2009) state this fact nicely: "New technologies should be used in the most appropriate way to provide a quality learning experience for students. " and "The most effective kind of learning experience is determined not by the technology available, but by considering what is most appropriate for the students, the subject and the learning

objectives and then selecting the most appropriate technology to use, be it a book, an online discussion, a multimedia simulation, or a workplace experience.”

In recent years, the process of creating educational e-learning content in Slovenia has been carried out for the most part with disregard to the teacher, thereby introducing a two-way relationship between the authors and users of the content, i.e. students (see Figure 1). In projects "Learning Programming" (Lukšič, 2009) and "Active Mathematics" (Lokar et al., 2009), which were done in scope of the public call of the Ministry of Education and Sports, we therefore gave emphasis on the preparation of materials that can be modified and combined into new content. In this way we tried to transfer knowledge, acquired over the years in the field of preparation and use of e-learning materials (Batagelj et al., 2007 and 2009), i.e. that the teachers want content that can be easily adapted and reused for their own purposes, to practice.

As the teacher usually serves as an intermediate between teaching materials and the learner, he or she should be able to make all proper choices concerning which content to use and how to combine it into a lesson. The lessons should be made out of small learning blocks or, as we call them, "knowledge objects" or "learning blocks". In this way, the teacher is able to change the lesson and promptly adapt the learning process to the situation in the classroom.

USAGE OF TEACHING RESOURCES

Let us think about the way "classic" teaching materials (such as textbooks, workbooks, etc) are used by teachers. They are actually constantly making different combinations of different materials. They choose (parts of) a workbook, tasks, pages on the Internet ... The class the teacher is teaching, the day s/he teaches, the pedagogical situation ... is always taken into account in this process. It is very rare a resource is to be taken and used precisely in the way it was developed. The reason for this is completely natural. Authors of resources (workbooks for example) envisage a hypothetical pedagogical situation with hypothetical students. But the actual teaching process is always at least slightly different and never quite the same as the hypothetical one the author had in mind. Since a good teacher (as the before mentioned quote says) uses resources in the most appropriate way, s/he is "forced" to adapt the resources. The teacher is leading the learner through the resource, giving the instructions on which part of the resource is to be used, how the learner should proceed, which set of exercises is to be done ... And these instructions are constantly changing. One set of instructions is used in one group, another slightly different set in another group. This means that the teacher adapts the combination to the particular group of learners.

So the major activity in the preparation for teaching is making combinations. And these combinations are changing all the time, according to the class or even to a particular student in the class. Therefore it is no wonder that the most common technological tools used by the contemporary teacher are scissors, sticky tape and a photocopier.

But what is about e-resources, namely resources that are prepared with, or exploit the usage of modern information communication technology (ICT)? Could teachers use them more effectively? Several studies (for example Assche and Vuorikari 2006; Lokar 2006) have shown that teachers use few of the e-resources available. Also, a research done in South Korea (Hwang, 2008) on teachers' satisfaction with e-learning content, gave interesting results. It showed that one of the main factors that affect actual use of e-content in the classroom is the possibility that this content can be adapted to the method of teaching. If teachers have at least the possibility of modifying the teaching material provided, they have a much more positive attitude towards using the particular material. And the teachers' attitude towards the task used is perhaps the most important part of the usage of ICT in the teaching process. Educators mostly do not like using close form solutions or solutions where the complete didactical situation in which the task is being used relies on a particular aspect of a certain tool; they want to be in control of the whole process (Lokar 2006).

So one of the reasons ICT is not used in the teaching process as is expected, is the fact that too many resources are created from the point of view that the student is the final and independent user. The author "prescribes" the exact way in which the resource is to be used.



Figure 1: Usual resources

On the other hand, the basic proposition when these materials were being developed was that they were to be used in the learning process with the teacher present. Students are not usually exposed directly to the task, as there is a teacher present in most cases. The teacher serves as an intermediary between the task and the student. If these materials are then viewed in this light, the teacher is actually in a worse situation than when using a

classic textbook. These e-materials are often so technologically “closed” that there is no tool such as the scissors that are used when “recombining” classic, printed materials. Teachers often encounter problems if they want to use only a part of the e-materials, not to mention the fact it is usually not possible to adapt the materials at all. Furthermore, it is a mistake to expect that teachers will only use the materials. They also have didactic and technical comments, since they are the ones who will teach with the content. The majority of them do not want to create new content, but just to adapt the existing one. Whether this is due to the lack of motivation, the complexity of the process or the poor quality of the available content, it is necessary to find the problems and to fix them.

The following widely recognized problems associated with the existing e-learning content are:

- insufficiently uses new teaching approaches - students will often use the content when a teacher is not present, therefore the concept of multiple interpretation of the same topic is very important, as well as the motivation, progressive building of knowledge, examinations, etc.;
- learners use the same e-learning content several times - some parts of the content should be modified automatically but in such a way that all presentations require the same process of learning (e.g., counting apples is the same as counting rabbits);
- instructions for the teacher are missing - how to present the material, what is the goal or purpose of the content on each step, etc;
- it is often realized as a digitized book, without proper interactivity and is multimedia-poor;
- there is no real interactivity - the question is not if but how can the augmented reality and other innovative ways be used to improve the learning process.
- it is linearly structured, although the process of learning is usually not linear;
- it has no contextual dependencies, which are useful while informing the learner about his / her mistakes and the consequences resulting from these errors;
- the content is too strongly integrated into the presentation of the material - no revisions and changes are possible (the structure is too monolith);

So there is a conflict between the possibilities technology provides, teachers' wishes and e-materials available. Many projects focusing on the development of e-resources are complete portals where navigation, the way of working through the resources ... must be followed in the exact way the author(s) had imagined. Even when teachers get the opportunity to combine and adapt the learning content, it is too often quite a difficult task for them. It required non-basic knowledge of managing of virtual learning environments (VLE) and at the same time substantial knowledge of different ICT standards: HTML, CSS, JavaScript, SCORM, etc. We encounter web pages with flash animations embedded, usage of frames, applets without the source ... and thus almost impossible to change.

PUT TEACHERS “BACK INTO THE GAME”

In the design of e-resources the role of the teacher is all too frequently neglected. The authors of the task usually focus solely on the students. They make decisions in which order the content should be presented, what the examples should be, how many of them, where it is suitable to require the student to do a certain number of exercises, what the responses should be, and any further steps in the event of wrong solutions ... Where is the role of teacher? Is it not his/her primary task to interact directly with the students, performing decisions which resource and in which way should be used at a certain moment? When e-materials are constructed as a whole, the teacher is required to use them in the order prescribed by the author. Is that really necessary? Do all teachers need the same materials, in the same order, with the same examples, the same exercises? Why not use the possibilities offered by new technologies and at least give the teachers the chance to adapt the materials to their and their students' needs. Is not the teacher the one who comes into direct contact with the student, the one who can decide which materials would be appropriate for the situation given. On the other hand, most authors of e-materials still rely on the teacher, since there are few materials that guide the student automatically (choose appropriate tasks, sequence of topics, extra explanations, ... in short all pedagogical actions) and therefore presume the presence of a teacher.

The process of using the task where the teacher's role is forgotten is shown in Figure 1. The author develops a resource and publishes it. A student accesses the resource and uses it. He interacts solely with the resource. Thus the author is required to incorporate all of the necessary guidance and feedback into the design of the resource itself.

However, as mentioned before, the majority of resources are used in a different manner. Students are not usually exposed directly to the resource, as there is a teacher present in most cases. So in the process of the development of resources, the teacher should be introduced into the author - resource - student relation. The teacher "comes first", i.e. s/he should have control over the content s/he uses to teach the student. The teacher

serves as an intermediary between the task and the student. S/he chooses the appropriate task. If necessary, s/he adapts it and/or provides additional guidance. So the process is really:

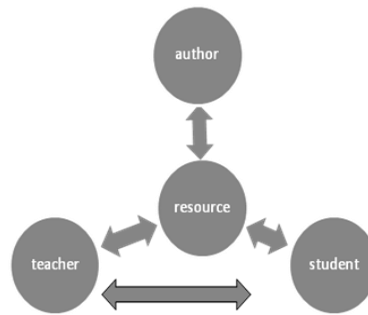


Figure 2: Teacher's role

The relation teacher ↔ resource where the teacher has the possibility to adapt the resource is of extreme importance in the teaching process. This role of the teacher must be respected and taken into account when designing e-materials.

Using analogy with toys – a ship made of Lego bricks has a far greater pedagogical value as pre-constructed, unchangeable models. So we should switch the process from building resources in the form shown in Figure 3:



Figure 3: "Static" resource
(Source: <http://www3.towerhobbies.com>)

to resources prepared in the way as in Figure 4:



Figure 4: An adaptable resource
(Source <http://www.lego.com>)

To conclude: most teaching materials are meant for the teacher, who then instructs the students how to use the materials and is present throughout the learning process. Therefore the authors of e-materials must recognize and acknowledge the role of the teacher. They must make it possible and easy for the teacher to use and adapt the resources.

4 E-MATERIALS PREPARATION GUIDELINES

The authors of this paper are members of the NAUK team (NAUK – Advanced learning blocks group, Lokar et al., 2009), which is a group that manages several projects in progress, involved in e-learning content creation.



Figure 5: The NAUK group portal (NAUK – Advanced learning blocks)¹

The main idea behind the NAUK concepts is that the teacher will take the teaching materials from the already available online sources, prepared within different content creation projects/systems and, with the help of NAUK system, change and combine them to make a lesson that suits his or her style of teaching and/or the current situation in the classroom. As he or she will be using the resulting content in different situations, the underlying system will offer different ways of export, which conform to the most important up-to-date standards. The common aim of NAUK projects is to create a computer-powered system for managing and serving e-learning content that will be extremely suitable for teachers. The main difference between NAUK projects and other software systems for e-learning content creation is in the philosophy supporting the project; namely, instead of the author-learner relation NAUK projects want to introduce the three-way author-teacher-learner relation.

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Therefore, NAUK project group conceived a concept that would allow combining existing content and with that the creation of one's own learning pathways. There are technical means that enable such combining nowadays. But the authors need to take the teachers' needs into account and respect them more. The teacher needs to stay in control: to have the option to change, correct, adapt the materials, to change the order of certain parts ... Therefore e-materials should be constructed as a combination of building blocks that can be recombined, corrected ...

The authors of materials should by all means prepare a finalized learning unit, with a logically combined sequence of tasks. Thus their own view of the use of the materials in a hypothetical learning situation will be presented. But this unit should be so constructed that it can be (if necessary) adapted, changed, upgraded, recombined ... by the teacher. Namely, the authors will follow a certain method, a certain "ideal" group of students, a certain number of lessons available ... However, no two groups of students can be taught in exactly the same way, as teachers are well aware, and therefore the final unit should only be a basis for the adaptation of the unit to the particular teacher's and students' needs.

So e-resources should be flexible and allow the teacher to adapt them, combine in his/her own way ... The ever popular Lego bricks (Figure 6 - 8) offer a perfect analogy. The primary concern of the authors of e-materials should be to offer:

- basic building blocks,
- pre-combined models (that can be "corrected" or "recombined")
- plans for making new models

¹ <http://www.nauk.si>



Figure 6: Basic building blocks²

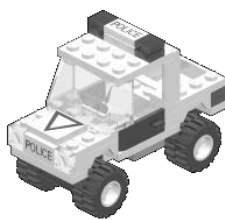


Figure 7: Pre-design models (that can be later customized)³



Figure 8: Instructions for advanced customized models⁴

What represents the basic building blocks certainly depends on the particular learning situation. They can be a short explanation of a concept, a picture, an animation, a short video clip, a question, an exercise, an interactive game...

But there is more. The basic building blocks should offer the possibility of being adapted. Thus the teacher should be able to reword a question, change the explanation slightly, add a link to another material on the topic in the feedback ...

It also makes sense that the teacher should be able to use a particular building block in different shapes. The “learning cube” should be able to be used as rounded, oblong, triangular ... Regarding the fact that this is not a big technical problem, why should not the teacher be able to use an exercise (a question) as a text (e.g. as part of a test written with the help of a word processor), a question in a Moodle virtual classroom, in the shape of Java assisted interactive question on a web page ... So the teacher would be able to use the technical form that is best suited to the given moment.

The author should merely be an initiator of the resource in various forms. A teacher is the one who upgrades the idea, adapts it to a certain pedagogical situation, his/her beliefs ... Namely, it is the author who creates the resources for an ideal situation, but it is the teacher who teaches in “the real world”. The resources a teacher knows to be adaptable are more widely accepted and used, even though they are not actually adapted most of the time (Hwang 2008).

If we summarize the guidelines into 5 points and try to state them in a slightly more technical manner:

1. **The teacher must be in control.** Every teacher is unique and has a unique teaching style. What is more, the way a teacher teaches differs from class to class. Therefore learning materials should not be limiting and prescriptive as to the way they can be used. The author should provide a learning path, but that path should be easily deconstructed, adapted, changed. And if the teacher believes that the main character’s name in the resource should be Johnny and not Jack, that should be as easily accomplished as possible.
2. **Teaching resources consist of small building blocks.** Teaching materials should be constructed from several atomary building blocks which can easily be changed and thus adapted to the individual needs of the teacher. In this way everyone can construct their own learning paths and have the possibility to combine their own resources with resources obtained elsewhere.
3. **Format and tool independent building blocks.** Basic resources should be small, adaptable, transferable and as independent of particular programming tools as possible. Building blocks should be easily obtained in different formats such as text files, html with different styles, original xml format, SCORM 1.2, MoodleXML ... This makes it easier for the users to embed the blocks into their own Internet pages, use them within their virtual classrooms, offer them on CDs provide CD copies of them, adapt them, etc.
4. **The teaching material should only be a sample combination.** A pre-constructed resource should only present one of several patterns possible It certainly makes sense that authors offer pre-constructed learning paths (in one or several different forms). These paths (constructions) show the possible use of atomary (basic) building blocks to construct a whole. However, the complete resource should be available in a technically easily adaptable way.
5. **Exploit the power of metadata.** All building blocks should have descriptions that enable the user to know of their content even before they are actually entered. Metadata provides quality searching and the user can thus obtain exactly the resource s/he is looking for.

² source: http://en.wikipedia.org/wiki/File:Lego_Color_Bricks.jpg

³ source: <http://www.track7.org>

⁴ source: <http://www.lego.com>

If quality use of e-teaching materials during lessons is to be attained, it is imperative that there are e-materials that can be adapted and combined according to the needs of individual teachers. For this purpose the following things are required:

- a repository of well described (metadata equipped) building blocks. These should be (where logical) in different formats and thus functional in different situations. The building blocks should not be too extensive and should only cover one way of dealing with a certain topic.
- examples of learning units constructed with those blocks. They can provide a base for the teacher. However, this base must be adaptable to the individual teacher's needs
- instructions for the use of building blocks, for the construction, changing, and adaptation of the pre-constructed units
- tools which enable preparation, changing ...

TOOLS FOR E-LEARNING CONTENT CREATION

The selection of proper technologies and tools for managing e-learning content and the establishment of a user-friendly and easy-to-use environment for creating and modifying e-learning content, are essential to ensure basic support and the popularization of e-learning. Of course selecting the technologies and the tools is not a task for the teacher. Creating an environment that will offer quality e-learning creation tools and related services is the goal of the interdisciplinary group of experts with skills from: multimedia, web technologies, web services, user interface design, programming, teaching with the usage of ICT, etc. Such a group was formed in one of NAUK's project named e-SIGMA (Services for building interactive content from mathematics), where they intend to offer technological support to educational material creation process in the context of other NAUK projects.

The main component of the proposed collection of services is the repository of materials, which, unlike the majority of existing systems, is not only intended for archiving and serving content, but at the same time offers the possibility of combining existing materials into new learning units. Sustainability and reusability in light of new technologies of thus created e-learning materials is the main advantage to the existing monolithic presentation of e-learning content that can be currently be seen all over the web. The main scenarios that were envisaged before creating the repository are:

- A teacher constructs a learning path, i.e. a complete learning course for teaching specific topics in the curriculum.
- A teacher that uses a virtual learning environment creates an assessment and imports it into the virtual learning environment.
- A teacher prepares homework with the same content as the teaching material he or she used while teaching, but with different data for every learner.
- A teacher modifies and reuses an already prepared assessment.
- A teacher modifies and reuses an already prepared content.
- A teacher adds interactive elements or descriptions on transitions between elements to already prepared content.
- A teacher uses mathematical notation.
- A teacher comments and grades an already prepared content.
- A teacher contributes his or her own content into the repository.
- A teacher creates new teaching materials or assessments.

By using NAUK services that are currently still in beta version and are intended to become stable in October 2010, the teacher will be able to take existing content from the repository, amend or supplement it, and immediately publish it in the repository. The other important functionality of the repository would be the possibility of exporting the content in the SCORM⁵ standard as well as in Common Cartridge⁶ format. The teacher will be able to use the e-learning content exported in SCORM in his/her own virtual learning environment (e.g. Moodle, BlackBoard, Dokeos, etc.). Thus, by using NAUK's export service the requirement for technical knowledge of the author (teacher) becomes obsolete.

Therefore, the teacher is no longer obliged to blindly follow the ideas of the original authors of the content, but is able to accommodate the content to his or her needs. He or she can easily:

⁵ <http://www.adlnet.gov/Technologies/scorm/>

⁶ <http://www.imsglobal.org/cc/alliance.html>

- take an already built teaching material, remove or replace a certain section, change the order of chapters and slides, etc.,
- add leaps in a learning pathway and thereby build a non-linear structure.
- add or improve responses (feedbacks) depending on the correctness of the answer to a question or an interactive part of the teaching material,
- correct an animation or add his or her own example,

The foundation of NAUK system for e-learning content creation uses GIT⁷ distributed version control system that greatly enhances the functionality of service by providing the possibility of:

- comparing differences between versions of the stored e-learning material,
- easing the possibility of modifying the already existing content by starting a new branch, and becoming an author (owner) of a new branch,
- cooperating with other coauthors in writing the same content.

FURTHER WORK

Teaching resources should be designed in a flexible way, supporting appropriate use of different ICT tools. An appropriate view on e-resources preparation should deal with the whole process of their design, usage and modification. Teachers should have the possibility to adapt resources respecting the knowledge, skills and needs of their students.

Informal interviews with many teachers as well as the first reactions of users have shown that the described concepts and solutions form a good approach that will provide higher quality of teaching and learning. The NAUK project group determined that it is wise to invest further efforts in upgrading demonstrated concepts. Therefore, the project group intends to build a web based community, where it will be possible to give opinions and comments on existing materials and to grade them.

During the project we found that several new tools needed to be developed, too. Namely, we want to hide as much technical details from the teachers as possible to still maintain the flexibility of the way teachers modify the proposed models as well as basic resources.

A research study is also in preparation. It should show the teachers' reaction to the idea that they can have control of the teaching materials, get the materials in the shape of models that can be adapted and combined, as well as how they believe this will affect the quality of knowledge and teaching. The research should also show the importance of the community (of teachers and students) for the development and usage of such materials. The approach mentioned brings several different options of using teaching materials which makes the exchange of experiences even more important.

Since good ICT solutions in the field of education spread quickly (Beyond Textbooks, 2009), all members involved in NAUK projects hope for the success of the presented solutions and concepts, but are also aware that further development in this area relies heavily on the satisfaction of the end-users - the students.

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⁷ <http://git-scm.com/>

