PRODUCING OPEN EDUCATIONAL RESOURCES THROUGH MASSIVE COLLABORATION

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Abstract

Open Educational Resources (OERs) have drawn the attention of professionals in the area of Computer Assisted Language Learning (CALL) for their potential in making classroom activities more rewarding. OER expansion in CALL, however, has been hindered by two recurring problems: (a) custom-made production of OERs is expensive or time consuming for the teacher, and (b) off-the-rack OERs typically do not meet the specific educational contexts faced by the teacher. To solve these problems we offer an authoring system that allows both teachers and students to work collaboratively, producing, remixing, adapting, distributing and sharing their OERs.

Introduction

The purpose of this paper is to show the evolution that occurs as we move from Learning Objects (LOs) to Open Educational Resources (OERs), considering the impact on language teaching in both theoretical and practical aspects. For the theoretical aspects, we bring the conception of Democritus, Greek philosopher of the fifth century BC, for whom matter was made up of both particles and the restructuring of these particles, which are internally rearranged in different combinations. Democritus is used as a metaphor to reinforce the idea that the term *open*, which is included in the acronym OER, can be used not only in the sense of *open for access*, but also in the sense of *open for change*, meaning the ability to manage and reorganize the constituent parts of the OER. On the practical side, we describe an authoring system that was developed to implement the proposal, based on mass collaboration resources, as provided by the Internet. That is what we will try to demonstrate in this text, divided into three parts, as follows.

The first part contains a summary of the theoretical journey that starts with the concept of LO and ends up with that of OER. That is where we refer to the Democritus concept on the constitution of the substances in the universe and show its relevance to computer sciences based on object-oriented programming, bringing up the concepts of modularity, recursion, polymorphism and especially elastic modularity, proposed in this paper.

In the second part, we describe and justify our preference for OERs, detailing each of its elements: (a) what the term *resource* means and why we opt for it; (b) how the *educational* content is inaugurated inside a resource; and (c) what makes a resource *open*, considering accessibility and mutational aspects.

Finally, in the third part, we try to instantiate these theoretical elements into an authoring system, practical in nature, allowing teachers to create, recreate and

adapt their own OERs, recursively encapsulating smaller modules into larger activities to meet the needs of their students and the demands of their teaching contexts.

From LOs to OERs

LOs have been defined in various ways, from the more generic idea of any object used for educational purposes to the more specific notion of a small electronic unit of educational information. LOs started with an emphasis on modularity, based on the object-orientation paradigm, as used in computer science (Wiley, 2000), in which certain blocks of code, carefully designed and tested, were saved as objects that were later reused by other programmers. When this is done, all the programmer has to do is send variables to the pre-existing code block, which automatically processes and outputs the desired result without the need for the programmer to rewrite it again. Wiley's idea was that the same principle of reuse could be used in the construction of LOs.

Defining LOs as minimum learning units, seen as the basic elements of a larger educational unit, leads to the concept of atoms, traditionally seen as indivisible particles of matter, a concept that permeates Western philosophy. Obviously, these minimum units, either LOs or atoms, can be combined with other minimum units and produce different results, depending on how they are internally organized. Combining atoms to create new substances or combining objects to produce learning is a fascinating aspect of both chemistry and learning. In chemistry, this is called allotropy: substances entirely different in their physical appearance are made up of the same elements. They differentiate only by the way their atoms are organized in the molecules.

The idea that matter is made up of smaller and smaller parts can be traced back to the Greek philosophers. Democritus in the fifth century BC already stated that everything in the universe was made of atoms, so that the difference between earth and water, for example, was in the shape and arrangement of these atoms. An iron rod is not a monolithic block but a cluster made of particles that attach to each other. Although the current view of the atom is no longer that of Democritus, in which the atom was seen more like a molecule, what he says is still important today. It suggests that the universe is made not only of elements, but also by the combination of these elements, creating new substances with voids between them, no matter how compact they can look.

The conception of Democritus that a change in the arrangement of the atoms could cause a change in the substance, transforming steel into salt, for example, is still true today, confirmed by the property of allotropy: diamond and graphite are allotropes that differ only by the geometric arrangement of the atoms in the molecule. In a way, we can argue that allotropy resurrects the concept that Democritus had of the universe, apparently as eternal as diamonds. Even if the psychic atoms, proposed by Democritus to describe the composition of the soul and fire, can no longer be accepted to the letter, it is not difficult to associate these psychic atoms to the current notion we have of light particles.

The atoms of Democritus can also be associated with the elements of a Lego set, which, not surprisingly, have been used as a metaphor to explain the Universe: a giant Lego set, consisting of little blocks of different sizes and shapes that fit into each other, as seen in movies, games, and popular literature. In *Sophie's World*, for example, Alberto, the philosopher character, explicitly compared Democritus' atoms to Lego pieces. The Lego metaphor is relevant to the concept of LOs because it crystallizes the idea of modularity, not as a puzzle, which always produces the same result, restoring the original object from which the pieces were taken, but as a Lego set, wherein the parts can be combined in different ways, producing different results.

The turning point in the rearrangement of particles happens when we move from the analog to the digital world, from matter to light. Negroponte (1995) addressed this point in a creative way, drawing attention to the difference between atoms and bits, showing that CDs and printed books, for example, are made of atoms, while the content of these books and CDs, transformed into computer files are bits. Unlike printed material, digital material is extremely inexpensive, easily transmitted from one country to another, easily modified, and weightless: a laptop with a million e-books in the hard-drive does not weigh a gram more than an empty one. We are in the world of light.

LOs, over time, seem to have lost their solidness as objects. Initially seen as monolithic blocks, they gradually replaced reusability, one of their main characteristics, by adaptive repurposing, allowing their reuse with the introduction of changes and thus evolving into OERs. Wiley himself, one of the early proponents of LOs, became over time one of the main advocates of OERs (Wiley, 2007). In fact, OERs are more easily implemented in a "produsage" world (Bruns, 2007), when we move from Web 1.0 to 2.0, from matter to light, from the atom to the bit, being free to mix the elementary particles that make up the digital world.

The Elements That Make Up an OER

One interesting way to define an OER is by focusing on the meaning of the three words that make up the acronym: What does it mean to be *open*? What makes an OER *educational*? What does it mean to be a *resource*? When we do that, we find out that the choice of these words is extremely appropriate, as we will try to show below, explaining what makes an OER open, which elements in it contribute to make it educational, and finally what constitutes a resource.

Being open entails two meanings here: (a) open to access and (b) open to change. Open to access leads to the idea of public domain without any restriction, whether operational, financial or geographical.

In operational terms, open access means that the resource can be accessed by any user, regardless of the device being used at the moment, be it a smartphone, a tablet, a netbook, a desktop computer and even a TV; and regardless of the device's operating system: Windows, IOS, Android, or Linux. Ideally, it should be open to what we have today and whatever we may have tomorrow. This is the interoperability principle, one of the aspects that have evolved more dramatically in computer hardware. The first computers in

the 1950s, such as the IBM 704, had a single operating system for each machine, blocking communication from one machine to another. It was only in the 1980s that generic operating systems such as UNIX and DOS came about, allowing for different machines to run the same operating system, thus affording intra-system compatibility: a DOS machine could communicate with another machine running DOS, but not with one running UNIX, for example. With the expansion of the Internet, especially with cloud computing, operating systems, literally and figuratively, go to space, and compatibility becomes universal: a file created on a machine running Windows can be viewed and modified on another machine running Linux, IOS or Android; and on any device, from a smartphone to a desktop computer. The movement known as *Bring your own device* (BYOD) finally materializes. Operating systems have become invisible. The average user, with time, does not know, and does not need to know, which system is running on his or her machine.

In financial terms, there are two aspects to consider: no-charge services for the user and free access to the Internet. The progress seems to have been greater with no-charge services, considering, for example, the expansion of social networks, Wikis, search engines, and even OERs. In terms of free access, the issue of the digital divide has been discussed in some circles, with some people arguing that extensive layers of the population are outside the information society and do not profit from the expansion of the digital networks. Sorj and Guedes (2005), for example, in one of the most frequently quoted studies in the area in Brazil, state that the introduction of the new ICT increases exclusion and social inequality. Obviously, in opposition to this pessimistic outlook, there is another one, more optimistic and positive, based mainly on Pierre Lévy's ideas (2001), expanded below. The main point is that what Sorj and Guedes stated needs some repairs. First, whenever a new technology emerges, a legion of people is excluded: when writing was invented, for example, the illiterate, who did not exist before, were created. Second, the study by Sorj and Guedes was conducted with data collected in Brazil in 2003, when there were not smartphones, netbooks, or the mobile Internet and a desktop would cost more than twice of what it costs today, with half of the processing capacity. The money needed to introduce a student to computer literacy at the time, today introduces four students, using conventional netbooks. If cloud-computing resources are used, seven students can be taken care of, with lighter, more portable and more user-friendly machines, without the need for lengthy updates and antivirus management. It is obvious that one cannot be so naive as to think that suddenly all human beings become fully generous and everything is resolved with technology; but one cannot deny that today, although a lot of information is still withheld, access to it is much cheaper and easier. Another aspect that should also be mentioned is that the exclusion is not always induced by financial problems; there are people who, for other reasons, choose not to join the digital world (Kvasny & Trauth, 2002).

Geography has long been an excluding factor. Living far from an urban center meant not having access to school, especially at higher levels of education. Currently, OERs offer the possibility of eliminating borders not only between the city and the countryside, but also between countries, allowing for a student

living on a farm in Brazil to follow different courses offered by the most prestigious universities on the planet, including Massive Online Open Courses (MOOCS). The same technology that initially excludes people can also include them later, when disseminated.

OERs should be open not only for universal access, but also open for adaptation. Adaptation involves the disassembling of the OER into its components, the introduction of changes in one or more of the disassembled components, followed by a reassembly of the modified components into a different OER. This means that OERs, unlike LOs, may not be monolithic blocks; they must always be modular systems, open for changes to be introduced whenever necessary. This implies a repository of parts to be used on a just-in-time basis similar to what happens on an assembly line.

The second word in the OER acronym is related to E: education. The problem here is to explain how a particular resource becomes educational. Videos, lectures or expository texts are not educational resources by themselves. Leaving a group of students watching a video when the teacher is absent does not make the video automatically educational.

We will use an operational definition here: an *educational resource* is something that requires the student to do something. In educational terms, this is known as *experiential engagement*. A video by itself is not an educational resource, but a video attached to a questionnaire that students must respond and submit to the teacher is. A novel, by itself, is not an educational resource, but will be if interspersed with questions between chapters. An academic well-written English descriptive grammar is not an educational resource, but a beginner's grammar with fixation exercises is. The quality and relevance of the video, novel or grammar are circumstantial aspects; they may be important but do not essentially characterize the instructional content of a resource, using the operational definition presented here.

Instructional content is defined as an activity that involves the student's documented practice. It is not enough to just read a text or attend a lecture, supposedly understanding what is being read or listened to; the student needs to do something, experiment and act in a given system, leading to feedback, which in a digital environment is always immediate. This feedback may provide clues when students get it wrong and encourage them to go further when they get it right -- emphasizing experience and leaving traces that document what was tried and done. Places like social networks and especially games, which value participation and user performance, encouraging action, not merely reception, are also places that offer intense learning possibilities (Gee, 2004).

The process of providing a resource with instructional content is a risky venture because it can destroy the object of study, be it a poem, a Bahktin's text, a famous painting or a cult movie. This happens, for example, when the author of the activity brings in totally irrelevant details, which contribute nothing to the work that is being discussed. Instead of showing the student essential aspects of what qualifies a text, for example, the teacher, in the guise

of some grammatical point, restricts himself or herself to some teaching liturgy, with the result of demotivating the student. The argument put forward here is that by using the digital resources available today, the production of instructional content is more feasible, interesting and creative, although not necessarily easier. Acquisition of this domain is a slow process that requires, from the subject, a positive attitude towards digital technology, using what we have proposed to define in our project as *critic dazzlement*. This involves a balance between enthusiasm and sustainability and the adoption of a constructive critical perspective, namely, not giving up when problems arise, and not summarily rejecting innovation possibilities, embarking on negative criticism. Essentially a resource with instructional content implies relevant action on the part of the students, not only doing something, but also doing something that is meaningful to them.

The third letter in the OER acronym, finally, R relates to resource. A *resource* is a means to an end. This is more precise than the word *object* in the LO acronym, which stands for both means and end. As far as LOs are concerned, we are never sure whether object is the cultural artifact used as a means to an end, such as a book or a video used to get information; or if object is the information itself. This ambiguity creates a serious problem in LO studies because instruments cannot be confused with objects. This becomes more serious because the same thing can be used as an object (a foreign language as an object of learning for the student) or an instrument (learning a foreign language to get a better job). Our point is that this distinction has to be made and that the use of an ambiguous word such as object, meaning both instrument and objective, brings unnecessary confusion to the area.

The socio-cultural perspective is of special interest here, considering a *pedagogy of action*, in which we learn by doing and by being empowered by the tools we use. The relationship between the subject and the object ceases to be direct to be mediated by some physical or psychological tool. This is taken primarily from Vygotsky and Activity Theory (Leontiev, 1978; Engeström, Miettinen, & Punamäki, 1999). The concept of resource becomes more important because it empowers the subject, enabling people to do what they would not be able to do alone. The relationship between subject and instrument is not competitive but collaborative: man *with* the machine, not *against* the machine. The player needs the ball to play; the pianist needs the piano to give the concert. People are able to develop to given points, in which they reach limits or ceilings of their capabilities, both mental and physical. To go beyond those ceilings, they may need the help of instruments (Leffa, 2013).

In terms of mental ability, our short-term memory, for example, is extremely limited (Sweller, 2003), getting to around seven items. When we use a laptop with a two-terabyte capacity, however, we can store the equivalent of a million books the size of the Bible, with almost immediate access to any word in any of these books. This disproportion between our mental capacity and the tools we use is found not only in data storage, but also in processing those data. A statistical analysis, performed in a few seconds by a computer, is impossible to be carried out by humans without the aid of a resource.

According to Pea (1993), intelligence is distributed among minds, people and symbolic and physical resources.

Implementing an Open Educational Resource Model

The purpose in this section is to describe an authoring system that was developed to create OERs, incorporating the four Rs proposed by Wiley (2007):

1. Reuse, reprocessing a resource already available in some repository.
2. Revise, adapting the resource for the needs of a particular context.
3. Remix, by combining different resources.
4. Redistribute, sharing the resource.

A small problem in Wiley's model is the absence of an initial OER, which initializes the four Rs, assuming that the OER is a digital artifact with instructional content, not merely any device available on the Internet. The prefix "re" in the sense used by the author suggests that we start from something already created: it is only possible to reuse something that was already created and used at least once. Before using any of the four Rs, it is therefore necessary that somebody created an OER, intentionally built with an educational goal; it is not something that arises spontaneously in the network. This is the first point: to create an authoring system that produces this original OER.

The second point is to afford the four Rs. The basic idea is to provide space in the cloud where OERs can be stored in a repository for the benefit of teachers and students, reusing, revising, remixing and redistributing what is stored there. For three of these Rs (reuse, remix and redistribute), there is ready-made technology, based on the creation of databases and numerous software proposals for the hybridization of different modalities. The problem is the fourth R: how to revise the OER, in the adaptive perspective, envisioned here.

To resolve this problem, we propose the *elastic modularity* approach, trying to solve a problem already anticipated by Wiley (1999): LOs are not pieces of a Lego set, which can be combined in any way to form a teaching unit but atoms, which can only be combined in a certain way. Wiley saw LOs as monolithic blocks, as the pieces of a Lego set really are. The point here, resuming the long journey from Democritus' atoms to Negroponte's (1995) electronic bits, is that the best way to change an OER is to modify the modules that comprise it, using the same molecular principle that transforms graphite into diamond, extremely easier here because we have moved from matter into light.

The modular approach, however, must be used with caution as the focus on the module can lead to OER fragmentation, seeing only the tree and losing sight of the forest. To avoid this problem, we have developed an authoring system that works from two perspectives, both from the producer, with an emphasis the part, and the user, with an emphasis on the whole, resuming the idea of "produsage" (Bruns, 2007). The person who produces the OER is

concerned about its assembling and tends to concentrate on the separate parts, on the molecules, unable to see either the graphite or the diamond as a whole. The user, however, cannot see the molecules, but only the diamond or the graphite, enjoying perhaps the brightness and hardness of the first and despising the brittle and crumble structure of the second. To address this part/whole perspective we created two open spaces. One is for the teacher, where the OER is shown disassembled in its modules, the molecules to be modified and rearranged. The other space is for the student, where the OER is shown in an assembled form, mounted in a given configuration. Any change the teacher may want to do in the OER, whether to adjust or duplicate it will be made from the modules, changing its internal structure or leaving them as they are, but rearranging them in the OER. The module is not a monolithic block as the Lego piece, but malleable in nature, like the imaginary graphite molecule, where the molecular structure can be metaphorically modified to turn graphite into diamond.

Some aspects should be highlighted to understand how the proposed system works. For didactic reasons, we use the terms *module, activity* and *authoring system*. The *module* is part of the OER and the *activity* is the OER when mounted, seen as a whole, incorporating the modules. The modules are located in the production area, usually operated by the teacher. The activities are displayed in the student area, usually visualized by the student. We use the term *usually* because they are open spaces, and, because of that, students and teachers can exchange places. The *authoring system,* finally, is the computer open source program that allows students and teacher to reuse, remix, revise and redistribute the OERs. This program was called ELO, which stands for *Electronic Language Organizer* in English. It is free for use and is available at http://www.elo.pro.br/cloud/

ELO enables the production of eight types of modules, three of the expository type and five of the interactive type. This is not the place to describe the modules; they can be seen and tested on the project website, but we would like to show the distinction between having and not having instructional content. The expository modules are characterized by not having instructional content. They were included considering advanced students, who are usually able to manage their own learning, without the need for constant guidance. They are expository modules because they only display texts, images, sounds and videos. They are produced both in the teacher's space (Hypertext Modules and Video) and the student's space (Composer Module). In the Composer module, the student produces a hypertext from the context created by the teacher: poster, advertisement, recipe, presentation, etc. By themselves, these three modules do not evaluate student's performance, failing to provide automatic feedback and, because of that, are classified as having no instructional content. As for the interactive modules, they are characterized as such precisely for providing some kind of feedback, accompanied by a score. Feedback can be of two types: (a) strategic, providing hints and tips for the student in case of failure in answering a question, or (b) progressive, building scaffolds to better assist the students in their performance.

Although the purpose here is not to describe these modules, we feel we should try to show how module and activity articulate with one another and how the revising process works, justifying why it can be seen as adaptive. It is on these two points that the originality of the project is based.

The part/whole articulation between modules and activities can be described tentatively, showing what happens when the student accesses a particular activity in the system. The description is tentative because there is no way to demonstrate on paper the dynamics of a virtual event with interactive features of text, image, audio and video. What the student sees is the integration of the modules into a single activity, as it was planned and assembled by the teacher. What he or she does not see is that this assembling is done in real time with the elements that are in the repository, using a "just-in-time" methodology in the fitting of the invisible elements into a cohesive whole. It reminds us of the hooks in Democritus' atoms; with the difference that in the world of light rearrangements are constantly made and remade in different configurations.

It is through the constant restructuring of the modules intra- and inter-activity that adaptation occurs. What seems ready for the student was disassembled and reassembled by the teacher to create the activity, using modules that he or she produced, reused, revised, remixed and redistributed from the repository. If the teacher has reused a module, produced by himself or by his colleagues, the system creates a copy of the module and saves it in the repository, leaving the previous version intact. This means that the modules may improve over time, producing activities not only tailored to specific contexts, but with the possibility of becoming more and more refined, reaching higher standards of teaching.

Modularity is elastic because, in activity adaptation, various treatments are possible. Here's an example: When browsing the repository, using the metadata mechanism provided by ELO -- including, language, age, advance level and keywords -- the teacher ends up finding the activity that suits his or her needs. Examining the activity, he or she finds it interesting, except for a small detail in one of the modules, which has inadequate information to his teaching context. As he likes the activity and knowing that he can modify it, he decides to use it by accessing teacher space and making the desired change in one of the modules. Later, while using the activity with his students, he receives from one of them the suggestion that it would be interesting to illustrate one of the texts presented in the activity. New change is introduced in the module to add the suggestion from the student. The next day another teacher, also adapting the activity, creates another version, without deleting the existing ones, so that there are now three variations of the same activity. Over time, other teachers may introduce more variations, and what was only a single activity may have hundreds or thousands of adaptations.

The production of an activity, as defined here, is laborious work, in practice only possible by using the principle of mass collaboration (Tapscott & Williams, 2007), with a large number of teachers, working independently with the same activity and producing different adaptations.

Conclusion

The aim of this paper was to present an authoring system for the production of adaptive OERs. OERs are seen as an evolution from LOs, with an emphasis on public domain and free access. The originality of the proposal is in breaking up OERs into their components, allowing for change in the components and then reassembling them into a different OER. The authoring system developed for the project uses crowd sourcing, based on a mass collaboration ecology, which empowers teachers to do more with less work.

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