LEARNING OBJECTS: THE ANSWER TO THE KNOWLEDGE ECONOMY'S PREDICAMENT?

Peter B. Sloep

Open University of The Netherlands

Fontys University of Professional Education

Introduction

This chapter is about a relatively recent addition to the learning technologist's vocabulary, the learning object. Putting it succinctly, learning objects are reusable bits of learning content. Their significance lies in their purported capacity to be flexibly reused, thus helping to create personalized learning materials, even at a reduced cost. This claim is voiced by many (Atkinson & Wilson, 1969) but particularly adamantly by the Advanced Distributed Learning Initiative (ADL) in its defence of the SCORM (Sharable Content Object Reference Model) approach (Dodds, 2001:1-12). Learning objects, it thus would seem, are particularly helpful in sorting out the problems posed by the knowledge economy (Westera and Sloep, 2001; Downes, 2002). It is this thesis that I want to assess in this chapter.

First, I analyze how personalization and costs relate to each other and to the demands of the knowledge economy (see section 1). As indicated, learning objects play a central role in this debate. Before delving into the question of what this role is, section 2 looks in detail at what learning objects are, and what they are not. Sections 3 and 4 then tackle the questions of how and to what extent learning objects may assist in getting a knowledge economy off the ground. Section 5 summarizes the findings and discusses some practical inferences one may make.

11.1 THE PREDICAMENT OF THE KNOWLEDGE ECONOMY

The starting point of the analysis is the generally accepted maxim that as a matter of sound pedagogy an attractive, effective, efficient learning environment needs to meet a learner's needs and preferences (see Collis and Moonen, 2001: Chapter 1). It should present exactly the right materials in terms of complexity and subject matter ('just in case'), at exactly the moment a learner needs it ('just in time'*),* and it should perfectly match his or her learning style*.* The second premiss, which also hardly needs defending, is that students do indeed differ in their demands and preferences. This implies that there is a need for customization of learning environments, which is usually referred to as the need for personalization.

Personalization comes at a price. Matching a learning environment with each and everybody's demands and needs is obviously more expensive than serving all the students with one learning environment only. More personalization implies increased costs per student, although clearly there is a limit. Someone has to shoulder the costs, irrespective of whether this is the student, the employer or the state. This presents us with a dilemma. The more personalization the better we might almost say, but the degree to which a learning environment may be personalized is limited, as learning should also be kept affordable.

A strategy which has worked well in the past in lowering the costs of personalization is to increase the size of the group of students served by a particular learning environment. Suppose one practises face-to-face teaching in classrooms, or lecture halls. The costs are mainly delivery costs which are determined by the teacher's salary. Delivery costs are dependent on the number

of students served. For every so many students a new teacher needs to be hired. By increasing group sizes, the burden of the delivery costs may be shared by more students, thus lowering costs. Delivery costs are not the only ones, there are also development costs. But these may largely be ignored here, certainly if one works with experienced teachers. In distance teaching, increasing student numbers also helps lower the costs. By contrast with face-to-face teaching, distance teaching is based on course books or 'canned' lectures (i.e. videos) and is usually mediated by asynchronous contacts between teachers and learners such as phone, fax and e-mail. Thus the delivery costs are low but the development costs are high. However, if the course books or videos are shared, the total costs may again be lowered.

This strategy of increasing group size works particularly well in initial education, with its fixed degree programmes and rather homogeneous groups of students. Distance teaching, on the other hand, tends to serve rather more heterogeneous audiences. However, by setting entry requirements or, as in open distance learning, by suggesting ways to overcome student shortcomings, homogenous groups can be formed before commencement. Over the last two decades or so, with the advent of the knowledge economy, a new situation has arisen. It demands that we do not consider someone's education complete after graduating from, say, university. It requires us to establish forms of *life-long learning* in order to *further* educate people. The arguments are well known and have been articulated in various papers and books, academic and otherwise (Davis and Botkin, 1994; Westera and Sloep, 1998, 2001; Brown and Duguid, 2000). What they boil down to is that, mainly driven by the increasing role of the computer, societal change has quickened its pace to such an extent that ever more knowledge workers are needed. Moreover, these knowledge workers have to re-educate themselves continuously to stay abreast of societal change. Unfortunately, the rub is that in further education the strategy that worked so

well in initial education now falls flat.

For each student, further education makes the same demands on personalization as initial education. Demands may even be a little more modest as we are dealing with experienced learners who are better able to shape their learning environment. However, students in further education tend to be extremely heterogeneous and all of them make significantly different demands on their learning environments (Bitter-Rijpkema, Sloep, Jansen, *in press*). It is therefore impossible to have large groups of students jointly cover the delivery and development costs. To make matters worse, the investment each student is prepared to make in his or her education is likely to decrease with age. Life-long learners are by definition older than learners in initial education. The time to earn back their investments has contracted. Usually these investments have to come fully out of their own pockets or those of their employers. Unlike the situation in initial education, governments do not usually consider it their duty to pay for or even subsidize further education. Seen from the perspective of an educational institution, this means that further education needs about the same degree of personalization but at a lower cost. I submit that this is the predicament of the knowledge economy. The current literature suggests that learning objects represent a way of overcoming it.

2 LEARNING OBJECTS

According to a working definition proposed by the Learning Technology Standards Committee of the Institute of Electrical and Electronic Engineers (IEEE, 2000: 5):

Learning Objects are defined here as any entity, digital or non-digital, which can be used, reused, referenced during technology supported learning. [...]

Examples of learning objects include multimedia content, instructional content, learning objectives, instructional software and software tools, and persons, organizations, or events referenced during technology supported learning.

Elementary logic dictates that proper definitions are required to obey a number rules (Rescher, 1964). The first is that they should neither be too narrow nor too wide. This particular definition, however, seems to suffer from both these faults. It is too narrow, for why should one restrict a learning object's use to technology-supported learning only? They may be most beneficial in this case, but there seems to be no reason to rule out their use in situations of learning which is non-technology supported.

The definition seems too wide too, as almost anything used in support of technology-based learning counts as a learning object. This same point is made by various other authors (Koper, 2003; Sloep, 2002a) and most poignantly Wiley (2002). It seems odd to count institutions and teachers as learning objects, and in fact there are sound reasons for excluding them. Use and reuse, the definition claims, are the defining characteristics of a learning object, and what makes them attractive as a possible solution for the knowledge economy's predicament in the first place. Unlike resources, persons and organizations have a fundamental limit to their ability to be shared. Resources, particularly digital ones, may be duplicated endlessly with little effort. This means that one person's usage of a particular resource does not affect someone else's opportunity to use that very same resource at all. Economists call goods with this characteristic 'non-rival' goods. Prime examples are a film in a cinema, a lighthouse, and indeed all sorts of digital resources such as texts, pictures, sound bytes and so forth (see Kohn, 2002). Note that this does not hold for non-digital resources, which deteriorate on duplication. Examples of rival goods are a bicycle and a computer. So too are persons. The time a tutor spends on one student cannot be spent on someone

else. This means that there is a significant limit to a person's (and an organization's) ability to be used and reused. That immediately disqualifies persons and organizations as learning objects.

Taking this into account, the following amended definition would seem more appropriate:

A learning object is any non-rival resource, digital or non-digital, which can be used, reused, or referenced in service of learning activities.

Will learning objects thus defined be adequate for the affordable personalization needed to sustain the knowledge economy? Unfortunately, not yet. In terms of the definition, the books and videos used in distance teaching are learning objects too but adapting them to a particular learner's needs is rather expensive. We have learned this from past experience. Objects such as books and videos are not really suitable for small-scale personalization. But suppose we restrict ourselves to digital resources only. Computers could then be used as an aid in the adaptation process. If this process could somehow be automated to some extent, the costs of adaptation would decrease immediately. Another reason why it makes sense to restrict ourselves to digital learning objects is the world-wide cluster of networks, the Internet, through which computers are linked, and which fosters the emergence and growth of networks of people. As the networks are not bound by the limitations of physical space, they span the entire world, thus greatly increasing the number of people who could use a particular learning object in principle. The emergence of such a world-wide learning object market place ultimately creates a learning object *economy* which is likely to result in cost reductions.

At this juncture one may either alter the definition of a learning object so that it only covers digital resources or agree to restrict oneself to digital resources

in the remainder of the discussion. Either way, for the affordable personalization needed by the knowledge economy to become reality, various obstacles have to be surmounted. First, we need to establish how we may organize the reuse of learning objects on a world-wide scale, by groups of users who may not even know each other. Second, we need to establish how the costs of adaptation could be brought down with the help of computers. The next two sections will be devoted to these questions.

3 REUSE OF LEARNING OBJECTS

During the last five years or so, a number of technical means have been developed to ease the exchange of entire learning objects. The Learning Object Metadata (LOM) specification and the Content Packaging (CP) specification stand out among them.

The LOM according to its latest draft version (IEEE, 2002) seeks 'to facilitate search, evaluation, acquistion, and use of learning objects, for instance by learners or instructors or automated software processes'. Thus it is clearly about sharing learning objects. It tries to achieve this goal by providing highly structured descriptions of learning objects in such terms as the technical requirements for their deployment (the category 'Technical'), their educational and pedagogical characteristics (the category 'Pedagogy'), and their intellectual property rights and conditions for use (the category 'Rights'). There are at least two factors that may stand in the way of the LOM's success, though. First, it has become a rather large specification with over 80 data elements in 9 categories. This may hinder its adoption. Second, its attempted certification as an official ISO standard seems to have become the subject of some political wrangling. Although the stamp of ISO approval would certainly lend the LOM a measure of credibility,

a long-winded process of consensus building is not in the interests of the learning technology community, which needs a standard sooner rather than later.

Imagine someone had created a learning object and had dutifully provided LOM-compliant metadata for it. Such a learning object would then be ready to be taken up and reused by others. How would that work in practice? More often than not such a course, lecture, or lesson will consist of several learning objects, organized in a particular fashion. The content packaging specification (IMSa, 2003) helps to capture this organization. This is not only useful in itself, but it also paves the way for the deployment of software that fosters reuse. Learning objects are processed by, for instance, authoring systems that assist their development, digital repositories that store them, and runtime systems that build the learner's learning environment, real or virtual, around them.

Thus the LOM and CP specifications show how the exchange of learning objects is technically feasible. A few wrinkles still have to be ironed out, such as the political issues surrounding the LOM (Kraan, 2003a). Clearly, additional specifications are needed, such as those referring to the organization of digital repositories (IMS, 2003b). Clearly, existing specifications will need to be completed or revised, such as the current efforts to update CP. But this does not detract from the clear success of the specification efforts undertaken thus far. This success may suggest that once all the technical issues have been dealt with, nothing would prevent large-scale reuse from occurring. Claiming that much, however, would be a serious mistake.

In face-to-face teaching, all teachers are more or less alike in the responsibilities they bear and the tasks they have to carry out. They prepare for class, lecture, mark papers and assess their students' performance. In an educational system based on learning objects, this situation will change

considerably. There will be extensive role differentiation. In a learning object's delivery phase, although the role of traditional teacher will still be recognizable for the most part, the details of the tasks will differ. Lecturing, for example, will become e-moderating (Salmon, 2000). During their development, however, a whole collection of new roles will emerge (see Schlusmans, Giesbertz and Koper, 2003). Preparing for lecturing now becomes an authoring process, involving various professionals, not just content experts but also educational technologists, graphic designers, multimedia experts and perhaps programmers. This is a major change, over which teachers already have voiced their concerns, some in no uncertain terms (LeNoble, 1998).

I already noted that the LOM is a rather elaborate specification. Even the existing attempts at pruning it have resulted in still large core sets (Anonymous, 2003). Thus it takes considerable time and effort to fill out a metadata form in full. It is crucial to note that it is not the person who fills out the metadata form who benefits from this effort but others who reuse the learning object in question. Indeed, creating a learning object in such a way that it may be used outside the context for which it was intended in the first place most likely requires an additional development effort. Once again, only others stand to benefit from this. No learning object economy will ever develop, let alone last, if the creators of learning objects are not somehow compensated for their efforts. A compensation system need not necessarily be based on the money-based system currently in use for books. Publishers may exploit learning object data bases. They may see to it that these are filled with qualitatively good learning objects or charge users of learning objects a fee and then compensate the authors for their creative efforts. However, other systems might work equally well or perhaps even better, depending on the circumstances (Suber, 2003). Any solution that relies on closed communities, however, should be avoided as it limits the potential for reuse.

A no less significant obstacle to reuse is the current way of managing intellectual property rights. For one thing, laws and regulations differ between countries, sometimes to the extent that countries lack such regulations altogether or do not enforce them. Second, and no less important, according to a number of scholars current systems seem to err towards maximizing the profits of publishers rather than striking a just balance between compensating authors for their efforts and protecting larger cultural values such as fair use or access to the common cultural heritage (Kohn, 2001; Sholz, 2001; Söderberg, 2002). Either way, reuse stands to suffer as the incentive to make learning objects available to others is diminished.

There can be no doubt that current and future technical specifications foster the reuse of learning objects. However, this will occur only if the required social affordances also exist. In view of society's resistance to overthrowing its evolved institutions, the societal hurdles will probably turn out to be far more resistant to removal than the technical ones.

4 ADAPTATION OF LEARNING OBJECTS

What about the adaptation of learning objects that is required for personalization? For simple reuse it suffices to look at a learning object *externally*, from the outside only, as is described by its metadata. In this way one may do the searching, finding and retrieving needed for simple reuse. For adaptation, that is for flexible reuse, one needs to be able to alter a learning object's *internal* structure, though. How could this be done? And what precisely is the internal structure?

For reasons that will become clear shortly, I shall focus on compound learning objects only. Such learning objects themselves consist of learning objects, simple or also compound, which are organized in a particular way. One could swap one or more of these constituent learning objects for one or more others, change the route the learners are supposed to follow through them, offer alternative routes, and so forth. All these alterations amount to a change in the compound learning object's internal structure. As I have already indicated, the content packaging specification is a means to record the way the learning objects combine in a compound learning object. This is formally called its *organization*. Compound learning objects may have multiple organizations.

The mechanism originally provided by the content packaging's organization element is not very adept at personalizing compound learning objects. It is really no more powerful than the table of contents in a book. Readers may decide to skip chapters, jump ahead and come back later, or whatever they like. Of late, more powerful tools have become available such as the IMS Simple Sequencing (SS) (IMSc, 2003) and IMS Learning Design (LD) (IMSd, 2003) specifications. Both substitute the CP's organizational element for one of their own. Both allow the designer to specify multiple routes through a collection of learning objects; to have routes split up and come together again; to affix conditions to these branching events; and to keep track of a learners' progress along the route chosen. Thus both allow personalization during the development phase with the educational designer creating the entire 'routing system' and, to some extent, also during delivery through conditional branching. However, this is where the similarities end. Simple Sequencing is aimed at the training market and only provides for single-learner, single-role designs (Kraan and Wilson, 2003). Learning Design has been developed to support learning scenarios in which multiple learners feature in multiple roles, if so desired. Thus complex scenarios such as problem-based learning may be supported. In

addition, its system of user variables (properties) and conditions is more flexible as they may be entirely defined by the designer, whereas SS works with fixed sets (see Koper, 2003).

Do these specifications suffice to create the flexible reuse of compound learning objects we are in search of? Both specifications are still in their infancy. No software applications able to play learning objects marked up according to either SS or LD were on the market at the time of writing, let alone the authoring systems that are needed to develop learning objects powered by LD or SS. Hence even technically, major hurdles still have to be overcome. At the social level, the same obstacles that simple reuse stumbled over, such as teachers' resistance to change and the lack of suitable compensation and rights' systems, hinder flexible reuse.

But there are additional problems. Thus far, authors of educational materials, whether they are textbooks as used in face-to-face teaching or course books as used in distance learning, have been admonished to fill their abstract texts with examples drawn from the students' previous experience or from their future working environment. They were also advised to make regular cross-references in the text, ('as we saw in Chapter 10 …') to make it easier for the student to get an integral picture of the subject (my own personal experience as a former course developer and textbook writer). All this advice, no matter how sound, should be ignored when developing learning objects. Learning objects need to be decontextualized as much as possible to enlarge their capacity for reuse. That seems to be feasible for examples, used for illustrative puposes. Each example may be regarded a separate learning object, capable of being swapped for another one that provides a more fitting illustration. Thus one may imagine a statistics text that introduces descriptive statistical techniques such as histograms or pie charts to use different examples to illustrate the abstract instructions. But

how should learning objects that are unaware of each others' existence cross-reference each other? Developers of learning objects will certainly have a hard time unlearning their 'bad habits'. The fact that CETIS, the UK Centre for Educational Technology Interoperabitly Standardization went to great lengths to issue guidelines on how to develop decontextualized learning objects illustrates that we are dealing with a significant social hurdle here (Casey and McAlpine, 2002). This reinforces and amplifies the conclusion drawn at the end of the previous section: It will prove to be far easier to take down the technical barriers to simple and flexible reuse than the social ones.

5 CONCLUDING REMARKS

The developed countries are moving in the direction of knowledge-based economies. In order to sustain a thriving knowledge economy, workers need to be educated before they enter the workforce (initial education) and particularly while they are part of it (post-initial or further education). We have seen that further education demands that we use learning objects, although their use still requires us to solve a variety of technical and social problems. The former are in the process of being solved, although many significant problems still exist. The latter have hardly been identified yet, let alone solved.

What role could our current educational institutions, whether distance or residential, play in further education? Traditionally, they have focused on initial education. However, because of their historical role as centres of knowledge and expertise, it seems plausible that they should also play a role in further education. To date, their solutions to the further education challenge are simple extensions of their approach to initial education. Residential educational institutions offer classes at more convenient hours and locations. Distance

teaching universities recycle their materials for use in their degree programmes. We have argued above that this response is inadequate as it leads to forms of education that are either affordable but insufficiently personalized (the most common approach in both distance and residential institutes) or forms that are sufficiently personalized but unaffordable, save for the happy few. An inevitable conclusion to draw from the arguments put forth in this chapter is that the current educational establishment needs to turn towards the use of learning objects if it wants to play a role in further education. In this way it could profit from the affordances for reuse, both simple and flexible, that learning objects offer.

Obviously, such a move would be easier if learning objects could also play a role in initial education. In that case educational institutions could base their entire operation on a similar approach. In distance teaching, this poses a relatively small problem. Distance teaching may be said to have followed a learning object's approach all along, albeit a deficient one, with its learning materials such as course books and canned lectures being perfectly reusable, but hardly adaptable. Adopting modern learning objects is just the next step on an already familiar road for them.

Things are different for the residential institutions that follow a face-to-face, classroom-based approach. At first sight, learning objects may seem to have no other use than perhaps to inspire teachers. Although this is a perfectly legitimate use, it is scarcely an argument for their introduction in initial education. Fortunately, face-to-face classroom teaching seems to be moving away from this traditional model (see *cf* Van Merriënboer, Bastiaens and Hoogveld, 2003). With the advent of constructivism students are being far more left to their own devices. In approaches such as problem-based learning, case-based learning and project-based learning the students, whether alone or in

groups, engage in learning activities and in doing so arrive at particular learning objectives (Oliver, 2000). In the course of their engagement in these activities they may consult various kinds of resources. Obvious candidates to fulfil the role of these resources are the learning objects discussed above. Thus learning objects would even seem to fit in with modern approaches to regular education. But note that particularly in this case the most difficult hurdle to face will be social rather than technical. It is teachers who need to be convinced of the value of a learning object-based approach to education.

The current situation *vis a vis* learning objects is still rather precarious. As we saw, both technical and social hurdles still need to be surmounted. With respect to their adoption, what strategy should one follow just now? Should one immediately invest heavily in their development, that is in authoring teams, in supporting software, and the organizational change needed to work with them; or would it be better to follow a more cautious course? In view of the instability of many of the required standards (efforts at harmonization, for instance, still need to be undertaken), caution would seem to be the best course to follow. In spite of the current marketing hype, there is no software available that fully complies with the current standards (IMSe, 2002). First, standards certified by accredited standardization bodies do not yet exist. The only one that is at least in the pipeline is the LOM. We only have specifications at various stages of their development. Second, with one exception (ADL's SCORM), there are no official compliance tests. 'Plug fests' organized by ADL and 'code bashes' organized by CETIS (Kraan, 2002) and Surf-SIX (Kraan, 2003b) reveal that software applications show widely varying behaviours with respect to standards. Following a 'best-of-breed' approach when acquiring software may therefore well turn out to yield the best but still not good enough applications. It is therefore much wiser to follow a requirements-based approach. If no software exists that meets the requirements, one may wait for it to arrive, create it oneself, or become part of

collaborative efforts to create it. Such collaboration, which also frequently follows an open source approach, may serve to spread the risk. (Sloep, 2002b).

In conclusion then, publicly funded schools and universities should embark upon the learning object journey. They have little choice if they want to cater for both the initial and the further education demand. However, they should venture into this still little-known territory with great caution.

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