FROM MULTI-USABLE COURSEWARE TO A MULTI-USABLE PEDAGOGY

M.J. Verkroost, PhD

ITC, International Institute for Geo-information Science and Earth Observation, P.O. Box 6, 7500 AA Enschede, The Netherlands
verkroost@itc.nl

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ABSTRACT:

The International Institute for Geo-information Science and Earth Observation (ITC) in the Netherlands started developing and implementing e-learning ten years ago. A project was set up to manage this. An important starting point has been the concept of "multi-usable courseware". Multi-usable courseware is defined as (digital) learning materials which are suitable for use in different teaching modalities such as face-to-face education, distance education and joint courses. It is assumed that developing multi-usable courseware will lead to a more efficient process of developing education and to higher quality teaching and learning materials. The experiences with developing and using multi-usable courseware at ITC lead to new insights about this concept. The development of multi-usable courseware out of a distance education perspective has been more successful than the development out of a face-to-face perspective. The teaching modality of distance education makes it necessary to make educational materials suitable for independent study. These materials are quite easy to use in face-to-face or other modalities of education. However, students only experience the benefits of using these materials when the pedagogy in the face-to-face teaching modality is changed away from the traditional lecturing setup. Cases in which the distance education materials were used in face-to-face education with a setup in which the number of lectures was decreased and the lectures changed in nature to more discussion sessions have been successful. The conclusion of this study is that it is better to start thinking about a pedagogy which is multi-usable then to start with developing multi-usable courseware. When the context, the pedagogy, is multi-usable the development of multi-usable courseware will follow automatically.

1. INTRODUCTION

The use of learning materials in different teaching settings is a natural part of most teachers' working method. When teachers are faced with a new teaching task, they almost automatically start thinking about the learning materials which they already have and could be re-used. These learning materials are often the product of a long process of thinking and experience and worthwhile to be considered for use in another setting. The use of learning materials in different teaching settings is also efficient within the context of the often demanding teacher's job.

The International Institute for Geo-information Science and Earth Observation (ITC) in the Netherlands has gained some experience with developing learning materials for use in different teaching settings through their e-learning project. The term "multi-usable courseware" is used at ITC to refer to (digital) learning materials that are suitable for use in different teaching modalities such as face-to-face education, distance education and joint courses. Figure 1 shows the concept of multi-usable courseware.
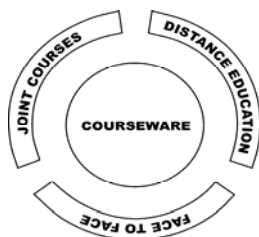

Figure 1. The concept of multi-usable courseware

In literature, the re-use of courseware or learning materials is discussed in the context of the re-use of "learning objects". Learning objects are defined as "any digital, reproducible and addressable resource used to perform learning activities or learning support activities, made available for others to use" (Koper, 2003). This definition excludes non-digital resources. In our study these are included in the definition because the textbook remains an important source of information in our educational practice. Many publications on learning objects focus on the technical aspects of learning objects: ontology, standards and engines (Koper, 2006). This paper however focuses on the pedagogical aspects of learning objects.

Laurillard and McAndrew (2003) address learning objects from a pedagogical point of view. They plead for the development of generic learning activities. These generic learning activities can be applied in different teaching settings and content areas. Their design should be based on a sound generic pedagogical framework, such as the Conversational Framework as developed by Laurillard (2002). The design of generic learning activities is a bottom-up process. Based on the generic pedagogical framework, an initial learning activity is developed, tested, refined and proven. The generic learning activity can be created by taking out the specific content and adding guidelines for use. Multi-usable courseware can be seen as generic learning materials, supporting generic learning activities.

ITC has used a bottom-up process to develop multi-usable courseware by monitoring several cases of re-use of courseware in different teaching settings and deducting generic principles for multi-usable courseware from these cases. These generic

principles will lead future courseware development at ITC and could be useful for other institutes facing the same challenge.

2. METHOD

A large number of data are brought together in this paper. Two types of data are distinguished: data on multi-usable courseware in general and data on specific cases in which distance education courseware is used in face-to-face education.

2.1 The ITC E-learning Project

ITC started developing and implementing e-learning ten years ago. A project was set up to manage this. The e-learning project has changed its focus over time based on experiences. In the beginning it is thought that multi-usable courseware can be developed for both face-to-face teaching situations and distance education. Money has been allocated to both distance education developers and face-to-face education curriculum development groups to develop multi-usable courseware. While the development of distance education increases in time, the attention for e-learning and multi-usable courseware in curriculum working groups at ITC is non-existent. This has led to a heavy emphasis on distance education development and the use of the distance education courseware in face-to-face education in the e-learning project.

2.2 Multi-usable Courseware in General

For gathering information on multi-usable courseware in general, two methods are used: a survey and interviews.

Survey on Multi-usable Courseware: In April 2008, a survey about multi-usable courseware is addressed to 32 ITC staff members of whom it is known that they have been or are involved in distance education at ITC. 17 staff members respond to the survey. The survey consists of 25 questions, spread over 4 sections:

Background information:
- Involvement in teaching and developing distance education.
- Teaching the same topic in face-to-face and distance education manner.

The use of face-to-face educational materials in distance education:
- The extent and manner of using face-to-face materials in distance education.
- Required changes of the face-to-face materials.
- Experiences with using the materials in distance education and plans for future use.

The use of distance education materials in face-to-face education:
- The extent and manner of using distance education materials in face-to-face education.
- Required changes of the distance education materials.
- Experiences with using the materials in face-to-face education and plans for future use.

Multi-usable courseware in general:
- The possibilities of designing education material which can be used in different teaching settings, such as face-to-face, distance education and joint courses.

- The importance of designing educational materials in such a way that they can be used in different teaching settings.
- The aspects of educational or working practice of a teacher that influence whether education materials will be used in different teaching settings.

Interviews on Multi-usable Courseware: Four ITC staff members are interviewed in May 2008 on the idea of multi-usable courseware after the survey. These staff members volunteer for the interview in the last question of the survey. In the interviews, the following topics are addressed:
- Experience with and plans for designing and using courseware in different teaching settings.
- The value of the concept of multi-usable courseware
- Types of multi-usable courseware
- The e-learning project

2.3 Cases

Five cases of using distance education courseware in face-to-face education are described in this paper. Each case is built on different data sources, which are shown in Table 2.

Case	Method	Date	Respondents
Geographical Information Systems	Survey	November 2006	43 students
	Group interview	November 2006	2 student groups: 20 students and 11 students
	Article: Augustijn-Beckers et al. (2008)	June 2008	50 students
Remote Sensing	Interview	October 2006	1 teacher
	Group interview	November 2006	11 students
Spatial decision support systems	Article: Boerboom and Groenendijk, 2007	March 2007	1 teacher
Geostatistics	Survey	August 2008	11 students
	Interview	August 2008	1 teacher
Hyperspectral remote sensing	Survey	August 2008	11 students

Table 2. Overview of data sources for the five cases

These data sources address the following topics:
- The way that distance education materials are implemented in face-to-face education.
- Student and/or teacher experiences of using distance materials in face-to-face education.
- Student and/or teacher experiences with a pedagogy in which students study more independently.

3. MULTI-USABLE COURSEWARE IN GENERAL

This section describes the results of the survey among and interviews with ITC staff about multi-usable courseware.

3.1 The Concept of Multi-usable Courseware

All respondents to the survey think that it is possible and important to develop courseware in such a way that it can be used in different teaching settings. Motivations for this are: efficiency of development, higher quality of materials and the enrichment of learning with e-learning. Availability and allocation of time is necessary to make a choice for using educational materials in a different teaching setting.

The concept of 'multi-usable courseware" is directly related to the teaching setting and pedagogy. According to the interviewees, distance education courses and multi-usable courseware can only be developed for well-structured topics at a lower level of knowledge and skills which can be studied without much interaction with and feedback of others. It is recommended to develop standard formats and tools for courseware types which are considered multi-usable in nature to reach uniformity.

3.2 Use of Face-to-Face Courseware in Distance Education

Distance education courses at ITC often contain courseware from face-to-face education. This courseware consists mainly of PowerPoint presentations, assignments and exercises, articles and books or readers. The courseware from face-to-face education is used in distance education with rather or very little change. The most common changes made in the courseware for use in distance education are: adding or improving explanations, making it suitable for use without supervision and changing the order or organisation of the courseware.

Most respondents to the survey are rather positive about the use of face-to-face courseware for use in distance education and plan to do this in future. Most suitable courseware from face-to-face education for distance education is: exercises and practical assignments, books and readers and PowerPoint slides.

According to the interviewees, PowerPoint slides are looked at first when teachers are looking for distance education courseware but they are less suitable for use in distance education than expected. They need to be adapted considerably by cutting them in chunks which can be handled by the learner and by adding animations and explanations.

Assignments are usable in distance education if they have a limited size and can be conducted without the presence of a supervisor. They should start with an introduction and be worked out from simple to complex using a step-by-step approach and giving examples. Feedback on the assignments can be given by the teacher or by peer students.

According to the interviewees it takes considerable time to make face-to-face courseware suitable for use in distance education. Sometimes it can even be a burden to already have face-to-face courseware.

3.3 Use of Distance Education Courseware in Face-to-Face Education

Distance education courseware is used in the regular programmes at ITC, and in short courses inside and outside ITC. Distance education courseware used in face-to-face education are mainly assignments, but also self-tests, and video recordings of fieldwork. This courseware is changed very little for use in face-to-face education. The experience with the use of distance education courseware in face-to-face education is rather to very positive and most respondents plan to do this again in future. Most suitable courseware from distance education for face-to-face education is: assignments and exercises, e-lectures, self-tests and videos.

According to the interviewees, distance education courseware is more explicit and better worked out into smaller learning units than courseware for face-to-face education. You need to think about your learning goals, content and assessment in advance because you cannot change things the last moment as is practice in face-to-face education. This leads to better quality courseware.

Some of the interviewees are involved in some of the experiments with the use of distance education courseware in face-to-face education. Teaching (part of) a face-to-face course in "distance education mode" is something which is not something to be done overnight. Students have to be prepared to work more independently and need time to get used to the idea. It should be introduced in such a way that students see it as an advantage to study this way, in stead of negative behaviour of the teacher. Minimal, you can use the distance education courseware as an extra resource for enrichment. It is questioned whether students with a weak background and motivation will do well in more independent work.

4. CASES FROM FACE-TO-FACE EDUCATION

Five cases have been followed and evaluated by the e-learning project in which ITC distance education courseware is used in face-to-face education. These cases show in what extent distance education courseware can be considered as multi-usable. The cases are described below, focusing on the distance education courseware used in the face-to-face module and the matching pedagogy.

4.1 Geographical Information Systems (GIS)

The face-to-face GIS course uses GIS distance education courseware consisting of e-lectures (enriched Powerpoint presentations, accompanied with spoken or written texts), introduction videos, video-lectures (recorded lectures), self-tests, practical assignments and a study guide. The distance education courseware is used to let the face-to-face students study independently. The students are supposed to do a large amount of self-study, using the text book, video lectures and e-lectures. This self-study is accompanied by face-to-face "question and answer sessions". The question and answer sessions consist of a summary of the main thoughts in the learning materials by the lecturer and the possibility to pose questions to the lecturer. These questions can be posted in advance in the digital learning environment.

The face-to-face students experience the GIS distance education courseware as a nice addition to the text book; they are not seen as a replacement of face-to-face lectures. The students feel that they are able to study the distance education courseware by themselves, but they disagree on whether they like to study like this. The students have adapted to the pedagogy of independent study but most of them prefer traditional lectures where the topics are explained in detail.

Augustijn-Beckers et al. (2008) report on a study at ITC, comparing the needs and use of distance and face-to-face learners regarding GIS distance education courseware. The *text book* is used above average by both distance and face-to-face learners. The text book is considered more important for the learning process by face-to-face learners than by distance learners. *Video-lectures and e-lectures* are used more frequently by distance learners than by face-to-face learners. They are also considered to be of more value for the learning process by distance learners. E-lectures (Powerpoint presentations) are considered more valuable for learning than video lectures (recordings of a teacher during a lecture). The *self-tests* are used frequently by both distance and face-to-face learners and are of high value for the learning process of both types of learners for assessing individual progress. The *practical assignments* are equally used by both distance and face-to-face learners. However, the face-to-face learners value these exercises higher for the learning process than distance learners. The *study guide* is used more often by distance learners than by face-to-face learners, but they value the contribution to the learning process equally.

4.2 Remote Sensing (RS)

The face-to-face RS course uses a series of practical assignments from the RS distance education course. These assignments are developed in such a way that the student can work on them without the teacher being physically present. The assignments come originally from the educational programme at ITC but have been adapted for distance education purposes. The assignments therefore have a long history of use. In the face-to-face RS course the practical assignments are used to let students work independently during practical sessions.

The students are able to do the exercises well and use the answer sheets for standard feedback about the correct answer or to find out where they have made a mistake. Some students prefer to have a coach for the practical sessions who is permanent available for advice and tips in stead of answer sheets. The answer sheets can not replace the teacher totally. Therefore students would like to also have plenary meetings for tailor-made feedback by the teacher.

4.3 Spatial Decision Support Systems (SDSS)

The materials of the SDSS face-to-face course have been used as a basis for the distance education courseware, consisting of an introduction video, e-lectures (PowerPoint slide presentations with voice-over), and a software video demonstration. The e-lectures are developed from face-to-face lectures which are recorded, transcribed, edited and recorded again and linked to the related slides. This is a labour-intensive process which according to staff involved leads to a higher quality of their education materials.

The e-lectures are used in the face-to-face SDSS course. They give students the opportunity to study more independently and to revisit lectures or to catch-up in case of personal circumstances such as illness. The use of these materials by face-to-face students has led to more thoughtful questions and discussions according to the teacher.

4.4 Geostatistics

The face-to-face Geostatistics course uses text-based e-lectures from the Geostatistics distance education course. These text-based e-lectures include theory and exercises, and are used as a basis for the theory in the face-to-face course.

The pedagogy in the face-to-face course is directly linked to these text-based e-lectures. The face-to-face Geostatistics course is organized in such a way that students can study most of the time independently. Each of the first eight days of the course is spent on one topic. The days start with a lecture, followed by individual student work and are closed with a question and answer session. When all students have submitted the results of the exercise, the standard outcome is submitted to the digital learning environment for students to compare with their own outcome. The last seven days the students work on an individual case individually or in groups.

The lecturer has the strong impression that many students hardly study the e-lectures. He bases that impression on the type of questions he receives in the question and answer sessions. Students might think or hope that the lecture covers the essence of the topic and start to work on the exercise directly after the lecture (as is done in most modules where there is no time for self-study in between the lecture and the practical). The students comment positively on the quality of the e-lectures in the evaluation.

The students are positive about the independent learning method: the lectures explain the theory well, the number of lectures is according to standard, and the attention by staff is sufficient.

4.5 Hyperspectral Remote Sensing (HSRS)

In the face-to-face HSRS course the complete distance education course HSRS is used. The pedagogy from the distance education course is slightly changed to accommodate for the face-to-face situation, but the course is used more or less unchanged. The face-to-face course is organised in such a way that the student spends a lot of time studying independently with the courseware from the distance education course. The staff organizes three face-to-face meetings per week in which an overview of theory is given and group discussions are held. They adapt this from the distance education mode of teaching because students expect to see their teacher when they are studying here at ITC.

The students evaluate the pedagogy of independent study well: the theory is sufficiently explained in the lectures, there is enough help from staff and the amount of self-study time is okay.

5. CONCLUSIONS AND DISCUSSION

The concept of multi-usable courseware is a powerful concept which is important to pursue for reasons of efficiency, quality and

flexibility. The experiences in the cases and in the overall picture show that ITC has developed a vast amount of knowledge concerning the development and use of multi-usable courseware. This section brings this knowledge together in order to draw conclusions and define further actions.

5.1 Re-defining Multi-usable Courseware

The e-learning project defines multi-usable courseware as: "courseware which is suitable for use in different teaching modalities, such as face-to-face education, distance education and joint courses". The experiences with using distance education courseware in face-to-face education show that distance education courseware approaches the concept of multi-usable courseware to a certain extent. This courseware is developed for independent study by distance education students and is therefore useful for all students wanting to study a certain topic independently; irrespective of whether these students study in a distance, face-to-face or joint course. However, not all courses use the independent learning or self-directed learning approach. In these cases, the distance education courseware might be of less value.

The initial definition of multi-usable courseware by the e-learning project does not mention pedagogy, but teaching modalities. Pedagogy can either be the binding or the differentiating factor between these teaching modalities. Differences and similarities in pedagogy between teaching modalities influence to what extent courseware developed for one teaching modality is usable in another teaching modality. A multi-usable pedagogy should therefore be added to the initial definition of multi-usable courseware:

Multi-usable courseware is educational materials which can be used in multiple teaching modalities. They are supported by a pedagogy which is applicable in these teaching modalities as well. Multi-usable courseware = courseware + pedagogy.

5.2 Towards a Multi-usable Pedagogy

The pedagogy of face-to-face teaching and distance education can differ substantially. In distance education students have to work more independent and have to motivate themselves to study because there is no teacher available at their location of study. Face-to-face teaching at ITC often follows a traditional pattern with lectures and practical sessions. In the case of GIS, Geostatistics and Hyperspectral Remote Sensing this traditional setup is left and a more distance-like teaching approach is chosen with fewer lectures, more self-study and on-demand question and answer sessions. The cases show that the use of the courseware in these situations is different. Courseware that is used in a traditional face-to-face teaching setup functions as extra study material, not as a replacement. In this setting, the courseware is valued less positively by the students because they rely more on the available face-to-face activities and the book. In distance education and a more independent approach of face-to-face teaching students rely more on the courseware and value it more positively. The added value of multi-usable courseware is only reached if the pedagogy is changed accordingly.

Independent learning emerges from the cases described in Chapter 4 as being the answer to the question about pedagogy from Paragraph 5.1. However, these results are coloured by the

pedagogy which was chosen for the distance education courses. Most distance education courses at ITC are set up as a kind of individual study package. The learner studies these materials independently; there is little attention for cooperation and peer learning. There are other pedagogies available (Laurillard, 2002; AUTC, 2002) which can be used in both distance education and face-to-face education.

The implementation of the independent learning pedagogy in education at ITC in the cases described in Section 4, give insight to what extent this pedagogy is multi-usable:
Students have certain expectations regarding pedagogy used in face-to-face education at ITC. The GIS and RS case both come from the first phase of the MSc curriculum. In this phase, students expect a traditional teaching setup and have little experience with studying independently. The pedagogy used does not match with this expectation and this leads to problems at the beginning of the module. In the Geostatistics and HSRS cases, which are much later in the curriculum, students are satisfied with the more independent way of studying.
There is heterogeneousness among ITC students in their experience with and ability to study independently. The GIS case shows that students have to be introduced to this way of studying and teaching by telling and showing what is expected of them. It would help if more modules would be taught this way so students can build up experience with this style of teaching and learning throughout the curriculum in stead of switching all the time.

The courseware which has been developed for the distance education courses differs in level of concreteness from the materials that are used in face-to-face education. The lack of teacher presence is often addressed by offering step-by-step exercises and guides which can be followed easily without mistakes. This conflicts with the academic nature of the MSc programme in which students are trained to work and think on their own in stead of following a step-by-step guide. It is therefore questionable whether step-by-step organized courseware is well multi-usable in later stages of the MSc programme and a student-centred curriculum. Other means of dealing with the lack of teacher presence should be sought.

5.3 Development of Multi-usable Courseware

Through the e-learning project a substantial amount of time and money is allocated for the development of distance education courses and their courseware. Although all distance education courses are based on existing in-house modules, it is not possible to use these materials for the development of courseware without serious rethinking and rewriting. The allocation of extra time and money motivates staff members to renew their educational practice and to enhance the quality of their educational materials and teaching.

The development of distance education courses is not always conducted with the concept of "multi-usable courseware" in mind but staff members involved in the distance education courses soon see new possibilities for using the well-developed distance education courseware. The approach for developing multi-usable courseware in the e-learning project has therefore become an elaborate one. First, an existing face-to-face course is totally reworked into a distance education course. Second, the distance education course is taught online and improved. Third, the

distance education courseware is used in face-to-face education at ITC or other educational situations. In this last stage, the multi-usability of the courseware is actually tested in practice. Although the process is elaborate, at this moment it seems to be necessary to come to multi-usable courseware because both the courseware and pedagogy coming from face-to-face education have to undergo a huge transformation before they can be used in other teaching settings such as distance education. More efficient development methods have to be sought.

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