

Design, development and delivery of distance study materials: An industrial approach to distance education

Dr. Paul A. Kirschner

Educational Technology Expertise Centre

Open University of the Netherlands

Valkenburgerweg 167

6419 AT Heerlen

The Netherlands

email: PAUL.KIRSCHNER@OUH.NL

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Abstract

Traditional education as we know it is usually the result of a craftsman-like approach to its design, development and delivery. In this approach the teacher fulfils all of the tasks necessary for the student's study from its inception through its delivery. The teacher here is a jack-of-all-trades and carries the full responsibility for the entire process.

The effective and efficient design, development and delivery of distance study materials requires a more industrial approach in which the process is broken down into a series of well defined and planned stages in which the teacher/content area expert is just one of the many participants in the total process. In this model the teacher/expert is a member of a team and is assisted in his or her role by experts in the fields of instructional design, media technology, media design and production, course content, evaluation, tutoring, project planning, etcetera.

This paper presents a framework for the design, development and delivery of distance study materials according to this industrial approach. It will describe and define the operational issues in the process of course development, its approach to design and media selection, the steps in a course development project, and the roles and functions of the participants.

Craftsman-like approach

The craftsman is an artisan and, as such, makes 'one-of-a-kind' articles tailored to specific people or small groups. The silversmith, for example, while staring out the window of her atelier conceives of a new piece of jewellery. She sees in her mind's eye what it will become and sets about to create it. Some jewellers may make a sketch of such a piece of jewellery, but others will define, refine and develop the idea solely in their minds and then set about to make it. First they will determine for whom they are planning to make the object or to whom they will be able to sell it. Will it be for a special person that the jeweller knows, will it only be affordable by the rich or can it be bought by a member of the middle class? Is it to be worn every day or is it only for special occasions? Answers to these questions begin to shape the actual design and development of the object by determining a number of its functional requirements. Next she will seek the proper raw materials. Based upon the already determined functional requirements, the jeweller will decide the materials to be used (copper, gold, silver, platinum, . . .), extra/added materials such as precious or semi-precious stones or other metals and extra features such as safety latches, engraving, etcetera. The jeweller will then set about to make the object (melt the metals, form them, add the other materials, etc.) and finally to sell it. In this process, flaws in the materials and problems in the process are solved as they arise in ways that are problem specific. Each object is, in itself, unique and is highly dependent upon all of the external factors just discussed as well as on a number of other, more subjective or emotional factors within the artisan herself. This way of working does not present a problem as long as the production is limited.

Good teachers, too, are craftsmen or artisans. Their 'objects' are pieces of education that they conceive, define, design, develop, produce and deliver. They begin as conceptions of what the content of a course or programme, in their opinion, should be. The decisions that they make in this respect are dependent upon a number of external factors such as the domain or sub-domain of the field to be taught, the size and quality (age, level, type) of the

students and the raw materials available to them (text books, audio-visual materials, computer materials). They compose syllabi, prescribe the learning materials, acquire the extra materials that are needed, plan the lectures and work groups, determine the tasks that the students have to carry out, do the teaching, design the examinations and certify the progress of the students. Most importantly, the teacher can adapt the education during the course of its implementation to specific problems and needs of students that are encountered. Just as the jeweller, the teacher carries out all of the tasks involved in the design, development and implementation of education. Finally, as was the case in the jeweller example, this way of working does not present a problem as long as the production is limited.

Industrial approach

In distance education the situation is different. In the first place distance education is, in today's world, perceived of and used as a method to reach large masses of people at reasonable costs. Society has accepted the idea that education is a fundamental and inalienable right of all people and that the only way for a country or a person to achieve true prosperity is to possess knowledge. In the second place, modern distance education is a complete product. It contains all of the materials and media necessary for study, it is self instructional, it uses standardised examination, and so forth. It is these two factors that make its production (design, development and delivery) more like that of an industrial process for the production of mass produced articles than a craft process for the production of unique objects.

In industry different specialities are combined in a real or virtual team to achieve a final product. Designers, materials specialists, buyers, process technicians, production technologists, logistics experts, marketeers, transporters, etcetera all play key roles in the design and development process and each is responsible for her or his own part in the process. Each of the people involved in the team has specific knowledge which is used for the benefit of the whole process. The designer designs the product and makes a list of functional specifications for it. The materials specialist chooses the right

materials for the product or for its components. The buyer acquires the raw materials or partial products needed for the final product. The logistics expert plans, guides and guards the process. The marketer analyses the market and designs the advertising campaign. And so forth. Products here are not 'created', but are 'engineered'. In a similar way, distance education is 'engineered'.

In distance education there is also a great need to combine the specialties of the different members of a team to achieve the final product - quality distance study materials for guided self-study. The rest of this paper will deal with the different aspects of this process and the specialties of the members who play a part therein.

The process of design, development and production

Before beginning a discussion of the different players in the industrial process of course design and development, a number of key terms need to be defined along with the phases in the design and development process and the products of those phases.

In this paper a number of specific terms are used. These terms, though seemingly clear as to their meaning, have specific meanings when applied to the design and development of distance education. The specific meanings of these terms must be unequivocally understood in order to understand the significance of the rest of the paper.

The first term is *guided self-study*. Guided self-study is that approach to the study process which enables students to study on their own. Materials developed for guided self-study contain both explicit and implicit didactic techniques necessary for initiating, facilitating and maintaining relevant study processes. These techniques may influence the study process by making it more efficient and/or more effective and/or more satisfying. The role of materials in this setting can be summed up as:

- setting of objectives,

- structuring the study process,
- providing information and explanation where relevant or necessary,
- giving examples and/or making things concrete,
- guiding study activities,
- developing study skills,
- enabling self-assessment for the student,
- providing feedback as to the process and products of the study, and
- preparation for formal assessment.

The second term is *course*. A course which has been designed and developed for distance education is a study module with a specific nominal study load which can be used in a system of guided self-study.

The third term is *medium*. In the sense used here, media are literally the different carriers of or means of transmission of information, advice, feedback, and so forth. In this respect we can speak of three basic media for distance education, namely printed materials (textbooks, readers, reference books, . . .), electronic materials (linear such as audio/video and interactive such as CAI, CD-I, CD-ROM, IV¹) and people (such as advisors, tutors and examiners).

The final term is *educational technology*. Educational technology deals with the systematic development and implementation of solutions to educational problems. The educational technologist systematically looks for and applies relevant theoretical and practical knowledge as well as the professional application of tried and true methods and procedures in the solution of educational problems.

Phases and products

Course design and development is characterised by the following features:

¹ CAI = computer assisted instruction which includes the scala from drill and practice through intelligent simulations, games and models; CD-I = compact disk - interactive; CD-ROM = compact disk - read only memory; IV = interactive videodisk

- Courses are designed and developed in multidisciplinary course teams composed of content area specialists, educational technologists, delivery specialists, and so forth.
- Courses are the direct result of explicit course design which follows a number of (industrial) steps.
- Courses are characterised by their explicit structure, their intrinsic dialogue style and their use of self-testing as feedback mechanism
- Courses are based upon the least expensive and most portable medium (in most cases printed materials). Other media are used only when functional **and** necessary.

The approach used to design is not algorithmic, but is rather heuristic in nature. In this heuristic approach there are *no* absolute criteria that can be used or applied when designing distance study materials. The approach is based upon an analysis of the chosen learning objectives, on the educational functionalities required or preferred, on a systematic choice of available media and on the limiting conditions of the situation of either the institute or the student or both.

When applying this approach a number of factors need to be considered, weighed and eventually balanced. These are the:

- map or representation of the area/domain to be studied,
- content and objectives of the course or programme,
- characteristics of the students who will be studying the materials, both cognitive (knowledge, skills, competencies) and attitudinal (intention, needs) in nature,
- educational functions / didactic concepts underlying the facilitation of the achievement of the objectives within the context of the student characteristics,
- characteristics of all media available for the student,
- intended setting or study situation, and
- practical considerations and limitations.

There are six phases involved in the design and development of distance study materials. The phases, along with their products are enumerated in the following table.

<i>phases</i>	<i>products</i>
pre-planning	global course description
planning	course plan and course team
development	course in concept formative evaluation final version of the course items for examination
production	course materials: <ul style="list-style-type: none"> • books • audio/video • COO, IV, CD-I, . . . • tutoring plan
delivery	course: <ul style="list-style-type: none"> • materials • tutoring • examinations • evaluation
revision	revision plan

Table 1 Phases and products in the design and development of distance study materials

The *global course description* which is the product of the pre-planning phase of course design and development is comparable to a rough sketch of an object to be developed and includes the requirements which will be placed on the product to be developed and the process of development. The global course plan should consist of three major parts. The first part can be compared to a market analysis of the area to be studied through the course including the desirability of and motivation for the course, the perceived and/or desired target populations

(characteristics and size), competition for the course from within and without the institution, and so forth. The second part deals with content and didactics. It contains the global objectives, relevant content, didactic approach, possible media, description of delivery aspects, method of examination, and the like. The final part is a management document containing a rough time schedule for design, development and delivery, possible participants in the course team and estimate of costs. The global course plan as a whole can best be characterised as a cross between a work document for the (future) team and a policy document for the institution.

The *course plan*, the product of the planning phase, is a detailed blueprint of the study materials containing detailed information on the exact content at the chapter or lesson level along with the authors, the definite didactic method chosen, the definite media mix (often including functional specifications for the media), the tutorial and examination requirements, a detailed planning of the production process in phases, the financing of the project, and the members of the team, their roles and responsibilities.

In the developmental phase, there are four products, namely the study materials in concept, the formative evaluation (developmental testing) of the study materials, the final version of the study materials and the items necessary for future examination of the course. The *concept course* is a version of the study materials which has been commented upon and revised, but which is not final. It can best be compared to a working prototype of an object which a prospective user can try out and evaluate, but is one or two revisions away from being a final product.

The *formative evaluation / developmental testing* of the study materials has as its goal the adjustment and improvement of study materials prior to their production. The evaluation is carried out by the course team chair, authors, tutors, prospective students and the media technologist under the auspices of the educational technologist. During this evaluation the quality of the materials, the effectivity of the didactic approach used (including all media), the required study time, the formal assessment procedure and the form and layout of the

materials are all evaluated. The results of the evaluation are used as feedback for the course team for the final revision of the study materials prior to production, the *final version* of the materials.

Finally, during the production phase, the items for examination are developed. The first of these items are developed along with, and not after, the materials and as such are also tested in the formative evaluation. In this way, the form and function of (each of the types of) the items alone as well as of the examination as a whole can be tested. Based upon the results, further items can be developed under the tutelage and direction of the test specialist and the course team chair.

In the production phase the materials are *produced*. These can be of many types and forms, but can basically be divided into four categories, namely printed materials (textbooks, workbooks, integrated study books), linear electronic media (audio and video, either broadcast or for personal use), interactive electronic media (CAI, IV, CD-I, CD-ROM, etcetera) and the tutoring plan for the course.

In the delivery phase, the *study materials are delivered* to the student in all of their components. In the first place this means the materials themselves which are delivered to either the student at his or her home or at a study centre. Also, the *tutoring* is delivered to the student. This may consist of face-to-face contacts in a study centre (lecture, study group, one-to-one consultation), telephone contacts (real time or voice mail), mail (email or snail mail) and/or conferencing (audio, video and/or computer either in real time or delayed).

Since the study process takes place in an organised way at an institution, the goal of the student is often the achievement of a certain certification. This is often achieved by some means of formal examination. This can range from the use of a multiple choice test to the production of a (mini)dissertation with or without an oral defence. The choice of the examination depends primarily upon the objectives of the course. The objectives of the course determine the most adequate c.q. effective method of examination.

Finally, the delivery phase is the place where the *summative evaluation* of the study materials and the study process are carried out. The goal of the summative evaluation is, in the first place, the testing of the materials and process with respect to their efficiency and effectivity in achieving their stated goals. In the second place, this form of evaluation helps to attain information relevant to the revision of the materials and process as a whole and/or specific aspects of the study materials (e.g. tutor-plan, media use, content, etc.). The result of the summative evaluation is a *revision plan* for (parts of) the materials and/or their delivery.

Roles of the participants

In this section, the roles of the different participants in the process of study materials design and development will be discussed. Although all of the participants will be handled, the emphasis will be on the role and function of the educational technologist in the process.

Course team chair

The course team chair is a specialist in the content area of the study materials that is to be produced. He or she does not need to be an expert in the specific area that the materials will cover (i.e. quantum chemistry) but must have a better than working knowledge in the general area of the materials (i.e. chemistry). The course team chair is responsible for the basic content design of the study materials based upon predetermined objectives (the didactics is the job of the educational technologist), for recruiting and evaluating the developers who will bear the brunt of the development of the study materials, for the evaluation of the contributions of the developers with respect to specific content and cohesiveness of the materials in their totality and for the processing of the comments and suggestions of the other team members during development and after developmental testing.

Along with these content related functions, the course team chair is responsible for the project as a whole (budget, logistics, deadlines, etcetera).

Material developers (content area experts)

The material developers are responsible for the specific content of the study materials (course). Each developer is an expert in her/his field of endeavour and may be recruited from different segments of society depending upon the specific expertise required for the study materials or parts thereof. A course on environmental policy could, for example, include experts from universities (i.e. environmental scientists, jurists), government ministries or agencies (i.e. policy makers and law makers who are responsible for setting government standards and policy), industry (i.e. those in charge with living up to the standards and policies set forth by the government) and pressure groups (i.e. Greenpeace).

These developers are not simply authors, though most of their work will be centred on the development of printed study materials. There is also a need for content area experts for the design and development of electronic materials such as audio, video, computer assisted instruction, interactive video (CD-I or CD-ROM) and simulations. This too, under the guidance of the educational technologist and/or the media technologist is a part of the role of the course developer.

Finally, the material developers are responsible for the production of items (questions) that will be used for the examination of the completed course. These items, developed on the basis of a test matrix (objectives X content), are gathered in a data base for the automated production of valid and reliable examinations.

Educational technologist

As stated earlier, the educational technologist systematically looks for and applies relevant theoretical and practical knowledge from the fields of psychology, education, instructional technology, mass media, etcetera as well as the professional application of tried and true empirical methods and procedures in the solution of educational problems. To this end, the educational technologist within a course team:

- designs and develops, together with the course team (chair), the proper didactic approach to the study materials including the media mix and tutoring plan;

- develops the functional specifications for the materials to be produced;
- instructs the developers as to what is expected of them and how they can best meet those expectations;
- manages the development of the media;
- reads, critiques and makes suggestions on the developed materials;
- designs, sets up and carries out developmental testing of the materials prior to the final draft of the materials;
- carries out staff development with respect to the design and development of study materials and examinations; and
- gives ad hoc advice.

Within the framework of the phases defined earlier, the role of the educational technologist in the different phases of course design and development are shown in table 2.

<i>phases</i>	<i>role</i>
preplanning	help determine the didactic concept including media-mix
planning	develop didactic design: <ul style="list-style-type: none"> • definite didactic design • determine media-mix • estimate costs (money / personnel) • help determine type of examination
development	help develop the course with an accent on didactic aspects: <ul style="list-style-type: none"> • instruct course team • read and comment on drafts of the printed material • design and supervise the development of electronic material • set-up, carry out and report on developmental testing • advice on lay out questions
production	none
delivery	none
revision	help develop revision plan

Table 2 The role of the educational technologist in the phases of the design and development of distance study materials

Media technologist

The role of media technologist sometimes overlaps with that of educational technologist. The difference between the two is that the educational technologist is primarily a generalist, often with a specialty in one or more specific media. The media technologist, on the other hand, is often a specialist in a special medium and is called upon when the media mix for a specific course warrants her or his specialism. Typical examples of such specialisms are: broadcast

television, computer assisted instruction, simulation/game design and development, CD-I or CD-ROM design and development, etcetera.

The media technologist is responsible for the:

- development of the functional design and functional specifications of the media production to be developed,
- leadership of the development project (including working with the content area experts involved in the process),
- developmental testing of the production, and
- leadership of the production process including the sub-contractors (camera crew, programmers, designers, etcetera) and the dissemination process of the final product.

Logistics

Because the process of design, development and delivery of a distance learning course has been industrialised, it is necessary to make use of a professional to guide the logistic aspects of the process. Contracts need to be drawn up, rights to materials (both one's own and those to be acquired from others) need to be secured, the work planning of the different specialists need to be co-ordinated, budgets need to be administered, production capacity needs to be planned and deadlines need to be met. The logistician is in charge of the day to day planning and administration of these facets of the process.

Editor

In most distance education situations, the primary medium for the materials (even those which are electronic in nature) is text. Those responsible for the development of the materials, though highly trained in their respective areas, are not used to writing for students. This is compounded by the fact that study materials for use at a distance - thus without the 'luxury' of a teacher to clarify the content - need to be especially well written in order to anticipate and prevent problems. An editor, specially trained in the development of distance study materials plays an important role in assuring the pedagogic quality of the materials.

Production leader

After all of the materials have been designed and developed - including the developmental testing - the process of production must begin. Books need to be printed, computer programmes need to be set onto disks, CD's and laser disks need to be pressed, etcetera. The production leader, in co-operation with the logistician, is responsible for this process.

Other roles

The previous, hopefully, gave a quick overview of the most important players in the industrialised process of design, development and production of distance study materials. The list is far from complete. Along with those players already mentioned are people such as programmers for the actual development of computer programmes, illustrators for design and illustration, illustration researchers for finding and acquiring illustrations from other sources, information technology managers for installation and maintenance of hardware and software for the course, desk top publishing personnel for the introduction of the texts in electronic form, and so forth. Each of these people has a special role and function within the industrialised process needed for distance study materials.

Conclusion

Education is a fundamental right of all citizens of all countries of the world. It is clear that traditional face-to-face education cannot accommodate this need. When one makes the decision to switch from this type of education to the use of distance education one must also accept the consequence that the paradigm for design, development and production of face-to-face education (craftsman like) is no longer valid. Distance education requires using different tools and applying different procedures which are more in line with an industrial approach.

This contribution has centred on the industrial process of design, development and implementation of classic, second generation, distance education with emphasis on the role of the educational technologist in that process. If an institution chooses to take the step towards a third generation (contact at a

distance through the use of modern information technologies) or towards the addition of 'openness' to its curriculum and educational practice, then the role of educational technologist needs to be concomitantly expanded.

Biographical Note

Paul Kirschner is a senior educational designer / educational researcher on the staff of the Educational Technology Innovation Centre at the Open University of the Netherlands (OUN). At the OUN since its start in 1983 he has acted as educational designer on more than fifty course teams and has for the past four years also been involved in the research, design and development of learning environments for the acquisition of academic and professional skills and competence.