



University of Twente
Faculty of Educational Science & Technology
Instructional Technology

*Construction of a
WWW-Based Learning
Environment
to Support Acquisition
of Instructional Design
Theories*

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Preface

If WWW will be more than a giant library how can an instruction be designed to make full use of the capabilities of this new medium. Is this technology -that seems so promising- ready for implementation of instruction? Do we need new instructional strategies for the WWW? What are the features of this medium to implement the principles of "good teaching"? Do we need a new theory of instruction specifically developed for the Web-based instruction?

Answers to these and such questions can be found in this thesis. Although choosing instructional strategies and making use of some specific technology is a personal matter and depends largely on the designer. However, it is important to place the use of the World Wide Web in its proper perspective. It is a delivery technology that allows information to be distributed worldwide. Its advantages to other media make it a valuable tool especially for distance education. It can also support the classroom education. So, however powerful the educational tools become the WWW, traditional education will always have the additional feature of a live teacher-trainer. The World Wide Web will greatly improve distance education, but it won't replace traditional education.

Thanks to Sanne Dijkstra, my mentor, for his advice and to Betty Collis for opening doors to new possibilities and encouraging me along the way.

Also, to the members of TeleTOP team, especially to Wim de Boer, for their help during the construction of WWW site. Dutch students of the course and my friends in Masters program for their help with evaluation.

A final thanks goes to my family who supported me over long distance conversations and then come to the Netherlands for close-up support.

Abstract

This thesis describes a project carried out at the Faculty of Educational Science and Technology of University of Twente, the Netherlands: Construction of a Web-based learning environment to support acquisition of instructional design theories. This assignment is integrated in the TeleTOP Project, at the Faculty, which adapts the use of Internet in the regular course program and in the Master's program.

“Instructional Design Theories” is a three-credit course which is based on a textbook with some selected articles. Due to the fact that instructional design has so many relations with other fields of science, this course may be supported by a Web-based learning environment. Such an environment is designed to provide a course organizer, a communication center, discussion forums, self-tests, Web-based library, and a glossary specifically developed for the course.

First try-out is administered to the regular Dutch student of the Faculty of Educational Science and Technology at University of Twente. The evaluation results suggest that students find it useful and supportive for their purposes and use the site regularly.

Expert evaluation is conducted by Master's students, results of which justified these findings. Another expert walkthrough carried by a Professor at the Faculty yielded useful recommendations for further improvements.

Future directions of the Project consist of developing case-based instruction for the course comprising instructional design problem to be solved by the students applying their theoretical knowledge gained during the course.

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1

Introduction

This thesis is about the design and development of a Web-based learning environment to support the acquisition of Instructional Design Theories and Models. This course is taught at the faculty of Educational Technology of University of Twente, both to the Master students of "Educational and Training Systems Design" and to the regular Dutch students. The development phase of the product is realized within the frame of TeleTOP project at the faculty.

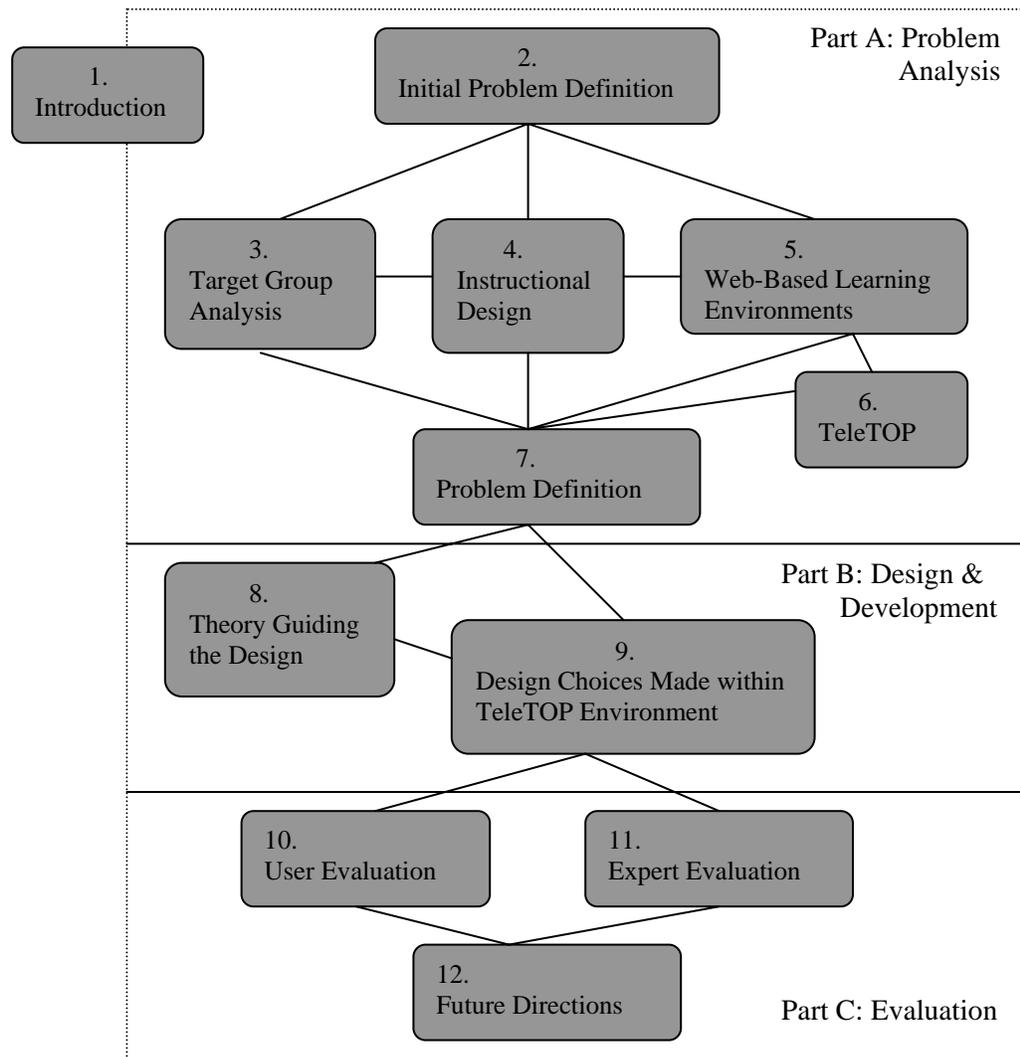


Figure 1. Overview of chapters

The construction of the Web-based environment is realized through three stages (see figure 1). The first stage is problem analysis. In this stage, first an initial description of the problem is defined (chapter 2) then a series of analysis are done. However, these analyses are not realized in a linear but rather in an integrated manner. Initial problem definition states that in order to promote the acquisition of instructional design theories and models a supportive environment is needed. This need points out three questions: what the characteristics of target group are (chapter 3), how teaching instructional design can be supported (chapter 4), and whether WWW is effective to construct such a supportive environment, if so, how the instruction should be designed on the Web (chapter 5, 6). Based on these analyses, problem is defined in chapter 7.

After the problem is defined, based on constructivistic principles first materials are developed in HTML form and the characteristics of Web-based learning environment is identified (chapter 8). Since this product is decided to be developed within the frame of TeleTOP project in University of Twente, the product is developed with the TeleTOP team. Chapter 9 describes the final design choices made for the environment.

The third part is evaluation and discussion. Two kinds of evaluation are held: user evaluation (chapter 10) and expert evaluation (chapter 11). After then suggestions for future directions of the project is explained in the last chapter.

Part A: Problem Analysis

The problem analysis phase will result in the identification of constraints and possibilities that apply to the product. As a first step an initial problem definition (chapter 2) will be made with which it is possible to search for possibilities and constraints more clearly.

As it is explained in the introduction, this thesis is about construction of a learning environment to support the acquisition of instructional design theories. After the target group analysis (chapter 3), the subject, namely, the Instructional Design theories and models will be explained to identify the subject itself (chapter 4). Then, the World Wide Web (chapter 5) will be discussed as the strongest candidate as a medium. After deciding on the WWW as a medium an important consideration is which authoring tools should be used to construct the Web-based learning environment. At the University of Twente, the TeleTOP project offers highly developed tools to support the environment. Therefore, TeleTop project (chapter 6) at the faculty of Educational Technology will be introduced. The problem analysis phase will result in identification of the problem definition (chapter 7) taking all considerations into account.

2

Initial Problem Definition

The faculty of Educational Technology of University of Twente offers the course on " Instructional Design Theories and Models" both to regular Dutch students and the students in the Masters program "Educational and Training Systems Design". Currently, only the textbook with some key articles is used to teach the course. Due to multi-national characteristics of the audience, each student has different background and different needs of learning. While some students want to know more in order to specialize in the area, for some others only the offered course content may be enough. And because of the fact that ID has so many backgrounds and so many relationships with psychology and with different subject matters, studying ID should be supported and promoted by a supported environment.

Therefore, there is a need to construct a supportive course environment to promote the acquisition of ID theories. This environment should be able to act as a supportive course environment to the students 'physically' participating to the course at the university while it also allows the participation of the students at the distance.

3

Target Group Analysis

The target group for the course "Instructional Design Theories" at University of Twente consists of two main audiences:

- Dutch students of regular undergraduate program, and
- Master students of "Educational & Training Systems Design"

In order to learn better about this target group, informal interviews, questionnaires, and CBAM tests are carried. In this chapter, the results of questionnaires and CBAM are described. After then, the implications the analysis will be discussed as a concluding section to this chapter.

Informal interviews are carried with the Masters students who have already taken the course before this project has started. Therefore, while preparing the supportive information per chapter in the textbook, the parts that they have most difficulties are identified by thesis informal interviews and included in the session notes of supportive environment. The results of informal interviews will not be reviewed here but interested reader may look at session notes to see its reflection in the content.

3.1 Regular Dutch Students

Two kinds of data collected from regular Dutch students. First a questionnaire is applied with the aim of determining:

- Which course(s) did the students take to support this course?
- How do they rate their prerequisite knowledge for the course?
- Have they taken a Web-based course before?
- Do they feel comfortable while using WWW?
- Do they have access to Internet at home? If not, can they easily access at the faculty?

The data suggests that they all took the course "instruction theory 1". Some of them also took "motivational design of instruction", and "adult learning". Out of eight students, one of them judge their prerequisite knowledge as 'good', two of them as 'sufficient', four of them as 'poor' and one of them as 'very poor'.

Only one of the students has taken a Web-based course that was designed within TeleTOP environment. All others have a Web-supported course in the first year of TO.

All of the students said they feel comfortable while using WWW except one who said that sometimes she feels lost.

Three of the students said they have computers at home and have access to Internet. All of the students have right to use the computers at the faculty. However, it seems that on weekdays, approximately on three days it is difficult to find a place because there are not enough computers. Three of them also mentioned that it is not always possible to work concentrated.

Another type of data is collected with using a Concerns-Based Adoption Model (CBAM) questionnaire. This questionnaire measures if the students are ready to adopt Web-based instruction. The result suggest that two of them are in a stage of renewal (very interested in the new developments in the field) and experienced user; four of them are in the stage of integration meaning that they are interested in and feel comfortable but are not so experienced; two of them are in the stage of routine; and one of them is in the stage of mechanical use.

3.2 Master Students

Master students are coming from all around the world. So, it is where the cultural diversity comes from. The questionnaire applied

to them has the same questions above. But, in addition, their educational background is asked. The results are summarized below:

They studied: Libraries and educational technology, mathematics education , sociology, tropical agriculture, fine arts, graphics, education, chemistry.

All of them took the course on principles of learning and instructional design but three of them state that that course did not provide much information to support this course. Also, some of them took psychology but long time ago. While evaluating their prerequisite knowledge one of them said good, three of them said sufficient, another three said poor, one of them said very poor.

Only two of them took a Web-based course, but they mentioned that they feel comfortable with WWW because they all had to prepare a Web-site course during one of the Masters courses.

Only two of them have access to Internet at their houses. Their concern for studying concentrated at the faculty was the same as regular Dutch students.

The results of CBAM questionnaire showed that while five of them are at the highest level (renewal) the others are at the next highest level (integration).

3.3 Conclusion

The target group is quite diverse. Especially, the Masters students come from all over the world, have different degrees. Also, it is hard to guess the characteristics of this population for the coming years. For the regular students it is fairly easier since the educational program is building up some background till they take this course. Nevertheless, there are a group of regular Dutch students who graduated from teacher-training schools and joined this program halfway.

In general the students evaluate their prerequisite knowledge poor. The support should first be in terms of prerequisite knowledge but also some practical exercises and examples should be included. Also, the language should be in English due to multi-nationality of the audience.

Another results suggest that in case the supportive environment is designed on WWW, the students in general will not have many problems in utilizing it. However, since not many of them have access at home finding a 'quiet' place may constitute a problem for the students.

4

Instructional Design

Instruction can be defined as a purposeful interaction to increase learners' knowledge and skills in specific, pre-determined ways. In this context, simply putting the information together cannot constitute instruction. Instructional design (ID) should comprise the elements of the instruction that is intended to promote the acquisition of knowledge and skills reaching the learning outcomes defined prior to instruction. ID is a field of application that is supported by a variety of disciplines and related fields with the goal of improving learning by effective development of learning environment.

In this chapter, instructional design, theories and models will be analyzed to reach an overall view of the subject, which the desired learning environment is to support.

4.1 Definitions of Instructional Design (ID)

As a process, instructional design is the systematic development of instructional specifications using learning and instructional theory to ensure the quality of instruction. It is the entire process of analysis of learning needs and goals and the development of a delivery system to meet those needs. It includes development of instructional materials and activities; and tryout and evaluation of all instruction and learner activities.

As a discipline, instructional design is that branch of knowledge concerned with research and theory about instructional strategies and the process for developing and implementing those strategies.

As a science, instructional design is the science of creating detailed specifications for the development, implementation, evaluation, and maintenance of situations that facilitate the learning of both large and small units of subject matter at all levels of complexity.

As reality, instructional design can start at any point in the design process. Often a glimmer of an idea is developed to give the core of an instruction situation. By the time the entire process is done the designer looks back and she or he checks to see that all parts of the "science" have been taken into account. Then the entire process is written up as if it occurred in a systematic fashion.

Overall, instructional design focuses on improving student learning. As a field of study, it provides a theoretical foundation to principles of instructional design, a research base confirming the theoretical foundations, and a direct involvement in the applications of those principles (Tennyson & Schott, 1997).

While some experts in the field use the term *instructional development* synonymously with instructional design, some others make a distinction between them and use instructional development to refer to the broad process that begins with need assessment and ends with implementation. By doing so, instructional design becomes a subset of so-called instructional development. Then, the consideration of instructional development include the major areas of project and organizational management; the process of needs assessment; front-end analysis; audience analysis; and task analysis; the role of instructional developer; models of development; and the environments for development, learning, and instructional management.

On the other hand, major content areas that can be represented as a part of instructional design include theories and models, authoring, basic elements, and environmental considerations. A holistic view of instructional design and development can be found in Appendix 1.

4.2 Instructional Design Theories & Models

Instructional design theory is a set of principles for determining appropriate instructional strategies to enable learners to acquire instructional goals. These principles are means to explain and to predict instructional phenomena. Most of them are borrowed from other fields of study. Therefore, ID theory is always supported by a variety of disciplines and related fields. For instance, Thorndike (1913) applied the behavioral learning principles of the law of effect and exercise to classroom instruction which gave way to Skinner (1958) who applied psychological principles and theories of learning by introducing educational technology to methods of teaching. Later on, Glaser (1962) recommended that to improve the quality of teaching methods, evaluation concepts from action research should be incorporated into ID. It is possible to extend this list by technology in teaching (electronic media), systems inquiry, risk management, program evaluation, systems dynamics and so on. However, psychological theories of learning will always be the dominant of all.

While theories of instruction remain broad and subject to empirical confirmation an instructional design model represents only part of a theory aiming at developing specific aspects of instruction. Therefore, ID models provide practical applications of designing an instructive program. Appendix 1 also provides a holistic view of instructional design theories and models. It is not a comprehensive picture but helps to differentiate between different types.

4.3 Conclusion

Knowledge of ID can be mainly acquired by studying key articles about the theoretical foundations and researches in the field. However, in order to understand those articles or books about instructional design one need to know other areas of science like psychology of learning and so on.

Our target group analysis shows that the students have divergent backgrounds not only in knowledge base but also in cultural base.

Therefore, students may have difficulties in understanding the information simply because they lack necessary prerequisites. Also, the needs of learning is different. While some students might find the knowledge presented in the book enough, some others (e.g., Masters students) might want to learn more about the field. In addition reading may not be an efficient method in the long run. Students may either loose their motivation to learn along the way or be overwhelmed with so much information.

Considering all above conditions, the need for a supportive environment, which will help to promote the acquisition of instructional design theories becomes clearer. Such a support can be achieved by:

- providing prerequisite knowledge;
- giving examples on how theories/models are applied;
- extending the information provided in the book by showing the different angles of the topic discussed.

5

Web-Based Learning Environments

As it can be seen at initial problem definition, a supportive environment for the course on "Instructional Design Theories" wanted to be constructed. The first consideration was to use World Wide Web as a medium due to the fact that it allows flexibility in delivery and the Masters program would like to offer this course to its students in the distance. Therefore, in this chapter WWW, Web-based instruction and its specific features will be analysed to see if it really can be adapted to the needs of the desired learning environment or not.

5.1 World Wide Web

As the Internet is rapidly emerging, the World Wide Web has become an increasingly powerful, global, interactive, and dynamic medium for sharing information. Because of Web's capability of linking a variety of information and communication formats, Web-based instruction is becoming an increasingly prevalent method for delivering instruction. The question arises is whether the World Wide Web have distinctive attributes that allows the design of uniquely superior learning activities. Hackbarth (1997) suggests that the Web appears to be distinctive in the following five respects:

- It provides economical access to people and multiformat information in ways unmatched by any other combinations of multimedia.
- Much content on the Web cannot be found in any other format, except the authors' originals.
- The Web permits the work of individuals, such as teachers and students, to be shared with the world.
- It is a powerful, flexible resource, in some ways (e.g., global hypermedia links) unlike any others, in that students are likely to encounter and rely on in the workplace.
- Students approach on the Web with eager anticipation and awe, knowing that it is at the cutting edge of technology used by their most progressive peers, and by successful adults.

As a medium of learning and instruction, the Web has the potential to support the creation of well-designed resources. Kearsley (1996) makes this more clear by elaborating on the attributes of the Web as follows:

The most significant aspect of the Web for education at all levels is that it dissolves the artificial wall between the classroom and the "real world". ...With the Web... the students can find original materials and collect first-hand information themselves...the second powerful aspect... is that it provides an easy mechanism for students (and teachers) to make their work public...Furthermore, students can examine the work of others..., [which] allows for global comparisons, collaborations and competition... A third aspect ... is that it provides an easy way to create and distribute multimedia materials...Finally ... students ...can include links to the source material in their work... [And they can] include input fields in a Web document [to] collect data or comments from everyone who visits. (pp.28-29)

It is possible to add the list of attributes of World Wide Web while some of these are generic through the WWW's hyperlinked organization also the capabilities of the World Wide Web to handle and display all other types of multimedia applications easily increase its importance. However, only above statements make it clear that the World Wide Web is promising to be a powerful medium to support the acquisition of knowledge in any domain. It is useful to state here that Mueller (1994) has found that use of the WWW as an information system can reduce average study time by better and more efficient

information provision, as well as relieve the instructor of some administrative burdens. Also, in his analysis of the contributions of WWW to teaching and learning Owston (1997) questioned the WWW from the following perspectives: Does the Web increase access to education? Does it promote improved learning? Does it contain the costs of education? He concluded that a promising case exists for the Web in all three areas and the case is rooted largely in how educators are using the Web today. There is no doubt that Web enables new kinds of learning. In the hands of able teachers it can play a prominent role in fostering development of skills like critical learning, problem solving, written communication, and ability to work collaboratively in students (Collis, 1996).

5.2 Web-Based Instruction

Relan and Gillani (1997) define WBI as the application of a repertoire of cognitively oriented instructional strategies implemented within a constructivist (Lebow, 1993; Perkins, 1991) and collaborative learning environment, utilizing the attributes and resources of the World Wide Web. From this definition it is clear that Web-based instruction should involve creating a learning-enriched environment where resources are available and well organized, collaboration and communication is supported, and where Web-based activities are incorporated into an overall learning framework.

In educational literature, the term "Web-based instruction", due to its novelty, is usually interpreted broadly as any form of instructional delivery in which the World Wide Web is included as a medium. Nevertheless, this definition does not say much about how and why WBI can foster learning since simply putting, for instance, the course syllabus and assignments on the Web will make no effect on learning of students other than having flexible access of students' to that information. Designing and delivering instruction on the Web requires thoughtful analysis of how to use the Web's potential in concert with instructional design principles (Ritchie & Hoffman, 1997). The important issue in designing Web-based instruction is to utilize the attributes and resources of the World Wide Web to create a meaningful learning environment where learning is supported and fostered.

5.3 Features Associated with Web-Based Learning Environments

A well-designed WBI program can provide numerous features conducive to learning and instruction. Hill (1998) categorizes these features as pedagogical, technological, organizational, institutional

and ethical issues concluding that the Web has clear potential to create a learning-centered environment. Below list is an attempt to summarize some of the features of Web-based learning environments derived from the articles of Khan (1998) and Hills (1998):

- *Interactive:* WBI students can interact with each other, with instructor, and with online resources. Instructor may act as facilitator. They can provide support, feedback, and guidance via both synchronous and asynchronous communication.
- *Multimedial:* A WBI course can be designed to address all students' learning styles by incorporating a variety of multimedia elements, such as text, graphics, audio, video, animation, etc. Students can browse through libraries, museums, and archives, or consult experts from around the globe.
- *Open System:* WBI is an open system. Learners have freedom to move outside their environment as opposed to a closed system (e.g. book), where they are confined to areas pre-determined by the designer.
- *Online Search:* Students in a WBI course can use a searchable course glossary. They can also use search engines to find relevant online resources related to course content and research projects.
- *Flexible in Time, Distance, and Device:* Students can enroll in a WBI course from any place in the world using any computer platform at any time.
- *Globally Accessible:* Information and resources around the world can be accessed by students. The rapid access to resources can promote higher levels of student motivation and involvement.
- *Electronic Publishing:* Both instructors and students are able to author and publish their work. The posting of student projects, papers, and other student work may be used for modeling, discussion, or review in WBI. Students' ability to publish their work on the Web serves as a powerful motivating force, which leads to improved effort and self-esteem. Another benefit is that students can be supported through interactive peer reviews.

- *Online Resources:* The Web provides instant and unlimited access to online resources. Access to new developments and discoveries is immediately available to learner. This feature provides instructors with access to information sources that are more dynamic, enabling them to incorporate recent examples into course materials.
- *Distributed:* the multimedia resources are easily attainable and provide a variety of materials so that learning becomes more relevant for all users. All materials on the Web can be easily downloaded and printed from the course itself or any other Web resources.
- *Cross-cultural Interaction:* WBI provides a medium that allows students and instructors to communicate online with sources from all around the world. Not only do students benefit from multi-perspective views of subject matter, but they also serve as representatives of their own cultures. The ability to explore and learn about distant cultures and civilizations is facilitated through the Internet. Learners are not limited to individual authors', editors', or instructors' points of view.
- *Multiple Expertise:* WBI courses can take the advantage of sources available on the Web that are provided by experts from various fields. The electronic community can provide a variety of perspectives from outside experts to guest lecturers. Experiences and instruction that come directly from the sources and experts represented on the Web can tremendously benefit students.
- *Learner Controlled:* The Web facilitates a democratic learning environment by permitting the learner to influence what is learned, how it is learned, and the order in which it is learned. The filtered environment of the Web allows students the choice to actively participate in discussion or simply observe in the background. WBI puts students in control so they have a choice of content, time, feedback and a wide range of media for expressing their understandings. This facilitates student responsibility and initiative by promoting ownership of learning.
- *Convenient:* Students can register, do homework, conduct research, and communicate via Internet without having to be physically travel. Instructors can update course materials with relative ease, provide guidance and support, both

synchronously and asynchronously, without being confined to a classroom and office hours.

- *Ease of Use:* A well-designed WBI course with intuitive interfaces can anticipate learners' needs and satisfy the learners' natural curiosity to explore the unknown. This capability can greatly reduce students' frustration levels and facilitate a user-friendly learning environment. The hypermedia environment in a WBI course allows students to explore and discover resources which best suit their individual needs.
- *Online Support:* A WBI course can be designed to provide the learner with online resources that aid in instruction or serve as information facilitators if students encounter unanticipated problems or questions on the course content.
- *Authentic:* WBI courses can be designed to promote authentic learning environments by addressing real world problems and issues relevant to the learner. The most significant aspect of the Web for education at all levels is that it dissolves the artificial wall between the classroom and the 'real world' (Kearsley, 1996). Kearsley (1996) emphasizes that accessibility to world wide information brings realism and authentic learning experiences to teachers and students, regardless of their educational level.
- *Course Security:* Only instructors or designated individuals can modify or alter information on a WBI course with the proper password. This limited accessibility enables both students and instructors to send and receive homework, assignments, reports, and exams confidentially.
- *Collaborative Learning:* Collaborative learning emphasizes cooperative efforts among faculty and students. This learning process stresses active participation and interaction on the part of both instructors and students. WBI creates a medium of collaboration, conversation, discussions, exchange, and communication of ideas. The sharing of knowledge and resources engages students in higher level thinking skills, which promote active and interactive learning from multiple perspectives. WBI facilitates cooperative learning which extends beyond the classroom to potentially every classroom that is connected to the Internet.
- *Formal and Informal Environments:* WBI courses can support both formal and informal environments. Formal environments

are instructor-driven. The instructor provides the course syllabus, times for weekly lectures, assignments, references, and related resources. Informal environments are more student-centered where students submit their assignments, engage in discussion, and post anecdotes on the class listserv.

5.4 Conclusion

Considering all the features of Web-based learning environments it is chosen to be the best alternative to construct a supportive environment for the course on "Instructional Design Theories". So, the students can have access to supportive information posted by the instructor as well as ideas of important people in the area and their work. They can also surf through the real life applications of ID theories. Furthermore, the environment can provide them to share ideas and involve in discussions and extensive communication. They can see other students' projects and comment on it. In addition, the students will be able to 'attend' the class even though they are not physically present.

Also, features of WWW suggest that a Web-based instruction can be best utilized by using instructional strategies for:

- **creative thinking** (brainstorming, role plays, creative writing, simulations, idea spurring questions, semantic webbing)
- **critical thinking** (graphic organizers, voting/ranking methods, pros/cons, summaries/reviews, critiques, case-based reasoning, categorization schemas/taxonomies)
- **collaboration** (asynchronous/synchronous conferencing, discussion groups, project-based learning, all kinds of group activities)

6

TeLeTOP

"TeLeTOP" stands for the "**Tele-Learning Toegepaste Onderwijskunde Project**" and is focused on extending the Faculty of Educational Science and Technology's innovative technological profile through integrating telematics applications in our own courses for more-flexible learning. TeLeTOP is the implementation project that supports the Faculty's C@MPUS+ philosophy: Extending the benefits of good teaching and a good campus-based experience also to students who are not always at the campus.

After deciding developing a web-based course environment to support instructional design theories the question is how to create a sophisticated learning environment that takes the design considerations discussed in the previous chapter into account. The environment should be user friendly, flexible in organization and be able to handle all kinds of communication options while giving support to collaborative work of the students. Considering all these aspects, the TeleTop project is analysed while searching for an alternative to some comprehensive authoring tools.

6.1 The TeleTOP Method at the University of Twente¹

At the Faculty of Educational Science and Technology (Toegepaste Onderwijskunde, T.O.) of the University of Twente a revolutionary process of institutional change is occurring. Under the banner of C@MPUS⁺, a commitment has been made to blend the best of old values of good teaching and an attractive campus life with new didactics and advanced technology to extend the curriculum and instructional practice of the university over distance and time, as well as enrich it. Beginning in September 1998, entire first-year program will be offered in an innovative way: integrating the students resident at the University with two other cohorts. One of these other cohorts will be first-year students remaining in Friesland; the second cohort will be mature students already in the working environment, attending primarily from their homes and workplaces and generally working during the day. At the same time, the Master of Science Program in Education and Training Systems Design is growing rapidly, and many of the senior courses are also being redesigned so that students in the Masters' Program can also participate in them, either locally or at a distance. The key to making this increased flexibility happen is the integrated implementation approach that have been developed and are now being used to re-engineer 39 of the courses for the C@MPUS⁺ initiative. The team responsible for the implementation is called TeleTOP (Tele-Learning at T.O.). Although the university has remarkable technology, in terms of innovative tools, high-quality network access and facilities, and new, state-of-the-art interactive classrooms, the key to the process is institutional change based on instructor engagement and commitment.

6.2 General Goal and Implementation of TeleTOP²

TeleTop project aims supporting the re-design of courses at the University of Twente so that they become more efficient, more enriched, and more flexible via innovative and appropriate applications of telematics, particularly WWW-based tools and environments.

¹ This text presents the summary of the paper " New didactics for university instruction: why and how?" by Prof. Dr. Betty Collis presented at the *BITE Conference* (Bringing Information Technology to Education), Maastricht, 25-27 March 1998. A more elaborate version of this paper can be found at <http://teletop.to.utwente.nl/TO/project/teletop/publications.html>

² A more elaborate version of this text can be found at: <http://teletop.to.utwente.nl/>

TeleTOP has the following strategic goal:

- to stimulate the innovative and appropriate use of telematics for learning purposes within the Faculty T.O., in order to make our educational delivery more efficient, more enriched, and more flexible.

Its implementation is supported by the TeleTop team using a rapid prototyping method based on faculty involvement

Keys to the implementation strategy

- (a) strong support by the faculty administration,
- (b) faculty engagement,
- (c) a deep base of experience,
- (d) a well-grounded conceptual framework,
- (e) a unique rapid prototyping method,
- (f) innovative WWW-based tools,
- (g) high-quality technical infrastructure and generous technical support

6.3 Conclusion

After a through analysis of the www-based environment that the TeleTop team offers it is decided that the supportive course environment will be developed within the TeleTop frame. It is mainly because all of the design considerations mentioned in chapter five of this thesis can be incorporated within the proposed environment allowing the distance delivery version for the master students as well as face-to-face delivery options at the Interactive Classroom for the regular Dutch students. Another advantage of this environment is that it allows the usage of advanced communication tools and it offers a place for collaborative work between the students, known as "Shared Work Space". In addition, the design of the environment is user friendly and well organized.

7

Problem Definition

The analysis phase is completed. The context of the problem is defined; target group is examined, the content is defined, and WWW is analyzed. The results are summarized below which gives the problem definition.

At the University of Twente, faculty of Educational Technology the department of instruction has a need of a supportive environment to help to promote the acquisition of instructional design theories course. Results of the analysis show that:

1. The learning environment has to contain some supportive information that makes easier to understand the textbook, examples, and exercises. Instructional strategies will be chosen to promote collaboration and critical thinking. In addition, a glossary will be prepared.
2. This support will be given as Web-based learning environment
3. The Web site will be developed within TeleTOP environment
4. Due to multi-nationality of the target group, the language will be in English. Also, Master students suggestions will be taken into account while developing session notes

Part B:

Design & Development

As with any new delivery medium such as the World Wide Web, a tendency exists to focus on design strategies based only on the technological capabilities of the medium, rather than the goals of the lesson, the needs of the learner, and the nature of the task involved. Therefore, considerations of these core instructional elements become even more important when designing instruction for this new medium. First of all, an appropriate theory should be chosen which would guide the design. An underlying epistemology for such a theory may vary in a continuum from objectivism to constructivism. However, an objectivist epistemology would not be appropriate for Web-based instruction since it cannot fully utilize the features of WWW. Therefore, constructivistic principles are applied which help to choose appropriate instructional methods and strategies (chapter 8). According to those, the instruction is prepared in HTML language.

However, designing a Web-based instruction does not only consist of designing the instruction. There are some other considerations like user-interface, navigation etc. Nevertheless, TeleTOP team has already developed a frame by using rapid prototyping. After an analysis of the frame, some basic choices are made (chapter 9). During the development process rapid prototyping is continued to be used till the product is ready for implementation.

8

Theory Guiding the Design

Designing any type of instruction involves the overall instructional approach and the theoretical or pedagogical basis for that approach, as well as the potential strategies or methods and corresponding instructional activities.

Hypertext capabilities of WWW can be extremely effective in supporting information access providing that representation of knowledge and structure of user interactions are determined to facilitate learning. Therefore, identifying and applying a particular theory of learning is necessary when designing instruction.

This chapter explains the theoretical frame chosen to design the Web-based learning environment and how it is used in choosing corresponding instructional methods which will fully utilize the attributes of WWW.

8.1 Application of Constructivist Design Principles to the Web

Theory reflects epistemology. Underlying epistemology gives meaning to the instructional methods and strategies chosen for design and implementation of instruction.

The analysis on the features of WWW (section 4) shows that in order to utilize the resources and attributes of the WWW at maximum the cognitively oriented instructional strategies should be decided on and be implemented within a constructivistic and collaborative learning environment where resources are available and well organized.

Therefore, while designing this Web-based learning environment constructivistic principles of Cunningham, Duffy, and Knuth (1993) are used. These principles provide a framework for design, as well as serving as a basis for facilitating teaching and learning. They are listed below, with statements on how the courseware supports these principles for students:

- *Embed learning in realistic and relevant contexts.*

Real life problems may be presented to the students as instructional design problems to be solved. An effective design model for such a hypertext should be based on Cognitive Flexibility Theory and provide options for multiple perspectives, themes, and solutions as well as allowing criss-crossing between cases using the hypertext capabilities of the Web.

- *Embed learning in social experience.*

The courseware should create a collaborative environment in which students can communicate electronically with each other, with instructor, with other students in similar courses (through forums), and with experts in the field.

- *Provide experience with the knowledge construction process.*

While students reflect some of the critical issues in ID as a follow-up assignment, they have to make decisions. In order to make such decisions they need to see the problem in its entirety, with all different perspectives. The courseware should organize internal as well as external links to display whole perspectives about the issue but should not make decisions for them. The students have to construct their own understanding and contribute to the web-site by submitting their ideas. The courseware should also enable them to add external resources to the site to support their ideas. The role of the instructor should be more of a facilitator rather than a didactic.

- *Provide experience in and appreciation for multiple perspectives.*

The Web-site should be designed so that the students can form discussion forums or 'formal chats' to discuss critical issues. These forums may start with each student writing their idea on the topic then it may follow with reading each other's ideas and post a comment on it. They should also be encouraged to attend external forums like IT Forum or another Web-based forum in a similar course in other universities.

In order to operationalize these principles, the features of the Web-based learning environment should be as follows:

- An enriched learning environment to extend the physical boundaries of learning that occurs either in the classroom or in the textbook;
- A learning environment to support and challenge learners' thinking;
- A resource center for the identification, evaluation, and investigation of variety of information;
- A medium of collaboration, conversation, discussions, exchange, and communication of ideas;
- An international platform for the expression and contribution of artistic and cognitive understandings and meanings;
- A medium for solving ID problems as well as reflecting instructive programs based on a theory to see how theories are applied;
- A platform for multiple opportunities for the students to synthesize, organize, and restructure information as well as creating and contributing their own resources.

The next step is to decide on which instructional methods and activities should be used. Selection of these should be consistent with the constructivistic principles and, therefore, the features described above. Also, it should allow the best utilization of the capabilities of WWW mentioned in chapter 4. The full list of methods and activities chosen can be found in table 1 and table 2.

Table 1. General instructional methods used

General Method	Purpose
Dissemination	Information distribution
Facilitation	Student Assistance
Inside Collaboration	Student Communication
Outside Collaboration	External Interaction

Table 2. Specific instructional activities used

Specific Activity	Purpose
Posting Information	Information delivery
Electronic Mail	Course Interaction
Shared Work Space	Group Communication
Link Resources	Links to Web Sites
Contributed Links	Student Generated Links
Shared Work Space	Group Discussion
Posted Presentations	Shared Examples

8.2 Model for WWW-Based Learning Environment

The considerations arouse from the conceptual framework presented in section 8.2 lead to the decisions on how to organize the information on the Web-site. The basic categorization consists of session notes, follow-up assignments, and a WWW-resource-enriched glossary. Figure 3 represents how the classroom practice the information on the WWW and the Web site are integrated for active process of learning to support the acquisition of ID.

8.3.1 Session Notes

Each session note comprises chapters that the instructor selects to discuss from the book. Each chapter contains objectives to inform the students what they are expected to learn from the chapter, overview of the chapter, and further information about the chapter. This further information contains (see Appendix 1):

- information about the developments on the issues discussed in the chapter;
- updating information (if necessary)
- views of other theorists in the field about the issue;
- supportive information identified as prerequisites;
- external links for further exploration
- external links to examples/real life applications

8.3.2 Discussion Forums

In the field of ID there are continuous discussion about some of the assumptions. They are well explained in the textbook. The capabilities of the medium enable the instructors to encourage the students to discuss about these issues. Therefore, parallel to the chapters some key topics are chosen as follows:

- Will media influence learning and teaching? What should be the role of the media in ID?
- Objectivism vs. Constructivism
- Is Instructional Transaction Theory really useful?

Each discussion questions are supported by external links to the original their original forum. By the help of these forums, the students can see the multiple perspectives of the issues discussed and construct their own. After then, they post their comments on the courses Web-site and also reflect to the other students' comments.

8.3.3 Paper Assignments & Tests

For some of the sessions paper assignments are organized. These assignments are also guided by organized external links. The students are also free to search Internet for more resources and find links to support their ideas. After finishing the assignment, they post their paper on the course Web-site to allow for peer-review. For other sessions, java-enabled tests are prepared to help the students to test their knowledge after reading an article, using Java, a test may be developed which gives immediate feedback and leads the students to find the correct answer if their original is wrong.

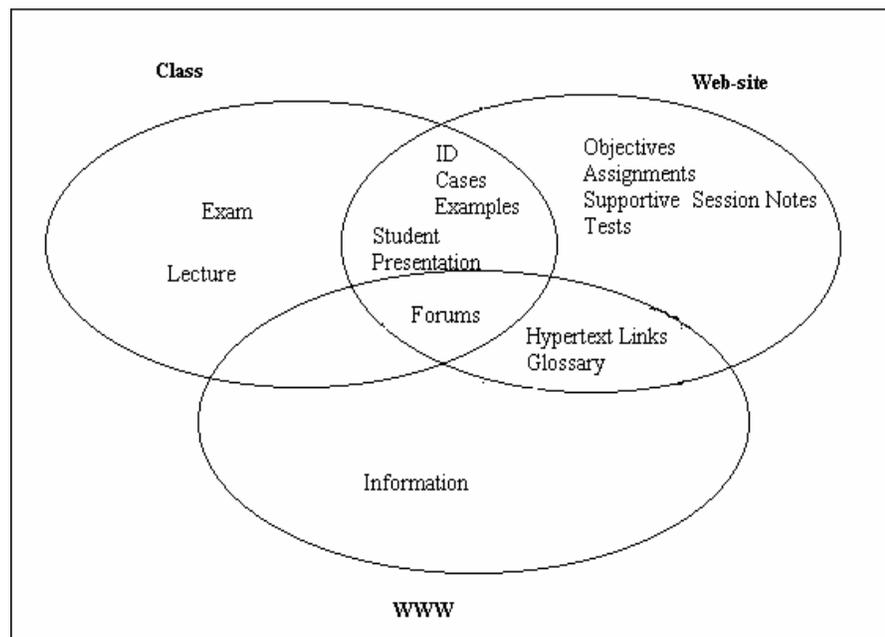


Figure 3. Classroom practice, course Web-site, and WWW

9

Design Choices Made for TeleTOP Environment

After determining the instructional methods and strategies to be used and developing supportive materials accordingly, design choices for the user interface of the Web environment are made. Then, the materials developed are organized in a systematic fashion to allow clear navigation for the user. This chapter explains the design features of the product.

9.1 User Interface

A user interface is the link between a human and a computer. Brockman (1990) defines a user interface as the means by which information is passed back and forth between the user and the software.

Browser window is divided into three windows by using frames which allow the interactivity and friendly user interface. The left frame is used as the menu bar that has five areas: Roster, Communication, General Information, Shared Work Space, Glossary, Resources. The upper frame displays the title of the course and has a 'home' button which will take the users to the first page when they click on it.

When the users first reach the first page they see the news flash which is aimed at informing the students about the current and important events of the course (see figure 1).

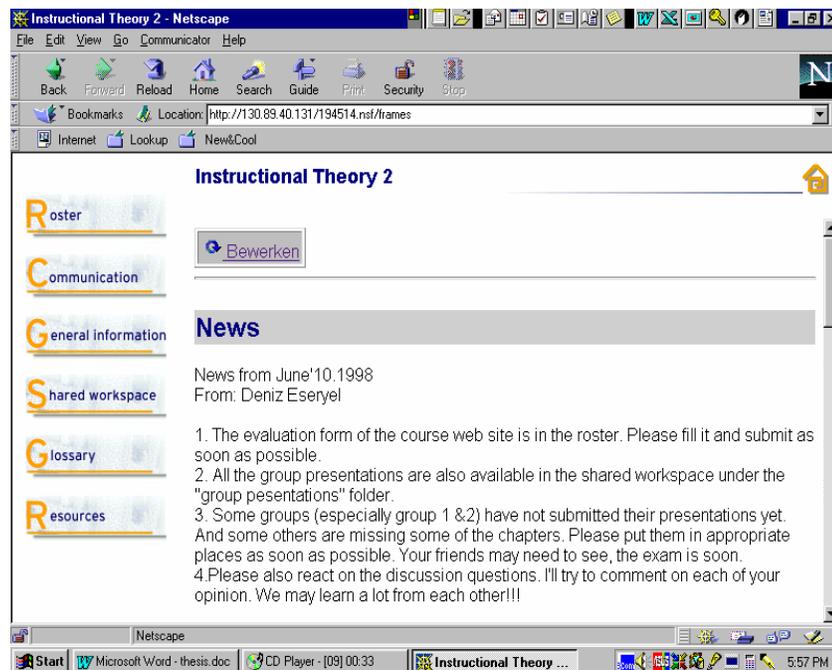


Figure 1. The user interface for the homepage

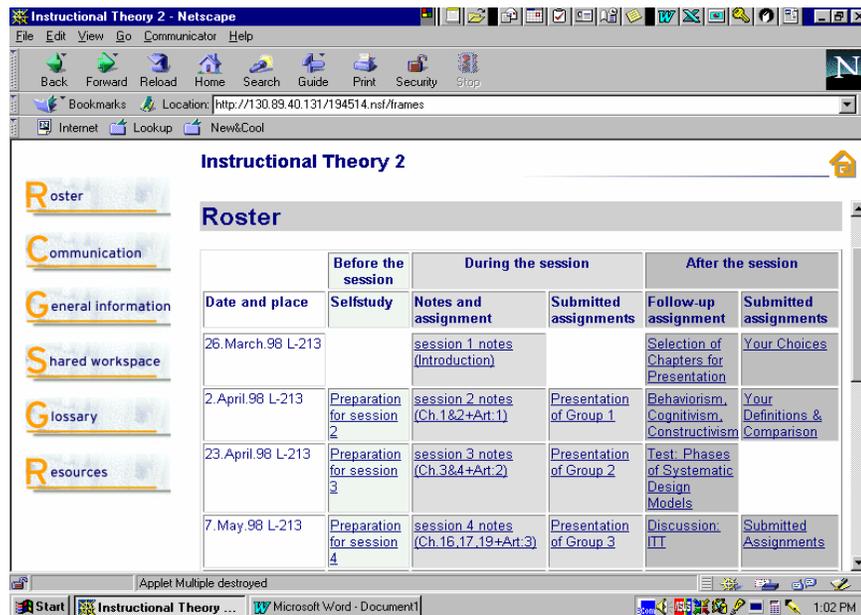
9.2 Roster

Roster works as a course organizer. It consists of a matrix that is divided into four main headings: date and place of the session, self-study before the session, activities during the session, and follow-up assignments after the session (see figure 2).

When students click on self-study for any of the session, they see the information what to study to be prepared for the session. The area for 'during the session' consists of session notes (section 8.2) and information on which activities will take place in the classroom session. Also, students publish their presentation notes here, which reduce the problems of providing and managing paper copies as well as informing students who are not present during the session. 'After the session' area contains follow-up assignments (section 8.2) and students' submitted assignments.

9.3 Communication

Communication area has a list of students' and instructor's e-mail addresses. When the user clicks on a name an e-mail window appears with the selected address. It provides fast and convenient communication.



Instructional Theory 2					
Roster					
	Before the session	During the session		After the session	
Date and place	Selfstudy	Notes and assignment	Submitted assignments	Follow-up assignment	Submitted assignments
26.March.98 L-213		session 1 notes (Introduction)		Selection of Chapters for Presentation	Your Choices
2.April.98 L-213	Preparation for session 2	session 2 notes (Ch.1&2+Art.1)	Presentation of Group 1	Behaviorism, Cognitivism, Constructivism	Your Definitions & Comparison
23.April.98 L-213	Preparation for session 3	session 3 notes (Ch.3&4+Art.2)	Presentation of Group 2	Test: Phases of Systematic Design Models	
7.May.98 L-213	Preparation for session 4	session 4 notes (Ch.16,17,19+Art.3)	Presentation of Group 3	Discussion: ITT	Submitted Assignments

Figure 2. Roster

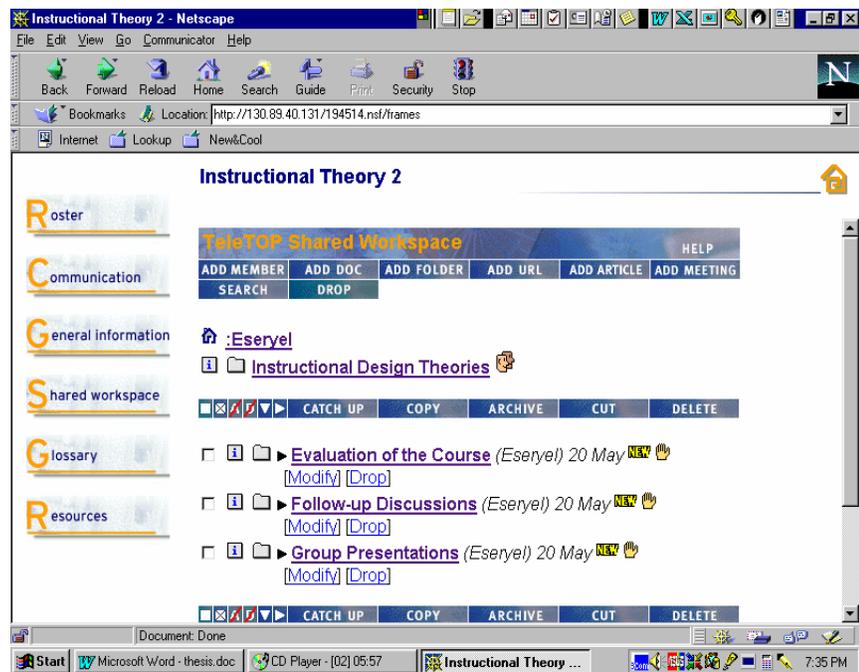


Figure 3. Shared Workspace

9.4 Shared Workspace

This environment provides the students tools to allow collaborative group work. They can also store their products. In the course, this area is also used for the discussion forums between students. (see figure 3).

9.5 Resources

This part of the Web-site contains external links related for the course. These links are generated by students as a result of a given assignment. It also contains links to help students to use the site.

9.6 Glossary

The functionality of the glossary that the TeleTop team offered was not compatible with the design in mind. Therefore, a new Web-site is developed and integrated with the course's Web-site. In the glossary, besides an introduction of how to use the glossary, there are five main parts (figure 4):

Our Glossary: Especially designed to cover the terms that are mentioned in the textbook but students may not know the meaning due to lack of prerequisites. This glossary differs from the classical

meaning of glossary in the sense that each term, besides the definition, has a link to organized WWW resources for the students who would like to have more information about the concept.

Other Glossaries/Libraries: This area has links to other glossaries and libraries specially selected among the good examples of their kinds in instructional design.

WWW Resources: This area contains links to organized WWW Resources for Instructional Design.

Search: This is a search engine for the students to find information.

Your Entries: This area of the glossary allows the students to enter new words to the glossary or send a message to the instructor for the terms they could not find in the glossary. The instructor, then, can enter the definition of the term.

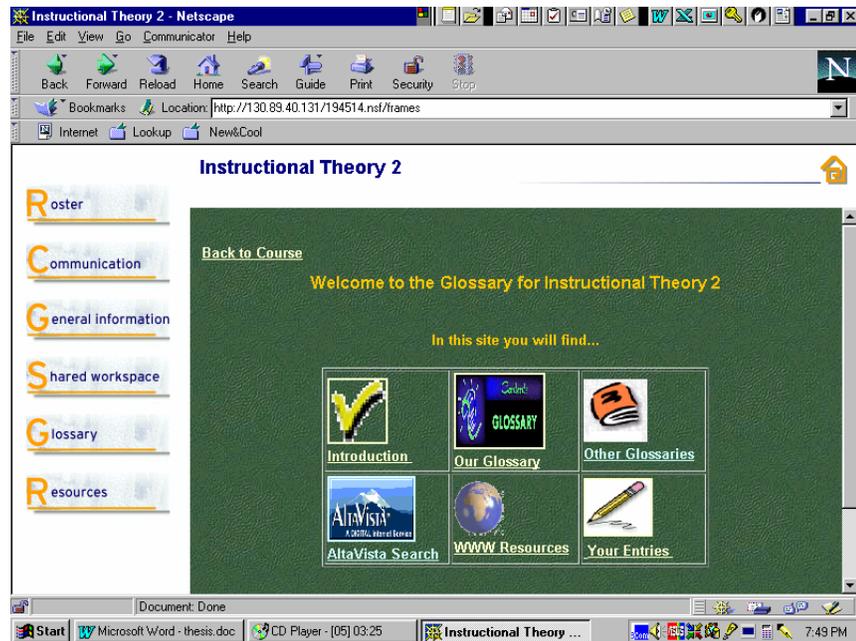


Figure 4. Glossary

Part C: Evaluation

After the design and development of the Web-based courseware it was necessary to know whether it really gives the support to the students during the study process as it is intended.

This supportive Web-based learning environment for "Instructional Design Theories" is implemented in a course taught to regular Dutch students. Therefore the user test is applied to them. Unfortunately, it could not be tested on Masters students because they had already taken the course in January. So, those Masters students evaluated the product considering their needs while taking the course and whether this site provides it.

This part of the thesis also contains the future directions suggested for improvement.

10

User Evaluation

First tryout is executed within the course taught to regular Dutch students. However, it is useful to note that due to some technical considerations regarding the databases of the environment provided by the TeleTop team, the courseware was not ready in April when the course started. Therefore, only at the fifth session the courseware is presented as a supportive environment and the students were not forced to submit the follow-up assignments as a part of their assessment for the course. Therefore, it was not possible to measure whether such activities really enhance learning or not. However, some of the questions in the questionnaire tried to measure their reactions to such exercises comparing with the traditional ways of assessment.

In general the students use the supportive functions of the environment like session notes gives supportive information for each chapter with organized external links, glossary and WWW resources in general. Also, they use the site to publish their group presentations and for communication purposes.

10.1 Evaluation Focus

The aim of the evaluation is to measure whether:

1. The Web-site fulfilled its supportive functions
2. The students find the specific activities designed useful
3. The user interface and the navigation are clear to the users
4. The layout of the site is visually attractive

In addition to above questions, the students are asked to comment on how the site (and the course) should be designed so that it would best serve to their needs. Therefore, the questions are of two types: multiple choice questions and open questions.

10.2 Method

The Web-site is introduced to the regular Dutch students as a supportive environment to the course. Three sessions at the "Interactive Classroom" are organized. After the third session the students are asked to evaluate the Web-site online. The evaluation form is already posted in the course site. Also, during the sessions it was possible to observe their reactions to the site.

The questionnaire (Appendix ...) has 22 multiple questions and 17 open questions. Multiple questions have several categories. The first nine questions are focussing on the content while the rest deals with the design focussing on user-interface design, navigation, layout, and other technical aspects. The answers for all of these questions are formulated in three categories: 'needs much work', 'needs some work', and 'good'.

10.3 Results

There are three kinds of results. First, apart from the evaluation itself, observation of the students during the sessions while working with the courseware. The second and third categories are generated from the evaluation forms, namely, the multiple questions and open ended questions.

10.3.1 Observations

Especially during the first introductory sessions, the students asked some questions. These can be categorized as follows:

1. What the password is for the course
2. Why this site is not introduced at the beginning of the course
3. How to submit an assignment/publish a presentation
4. How to work with the shared work space

10.3.2 Multiple Choice Questions

After a student fill in the online evaluation form, they hit the submit button at the end of the form which posts the results by e-mail. An overview of the multiple-choice questions is given in Table ?.

Questions	Needs much work	Needs some work	Good
Content			
1. How useful is the content in session notes?		3	6
2. Are the links to the external sites well described?		2	7
3. Did you like the way hyperlinks are used to explain concepts in detail?			9
4. Is the content carefully written, using good language and spelling?		1	8
5. Are the objectives clear and achievable?	1	2	6
User Interface			
6. Do you think the lay-out if the screen is logical?		2	7
7. Do you think the lay-out of the screen is attractive in general?		3	6
8. Do you like the ways colors are used?		2	7
9. Do you think text is easy to read?		1	8
Navigation			
10. Is the overall structure of the site is clear to the user?		3	6
11. Are all meanings of the buttons within the site clear and consistent?		1	8
12. Are the external sites well chosen?			9
13. Do the links to the external sites work smoothly?		2	7
Layout			
14. How effective are the color combinations used in the site?		3	6
15. Is the look of the site consistent from page to page?			9
16. Are the images chosen for the site appropriate for the topic and target group?			9
17. Are the headings used effectively to organize the content?		1	8
18. How effective is the balance between space and text?		2	7

19. Is the size of the images appropriate?		2	7
20. Is the way text is formatted and organized effective, so that main points are highlighted?		1	8
21. Summary: How attractive is the site visually?		2	7
Technical			
22. Does everything work smoothly?	1	2	6
Total	2	35	161

Table ? Overview of the answers to multiple-choice questions

Table?, below, presents the summary of the answers per group of questions. 'Needs much work' is interpreted as negative; 'needs some work' is interpreted as normal; 'good' is interpreted as positive.

Evaluation Focus	Negative	Normal	Positive
Content	1	8	36
User Interface		8	28
Navigation		6	30
Layout		11	61
Technical	1	2	6
Total	2	35	161

Table ? Overview of results per group of questions

10.3.3 Open Questions

The answers given to the open questions are summarized below. The answers are organized to include all the comments. And if it is stated more than once and a short comment then the number of response is indicated in the parenthesis.

1. *How often do you visit the site?*
 - Once a week (n=2)
 - Twice a week (n=5)
 - Three times a week
 - Four times a week
2. *Why do you usually visit the site?*
 - To look for new assignments
 - To search for supportive information
 - During the study for exam
 - To see sheets and summaries of other students
 - To look up glossary
 - To visit external links
 - To see who is presenting and what
 - To see the goals and questions of the teacher
 - To publish the sheets (group presentations)
 - To see the overview of the chapter before reading

3. *What did you find especially good about the site?*
 - The glossary (n=4)
 - That every class is subscribed
 - The shared workspace to allow to view assignments of other students (n=5)
 - External links that explain the concepts (n=2)
 - That students can participate on the site
4. *What do you recommend needs most improvements on the site?*
 - Nothing (n=3)
 - I don't know
 - More discussion questions can be added (n=2)
 - Roster can be designed more clearly (n=3)
5. *Have you found the site supportive for studying the course?*
 - Yes, while studying the book and for the exam (n=8)
 - Sometimes
6. *What do you think can be added to the site to make it more supportive?*
 - Nothing (n=7)
 - The roster in another form
 - Students should put their presentation notes before the class
7. *What do you think about the content of the book?*
 - Dry
 - Difficult (n=2)
 - It is written by different people which is not so good
 - Information is compact
 - Interesting
 - More examples should be added
 - Good
 - Content is very limited
8. *What have you gained from the course? Does the site help you in any way for this gain?*
 - A lot of theories and models
 - Important people in the field
 - How to work with different theories
 - Development of instruction
 - The site motivates to search for more information
 - The site helps to organize the information
 - The site helps to understand the book
 - The site helps for studying the exam
 - The site provides supportive information that helps to learn
9. *Which features of the site do you find most useful? Why?*
 - Glossary- often there are words that are hard to place and they are so specialized that they cannot be found in dictionary (n=3)
 - The sheets about the classes (n=2)
 - The external links (n=3)
 - Assignments of other students (n=2)

- That you can get overview of the whole course in different ways
- The possibilities to find extra information by a chapter
10. *Have you found the sessions at the IAC useful?*
 Yes- to learn how to work with the site (n=6)
 Instructive program of Gagné & Briggs was useful to study
 Not really, it helps to get used to working with the site but I can already manage it (n=2)
11. *How do you value the follow-up assignments?*
 Good idea
 Should be a part of the assessment otherwise it takes much time
 Good (n=5)
 Self-test is nice to check one's knowledge
 More discussion questions can be added
12. *How would you prefer this course be designed?*
 It is ok. like this (n=2)
 The classes were not interesting
 Students presenting the chapters are not good because there are some difficult things to understand and other students do not know any extra information (n=4)
 More interactive- presentation from the teacher himself during the class with activities on the internet like sharing information with each other, study questions, and so on
 Closer interaction between the book, the course, the presentation, and the studying of the book
13. *What do you think about the current assessment of the course?*
 Exam would be difficult- no clue about the types of questions (n=4)
 Learning is not optimal, there can be better ways to improve learning and assessing what is learned (n=2)
 It is ok. (n=3)
14. *Give your comments on some relative strengths and weaknesses of the following environments commenting both on what you could do with the environment and also their user interfaces.*
- a) *Roster*
 Ok. (n=6)
 Everything about the course organization is in the roster so it contains a lot of things which may not be clear to some.
 Roster is very structured but it needs explanation of how it is used especially how to submit assignments
 Students should be able to see other students' submitted assignments
 The organization of the roster as before the class, during the class, and assignments after the class is good structured

b) *Shared Workspace*

Good (n=7)

Ok. (n=2)

Strength is that you can work together as a group and not have to work on the same time or be on the same place. You can access the work from your own group members and that of others. This gives you more learning opportunities and examples when doing your assignments. The navigation in the shared workspace is very clear to me but I think it is difficult for people with less computer experience.

Weaknesses in the shared workspace lays in the fact that when you add documents to the shared workspace without a proper structure it becomes very messy Also it becomes very important that all the members give good names to documents they upload. Working in the shared workspace demands special skills from the students in terms of organization and navigation.

c) *Communication Center*

Good (n=8)

Ok. (n=1)

It is very convenient to communicate among the learners and with instructors via E-mail on the "Communication Centre".

A mailing-list option can be added

It would be nice if the users of the communication centre can make a choice:

-click on three or four individual addresses.

-click on individual addresses

-click on a group of addresses.

d) *Glossary*

Good (n=2)

Very good (n=6)

The colors do not fit the rest of the environment

Linking the terms in the glossary to WWW resources is a very innovative idea

The database allowing students' entries is very useful

15. *Please state if you have any other comments about the course in general or about the Web-site.*

Learning from presentation of students is not good because they can tell wrong things, they cannot explain well, when teacher explains it is interesting but there is always too little time because of presentations (n=3)

Site is great, good support (n=3)

Sometimes, the site is carried to another server, then nothing works, this should not be done. (n=2)

10.4 Discussion

In order to be clearer, the results of the evaluation are discussed in subsections that are parallel to the methods of data collection.

10.4.1 Observations

From the questions asked during the first introductory session it is possible to derive the conclusion that it is necessary to make such an introduction. In general, the problems were how to submit an assignment or how to publish a particular presentation in the course's Web-site. Keeping those in mind, in all assignments detailed descriptions are also provided even though the problem seemed to be solved after one demonstration. Also, the password had already been sent to the students along with an invitation to the Web-site but the question, "what the password is for the course" showed that some are not checking their mails regularly. However, this became a habit after the implementation started. Particular problems were due to the use of Shared workspace. Therefore, a link to user manual (both in Dutch and in English) is added to the resources. Still, the user interface of the shared workspace may need to be improved. Since this is a concern of TeleTop team, the suggestions for improvement are forwarded to them.

An encouraging observation was to see the students very enthusiastic about the Web-site. Some of them even continued to work with it and search for information after the session ended. Main concern was why it was not available at the beginning of the course. The students seemed particularly liked the richness of the resources and stated that they are also useful for other theory-based courses.

10.4.2 Multiple Choice Questions

From the totals of the answers to the multiple choice questions can be concluded that the participants have a positive reflection to the site.

The content got a positive judgement in general. This shows that students can find the supportive information they need in the session notes even though they do not read the total text unless they need. It is also stated that the objectives and overview of the chapter are read before they read the book. Only one student thinks that the objectives are not clear and achievable. Probably, they need to be reconsidered.

The user interface also got a very positive judgement on the whole, especially, the attractiveness and logic of the layout of the screen

and the way colors were used. Also, the text is judged to be easy to read.

Navigation and layout of the screen are also found very clear and easy. External links are judged to be well chosen. All the pages are consistent, the images are appropriate for the target group, and headings are used effectively to organize the content, main points are highlighted, the balance between the space and the text is effective. Also, the site is judged to be attractive visually which helps to motivate the students.

The technical aspects are also judged positively. However, one student respond negative while two students respond normal. This can be explained by the fact that sometimes there is a server breakdown at the faculty which makes it impossible to work with the site.

10.4.3 Open Questions

A lot of information is gathered from the open questions. Structuring these shows that the site fulfills its supportive function and students appreciate this. They use session notes, external links, glossary and other students' presentation notes. In general, all of them liked the follow-up assignments but could not participate in discussion forums due to lack of time. However, some of them states that more discussion forums should be held. Interesting to note that some of the students do not want students presenting the chapter either because they do not trust the information presented or they think students cannot explain well and there is not much time left for instructor's reflection during the class. In fact, this activity is a part of the classroom practice and not related with the course site. However, after the class, live chats can be organized with the instructor that allows sharing instructor's ideas on the chapter discussed (to extend classroom practice). Students' comments on the roster, shared workspace, communication center, and glossary are reflected in detail in question 14, therefore, will not be covered here. Nevertheless, it seems that the structure of the roster should be redesigned.

10.5 Conclusion

In general, the site is judged positive. The students use all the functions of the Web-site and are able to find all kinds of information they need. Navigation is found easy and the user interface is found motivating. However, in order to use the roster, the students need clear introduction and some practice. Only after

that it becomes easy to use. The same case exists for shared workspace. Although the user manuals are included in the site, it seems that majority do not want to use manuals and prefer face-to-face instruction.

Originally, this site was aimed to be supportive. However, it seems that students are not comfortable with the current assessment of the course which is mainly done by each student presenting one of the chapters of the book and then taking an exam at the end. This can be improved by engaging students more with follow-up assignments and grading them with small points on weekly basis. It will help to actively participate the course while they are reading each chapter on time, not all of them at once before the exam. Also, more examples of instructive programs can be added to the site. In addition, some instructional design problems can be included in the site for the students to solve following a theory of instruction. Such exercises can help them to apply their theoretical knowledge lessening the burden of information they read and can be used as an alternative to current assessment if well designed. Originally, that was intended but could not be realized due to time constraints.

Though, it is not known whether such activities like discussion forums or solving instructional design problems will enhance learning or will be a good replacement of an exam.

11

Expert Evaluation

Expert evaluation was conducted to determine whether further improvements needed to be made. As subject-matter experts, former Masters students evaluated the product. This is seen especially useful because they have taken the course in January without such a supportive environment and based only on the book. Therefore, they could tell whether they missed some kind of support during their study and whether this courseware provides it or not.

A second expert is one of the Professors at the University of Twente who is very experienced in designing and teaching with Web-based courseware. She particularly examined the teaching methods and strategies used and comment for further improvements. Also, she commented on the user interface and navigation based on her experience with TeleTop environment. In addition, during the rapid prototyping process of glossary her comments are used for improvement.

11.1 Masters Students

With each Master student a first walkthrough is held. After then they are left alone to further analyze the site in order to do the online evaluation. They are encouraged not to feel restricted by the questions and comment on whatever they feel necessary.

The questions asked to the Master students are more or less similar to the ones asked to regular Dutch students. While some questions are kept as the same, some others needed to be changed due to the fact that they took this course before (without such an environment). Therefore, they act as a subject-matter expert who judge the supportive functions of the site based on what type of support they needed during the course.

11.1.1 Multiple Choice Questions

Multiple choice questions asked to Masters students were similar to the one asked to regular students. In general, the content is found supportive with clear objectives, enough knowledge support, and well described external links. Also, the user interface is judged to be logical and attractive. Text is found easy to read. The choice of colors is good. The navigation was clear. Overall, the site was judged to be positive. Table 5, below, presents the summary of the answers per group of questions.

Evaluation Focus	Negative	Normal	Positive
Content		1	14
User Interface		3	9
Navigation		2	10
Layout		7	19
Technical		1	2
Total		14	54

Table 5 Overview of results per group of questions

11.1.2 Open Questions

From the answers to open questions, it seems that, while studying this course without the support from the site, they needed more detailed description of basic terms used in the textbook and prefer to have written assignments after each part and discuss the results during the lecture. When asked whether they found the support they need in this site, all answers were positive. Among the mentioned, the glossary and external links are judged highly valuable. In general, the site is judged to be motivating, however, some stated that the color combinations can be more attractive. While some says the information in the session notes is enough, some also stated that it can be extended. Those would like to see more content in this part. They judged the content in the book to

vary degrees from not appropriate for Masters students to enough and useful. It is stated that some of the chapters can be excluded while some others need to be extended. At this point the judgement was that external links in the site are well organized to extend the content for further search. Also, follow-up assignments are judged very good and especially the discussion forums are found very useful and motivating. Glossary was one of the most appreciated function of the site. General comments were it helps the students quickly familiarize themselves with the terms used in the textbook by clarifying difficult terms and the entry database is an excellent idea. In general, the site is found to be very useful, motivating, visually attractive, well organized, the composition of the screen is clear and pleasant to work with. Some also stated that they wished they had it during their study of the course.

11.1.3 Discussion

In general, the reflection was very positive about the site. However, it seems that content in the session notes need to be extended although such extension is done by the help of external links. Also, they seem to appreciate big fonts with colorful things in the site. Overall, it seems the site fulfills its supportive function.

11.2 Second Expert Walkthrough

This expert is asked to work with the Web-site and give her comment meanwhile. She has just completed a Web-based course in a similar environment, therefore, she also pointed out the comments of her students and made a comparative walkthrough. Her comments are summarized below:

- Roster: she had stated that in her course the students found the roster hard to use. She related this to the fact that she did not name it very clearly. However, she stated that the roster in this site is very clearly named and is an example of a good use.
- Session notes: She asked whether the session notes contain required reading or not. When she learned that it is only a supplementary reading to clarify the text, she said that is better since students do not like to read long texts from the screen. However, she found the organization of the session notes as objectives, overview of the chapter, and further information with external sites very well thought.
- Communication: The names of the persons underlined should have the link to mailing function not the mail-to figure. Also, alternative mailing options can be added allowing to multi-use.

- General Information: Useful to include for the students. The sections are well written with good language and clear descriptions concerning the course.
- Glossary: Incredible information. Very well organized. Clear navigation. One thing, though, that in the future it might be forbidden to include external search engines within the site. Also, it may be a good idea to add addresses of the external sites the links are made. In addition, the colors used are very sophisticated and site looks very professional but colors should be consistent with the colors of the site in general.
- Follow-up assignments: Very well thought. Discussion questions supported with similar, external forums and sites are excellent. For paper assignments, the support organized by external sites for students to explore and do the assignment is a strong point. Also, the java-enabled test with immediate feedback can be very effective if students check their understanding of the book right after reading. But, there should also be a text version of that test that can work in less-capable computers. In general, all exercises in follow-up assignments will constitute a very good experience for the students, however, you need to grade the assignments with small points (like five point each) to encourage them.

11.3 Conclusion

In general the findings of the regular students' evaluation was similar to that of master students. Different points come from master students are extending session notes and designing with more colorful pictures with bigger fonts.

From the second expert suggestions for improvement are encountered. First, the colors of the glossary will be changed to fit the colors of the site. Second, the communication center will be improved to have more options for mailing to groups. Third, a text-version of the test will be included. Fourth, a new strategy for assessment will be generated. Additionally, the roster is judged very well organized to this expert, but, the students do not find it easy to use. So, a new design having the same functionality may be thought of.

12

Future Direction

Evaluation results, in general, suggest that the courseware is successful in supporting the acquisition of "Instructional design Theories". However, originally, it was intended to include some instructional design cases for students to solve by applying their theoretical knowledge. Unfortunately, due to time limitation this could not be achieved. This chapter will first examine how such cases should be designed by using cognitive flexibility theory.

In addition, in the future, some Masters students may want to take the course in the distance. In such a case, since the courseware is Web-based, the delivery matter will not constitute a problem. But, there are some considerations that should be taken into account. The rest of the chapter will examine how the Web-based courseware should be implemented for more active learning process in distance learning and how should the assessment be.

12.1 Cognitive Flexibility Theory

Cognitive Flexibility Theory deals with "the special requirements for attaining advanced learning goals, given the impediments associated with ill-structured features of knowledge domains" (Spiro, Feltovich, Jacobson, and Coulson, 1991). It is a conceptual model for designing learning environments that is based on cognitive learning theory. Its intention is to facilitate the acquisition of advanced knowledge to serve as the basis for expertise in complex and ill-structured knowledge domains. It uses hypertexts to arrange "instructional sequences, for multiple dimensions of domain representation, for multiple interconnections across knowledge components, and so on. This desire for multiple perspectives and knowledge criss-crossing is well supported in the Internet environment, especially using the hypermedia of the World Wide Web in conjunction with one of the Net's discussion facilities as well as interactive technologies like videodisc, interactive CD-ROM etc.

Following Spiro's discussion of the "criss-crossed landscape", the Hypermedia Design Model uses a geography/cartography design metaphor. It is important to note the difference between design metaphor and instructional or interface metaphor. The design metaphor deals with how the designers organize the learning domain during the creation of the learning environment; while interface metaphor deals with how the learner accesses knowledge within the environment. One of the assumptions behind the model is that the role of the guide will be taken by the instructional medium rather than by a teacher in a classroom situation. Another important aspect of this model is that it differentiates between design goals and learner objectives. Design goals are that knowledge which the designers hope that the learner will construct from the environment. Learner objectives are what the learner actually comes to the environment wanting to learn.

12.2 Considerations for Implementation of CFT on WWW

Since cognitive flexibility theory focuses on learning in complex and ill-structured domains, the field of instructional design seems like a very appropriate content domain for implementing cognitive flexibility theory. In the field of instructional design there are many theories and models which allows to offer any perspectives and themes with which to view instructional cases. Instructional design represents an archetypal example of ill-structured problem solving because most design problems have vaguely defined or unclear goals, unstated constraints, multiple solutions or solution

paths, no consensual agreement on the appropriate solution, and multiple criteria for evaluating solutions (Jonassen, 1998).

Students of instructional design theories can be exposed to some instructional design cases providing different themes and perspectives. These cases linked with hypertexts will allow the criss-crossing. Links should take students to alternate perspectives and conceptions of the case being explored. The aim by presenting varying themes and perspectives is to make the students reflect on their current practices and understanding of instructional design as they attempt to produce their own solutions to the instructional design problems.

12.2 Considerations for Assessment

Constructivism emphasizes that testing should be integrated with the task and should not be a separate activity. This requires that the students should not be tested after the instruction.

Designing such cases as described above will allow the instructor to assess the student throughout the instruction. The students can be asked to select a case and design solution(s) to it. After that they can be asked to reflect on and write a paper on what have changed in their understanding of instructional design.

12.3 Considerations for Distance Learning

The Masters program at the faculty of Educational Technology of the University of Twente is growing very fast. Beginning from 1997, they start to offer the courses to the students on distance. Apparently, in the future, it is very likely that some of the students are going to participate instructional design course in this way. Since, the supportive environment is WWW-based, delivery is not a problem. However, assessing students in the distance may constitute a problem. The suggested way is to evaluate their participation and reflections to follow-up assignments (which comprise discussion forums and paper assignments, see 8.3.2 & 8.3.2) throughout the course. By this way, especially discussion forums will prevent them to feel isolated and provide motivation. Final assessment may be done with exposing them to instructional design cases designed based on cognitive flexibility theory and integrated with the supportive Web-based environment produced as a result of this thesis.

12.4 Conclusion

Research on flexibility theory has found no differences in reproductive memory between learners studying traditional, single-perspective materials and those studying flexibility hypertexts, but that learners studying flexibility theory materials are better able to transfer the principles to novel, unrelated cases (Jacobson, 1990; Spiro et al., 1987). Also, it was not possible, due to the time considerations of this thesis, to validate the contributions (if any) of discussion forums on enhancing student learning. Still, one thing known is that such activities are useful for students where they exchange ideas or apply their theoretical knowledge. Especially, for the students in distance it will provide motivation, active participation as well as scheduling them for learning on time.

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Appendices

In this section, appendices take place as follows:

- Appendix 1: A holistic view of instructional design and development_ ID&D Chart adapted from Connop (1991)
- Appendix 2: Session notes in the WWW-site as supportive information

Appendix 1: ID&D Chart



Appendix 2: Session Notes

Session notes are prepared for the selected articles from the course textbook by Tennyson, Schott, Seel, and Dijkstra (1997). They are divided into seven sessions according to the course syllabus.

