

Principles at the Heart of an Instructional Designer : Subject Matter Expert Interaction

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Abstract

Research on instructional design has not adequately addressed the conceptualization by the instructional designer of unfamiliar content as presented by a subject matter expert. There is widespread acknowledgement in the field of instructional design of its importance but there appears to have been no systematic efforts to develop a comprehensive strategy for the conceptualization and elicitation of subject matter knowledge. This paper addresses this 'gap' in the field of instructional design and outlines a number of key principles to consider in interacting with subject matter experts. Due to the crucial and unique role of the subject matter expert, the instructional designer must streamline the flow of information to prevent a communication 'bottleneck'. Without effective principles for interacting with the subject matter expert, valuable time will be lost understanding and organising the content, hence the need for an efficient and effective method to assist in the instructional designer–subject matter expert interaction (Keppell, 1997, 1999).

Keywords

Subject matter experts, Instructional designers, Multimedia design and development, Project management

What is the Problem?

Imagine attempting to design an educational multimedia module in an area in which you have no content expertise. How would you approach the

unfamiliar content area? What are your choices? One approach is to speak to experts in the area. Subject matter experts, however, are often busy people. How can you optimise your time spent with the subject matter expert? What questions would you ask of the subject matter expert? This paper examines a number of key principles to consider when interacting with a subject matter expert (SME) in order to design and develop a multimedia project. These principles are drawn from the "Content Production Process" (Keppell, 1999) (Figure 1) an approach that draws upon a variety of theories, constructs and methods including advance organisers (Ausubel, 1960), schema theory (Rumelhart & Norman, 1983), script theory (Schank & Abelson, 1977), consultation practices (Davies, 1975), elicitation procedures in instructional design (Wedman, 1987), knowledge acquisition strategies in constructing expert systems (Neale, 1989), ethnographic and teachback interviewing strategies (Spradley, 1979; Pask, 1975) and knowledge mapping (graphic organisers, concept maps and knowledge maps), (Barron, 1980; Novak & Gowin, 1984; Lambiotte, Dansereau, Cross & Reynolds, 1989).

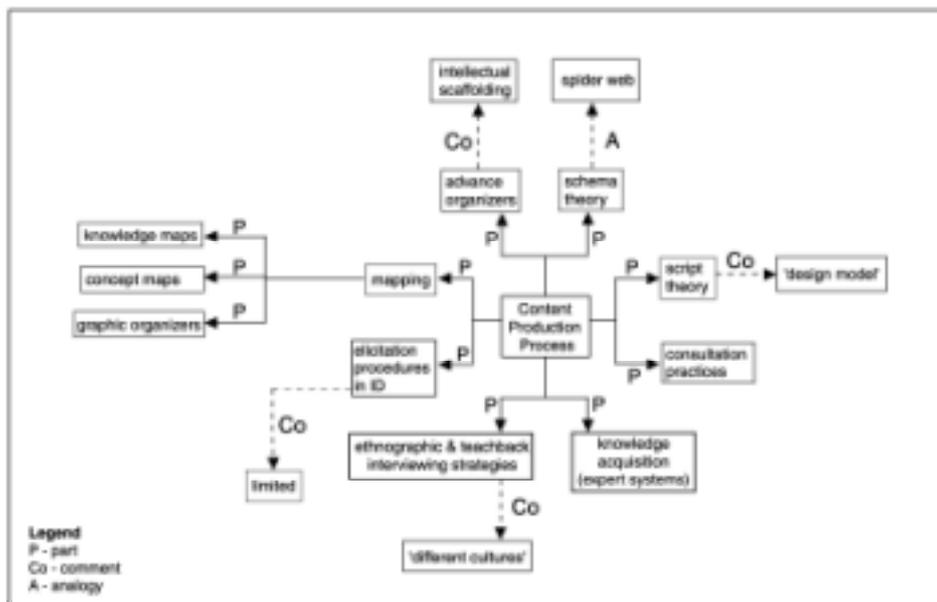


Figure 1: A knowledge map illustrating the theoretical underpinnings of the "Content Production Process"

What is the Context?

The design and development of multimedia modules requires a team with a diverse range of skills and talents to successfully complete all aspects of a module. Unfortunately a bottleneck still exists between the content expert and design and development staff (graphic designers, programmers, audio-visual staff) in terms of translating the content into a form that embodies sound educational design. The design and development of quality multimedia learning materials often require instructional designers/learning designers to assist subject matter experts in creating suitable teaching and learning resources. It is also suggested that the optimal role for the SME in a multimedia project (and probably the most cost-effective approach) is in concentrating on the content and not necessarily in a technical capacity for the project.

What do Instructional Designers do?

Instructional designers tend to be process-oriented individuals as they can apply instructional design principles to a wide range of content areas. One of the designer's main jobs is to select, sequence, synthesize and summarize the content for instructional purposes. Despite having *no content expertise*, the designer has a set of representations based on a '*design model*' which can guide the development of an effective training program (Nelson, Magliano & Sherman, 1988: 32) (*italics added*).

The *design model* is the designer's accumulated knowledge of how instruction should be developed. It is the amalgamation of general experience, educational background and instructional experience. The design model is analogous to a script. Scripts are knowledge packages in memory which allow humans to understand routine activities (e.g. eating in restaurants, visiting the dentist). They are prototypical or stereotypical information useful in everyday occurrences. Schank and Abelson (1977) suggest that we have hundreds of stereotypical situations coded in memory, each having idiosyncratic variations. The designer has a generic script which can be applied with variations to new instructional problems. The advantage of the generalized script is that it is adaptable to new instructional problems. The concept of the script suggests how a designer can approach unfamiliar content. Wallington (1981) suggests that the designer requires the ability to extract and assimilate chunks of information and then work them into a logical framework as defined by the SME. The aim of the designer in the interaction with the SME will be to "formulate a working content structure within which the information and skills to be taught can be formed into a sequence and hierarchy" or other appropriate structure (Wallington, 1981: 30). The interaction of the designer and the SME involves receiving, classifying and storing

information, building and rebuilding structure, requesting new data and recycling until an appropriate instructional module has been developed.

The developer must ... master new content ... The developer must not only take in large complex chunks of information quickly but he or she must create a theoretical framework in which to manipulate the information. The developer must question the subject matter expert to check both the validity of additional incoming information and the framework in which it fits. In this mode . . . if the developer has truly established a strong rapport with the subject matter expert, this expert may offer unlimited quantities of information simply as a sign of good faith. (Wallington, 1981: 30).

The designer and the SME are involved in a process–content relationship. In this model the designer is focused on the process of instruction and the SME is focused on the content.

Where Does this Fit into a Design and Development Model?

The Biomedical Multimedia Unit (BMU) at the University of Melbourne utilise a design and development model as a framework for completing projects (Keppell, 1998). Its main focus has been to develop a common framework (within the Faculty and within the BMU) in order to optimise the design and development of quality educational CD-ROMs and web-based materials. This paper focuses on the first four stages of this model as outlined in Figure 2. (see <http://www.medfac.unimelb.edu.au/ascilite2000sme/>). An obvious starting point for any project is to begin with a needs assessment. In this phase the purpose, organizational factors, trainee factors, available resources, teaching and learning design and the delivery environment provide the context for the work undertaken with the SME. A needs assessment determines the educational design parameters of the project and provides the context for the designer-SME interaction.

Costing and scheduling focus on a realistic appraisal of what can be undertaken with the available funds. It focuses on an analysis of the resources, time and funding. At this point it is essential to examine the scope of the project. Scoping determines the parameters of the module before design or development begins. England and Finney (1999) suggest that each project will define its "own quality priorities" (p.17). They also suggest that "design quality for media projects = content and treatment agreement" (p.17). A useful rule of thumb is to equate design/development hours to user hours. For instance high quality multimedia with high level animations may require 500 design/development hours for every user hour delivered (Phillips, 1997).

The level of interactivity also affects the total number of hours that can be developed. Stages 3 and 4 of the design and development model focus on interviewing and interacting with SMEs and articulating this content in the form of a storyboard for the graphic designers and programmers. This paper focuses on the interactions with the SMEs. Specifically this paper focuses on a number of key principles that I have found effective in working with SMEs. The principles are based on the "Content Production Process" and have been researched and refined after a number of years of experience in working with SMEs in many different content areas including academic and industry settings.

Determine the Philosophical Assumptions of the SME

In my interactions with SMEs one of the most important principles has been to clarify the roles and expectations of the client/SME. Many projects fail due to an inappropriate consideration of what the client/SME expects from the project. "An understanding of client psychological types and an ability to differentially respond to various types is a particularly effective designer strategy for relationship building and managing" (Coscarelli & Stonewater, 1979-80: 16). It is therefore essential to establish a successful working relationship with an SME by determining philosophical assumptions of the SME before beginning the instructional design as "a great deal of what is accomplished depends on the quality of the client-consultant relationship" (Davies, 1975: 351).

A client who views the designer through a product assumption will view the consultant relationship as a customer-seller relationship. This type of client expects that the instructional design consultant will assist the client in purchasing an 'end-product'. Implicit in this relationship is the belief by the client that their role is one of a customer and that a product will be delivered without intervention on their part. A client who views the consultant from a prescriptive focus will require the consultant to prescribe advice to the client as in a doctor-patient relationship. In this relationship there is less emphasis on a product and more emphasis on an ongoing and continuous relationship in which advice is sought and accepted with confidence. However, a more feasible approach in the designer-SME interaction is a collaborative approach.

This approach requires the designer and the SME to assist each other in the elicitation and conceptualization process. It focuses on "a process

directed towards the achievement of some mutually agreed and valued instructional result in accord with the organization's mission" (Davies, 1975: 355). This is a dynamic relationship between the designer and SME which relies on a good working relationship between the designer and SME. To successfully interact with the SME the designer must develop a level of rapport with the client. The communication process between the designer–SME cannot be overemphasized. The designer must also be aware that the characteristics of SME may differ in different institutional settings. Being conscious of these differences will assist the designer in developing a smooth working relationship with the SME.

Adapt the Interview Format to the SME

Interviewing appears to be a useful means of eliciting content from experts. Neale (1989) suggests that interviews are one of the most common means of eliciting knowledge by computer experts in the design of expert systems. Interviews represent a highly efficient means of working with SMEs. There are a variety of interviewing methods for eliciting knowledge from SMEs which may include structured, ethnographic and teachback interviews. The structured interview involves a detailed, in-depth elicitation of all information on a topic. The questions are presented to the expert in a natural way and the interviewer is thorough in clarifying concepts. The structured interview aims to elicit the detailed structure of the expert's concepts. The ethnographic interview involves conversations with the client which have the explicit purpose of focusing on the tacit knowledge of a culture. There are three broad types of questions: descriptive, structural and contrast questions. This is a thorough approach to knowledge elicitation as the ethnographer has less in common with the new culture than the designer–SME interaction. The teachback interview involves the SME presenting content followed by the designer re-presenting the material back to the SME to clarify the content. This built-in clarification process is intended to prevent designer misconceptions which may be prevalent in the use of the other interview procedures. The teachback interview strategy is based on the "conversation theory" of Pask (1975). This theory is not concerned with general conversation, however, but with the "processes of meaning exchange that underlie all language" (Gregory, 1986: 839).

A basic premise of the teachback interview is that the very act of teaching a concept "is likely to teach ... the verbalizer ... the concept in its own right" (Pask, 1975: 63). This factor has important implications for the designer–SME interaction if the very act of teaching the material back to

the SME assists the designer to conceptualize the instructional content. A second advantage of the teachback interview is that the concepts are made public or objective by the interaction between the participants. A third advantage of the teachback interview procedure is that there is active participation on the part of both participants. There is a constant process of explanation, clarification, translation and re-explanation throughout the interview. The teachback interview may also help to prevent misconceptions by dealing with each concept in turn until a mutual understanding occurs. This process of examining concepts until both share the same concept will almost guarantee both the designer and the SME are on the same wavelength regarding the content being elicited in the designer–SME interview.

Develop Generic Questions to Utilise in the Interview

In order to optimise the time spent with the SME the designer may find it useful to use a series of generic questions to assist in interacting with the SME (See Table 1: <http://www.medfac.unimelb.edu.au/ascilite2000sme/>). This schema of questions provides some means of scripting the interaction between the designer and SME. Initial questions should focus on the construction of a conceptual infrastructure whereas clarification questions should be used in subsequent interviews to elaborate the content. The designer can utilise generic questions in the following manner. The designer asks the SME to imagine a competent person completing the task(s) required in the instructional outline. Think about how this person is performing each of their tasks to complete the job. What is the very first step that the person performs in the task? What is the NEXT (N) step of the task? The designer now returns to the initial step and begins to address each step by framing questions around the REQUIRES step. Does this step REQUIRE (R) (a) pre-requisite knowledge, (b) background experience, or (c) specific equipment? Outline what some of these required aspects would be. The designer then asks what are the CHARACTERISTICS (C) of each step. For example does it take 20 minutes to complete step 1 as compared to step 3 which takes 2 minutes? After examining each step the designer asks the SME to outline the CRUCIAL STEPS (!) in completing the task. For step 1 provide me with an EXAMPLE (EX) of how a competent person would complete this task. The designer asks the SME to provide examples for each of the steps. For difficult steps the designer may ask the SME to suggest an ANALOGY (A) which will help the designer to understand the step. The use of an analogy will help to relate the step to information with which the designer

is familiar. The designer may also ask the SME to provide an opinion or COMMENT (CO) about content. In interacting with SMEs these questions assist in focussing the SMEs attention and in allowing the designer to approach unfamiliar content in a logical and systematic manner.

Use Mapping Strategies to Reorganize the Content

When dealing with difficult or unfamiliar content it is important to think about the relationships between the content and its overall structure. The use of mapping strategies by the designer such as graphic organizers (Barron, 1980), concept maps (Novak & Gowin, 1984) or knowledge maps (Lambiotte, et al. 1989) provide a means of 'portraying' conceptual relationships. They are similar in that they all portray information in a visuo-spatial representation. They differ in that graphic organisers do not explicitly show the relationship between the concepts on the map whereas concept maps and knowledge maps specify this relationship. Concept maps use idiosyncratic links between concepts whereas knowledge maps use explicit defined links between concepts. It is important to remember that any one of these types of maps could be used by the designer to reorganise content. I use all three types of maps and choose the type based on the project, time available and how I may need to communicate the content to the SME. The knowledge map, however does offer particular promise because it specifies the relationship between the concepts using defined links.

This is useful when interacting with the SME as these defined links can also be used as generic questions in the designer-SME interaction. (See Table 1). Multi-relational semantic maps are "two- dimensional diagrams that use a spatial arrangement of nodes and links to communicate about concepts and to specify the multiple relationships among concepts in a given knowledge domain" (Lambiotte, et al. 1989: 333–334). (Figure 3) (see <http://www.medfac.unimelb.edu.au/ascilite2000sme/>). Preliminary research in teaching the use of knowledge maps to an instructional designer and observing his use of the map with two SMEs has provided a number of fascinating insights and reflections into the 'mental wrestling' that needs to occur when a designer interacts with a SME in an unfamiliar content area (Keppell, 1997). The following outlines the process John (instructional designer) used in interacting with two military SMEs (Steve and Bob). The following excerpts concentrate on the use of the map for conceptualizing the content and in communicating with the SME.

Interactions with Steve (SME)

John (instructional designer) was positive about the development process in transforming the content into knowledge maps. "It forced me to think about what was said". John was positive about the use of the knowledge map as a tool for assisting his conceptualization of the content area with the SME. John suggested that there were advantages in using the map to assist his conceptualization of the content. "The map makes you think, the map makes you take a lot of disjointed information and put it down, it forces you to put it down in a logical format, because you're not going to be the only one that's going to look at it". He also suggested that it "gave me a framework on which to add more knowledge". The cognitive effort that John focused on developing the maps provided John with an ownership in the process. The maps showed Steve (SME) that: "I had a grasp for what was said before ... and it allowed me to very quickly show him without actually saying anything; I could just almost point to this and we were already thinking along the same lines ... there's a lot said non-verbally here ... and it allowed us to talk and interact together and move along the arrows, you know, and not get confused, and move along". It also allowed "us to avoid going over a lot of material that was covered before". John was positive about the use of the maps with Steve and suggested that there was an economy of effort for Steve in that he could simply point to items on the map, rather than verbally explain a correction of the content. The process provided a structure which appeared to facilitate the interviews with the SMEs. John felt that the maps provided him with a useful framework for interacting with the SME. The maps also provided a useful means of teaching the material back to the SME. John felt that the process of developing the maps followed by the presentation to the SME allowed him to conceptualize the content.

Interactions with Bob (SME)

John was positive about his ability to conceptualize the content by using the map as a structure for his conceptualization. "I think this focuses my thinking". "I sort of had to resign myself to the idea that in the first interview I was just there trying to get a feel for this topic ... whereas, I think my learning was accelerated with the use of the map".

Having a piece of paper with a map on it right or wrong is very helpful to the subject matter expert, because on it you'll have terminology and words that they will recognize and I think as soon as you do that, you know it

gives them that scaffolding to hang onto, and to attach more information to

...

John was positive about the use of the knowledge map for assisting his conceptualization of the content. As John developed the maps it appeared that he became more confident and conversant with the material. It was typical that John was eager to show the maps to the SME after they had been developed. A certain point had been reached where John wanted feedback on his conceptualization by the SME. John was also positive about the use of the map to elaborate the content and thus improve his own conceptualization of the content. The use of visuo-spatial representations such as concept maps and knowledge maps operationalize the intellectual scaffolding concept of Ausubel (1960). However, instead of attempting to create the intellectual scaffolding in the learner, the designer uses the knowledge map as a metacognitive tool for approaching the unfamiliar content. In other words the designer is attempting to create his or her own scaffold which will allow the attachment of further information elicited from the SME.

Using the Map as a Communication Prop

The use of the knowledge map in the designer–SME interview may act as a communication 'prop' to improve the interpersonal nature of the interview. The map may assist the communication process by providing a common focus of attention while at the same time demonstrating to the SME the designer's understanding of the content. The knowledge map appeared to assist John in handling the sometimes difficult interpersonal aspects of the interview. "And it really helps me, because when you're dealing with someone who you don't really know very well ... I'm nervous ... and rather than sort of concentrating and talking to him and looking at him in the eye, I could focus attention on the map". The knowledge map also appeared to provide added efficiency to the designer–SME interaction by helping to focus the attention of the SME on pertinent information. The knowledge map of the elicited content may provide a powerful non-verbal means of communication. It is possible for the designer to point to a concept on the map and help focus the SME on the same information being examined. The SME can also suggest the moving of a step in a sequence by simply pointing and suggesting that it should be moved to a more appropriate part of the map. The time required to verbally explain these changes would far exceed the time required to complete this physical gesture.

The knowledge map may also help to focus the attention of the SME and designer on the most important parts of the content. Accurate content on the map may not require further attention. It may not be necessary to further explore this information because the SME has verified the accuracy of the content. John used the map in this sense by check-marking accurate information on the map as it was examined by the SME. In this sense the map may act as a communication device that confirms the knowledge shared by the designer and SME. The focus of the interview can then be concerned with the areas that are most in need of attention. It also appears essential that the map does not contain too much information. The map should allow the SME to comfortably scan and read the map for accurate and inaccurate information. An advantage of the map in John's interaction with Bob was that it allowed the examination of parallel procedures. John commented that it was very easy to compare and contrast the information when there were two columns of information next to each other on the knowledge map. He also suggested that it allowed him to scan from column to column when a comparison of the procedures needed to be made. The knowledge map also appeared to assist both the SME and designer in recognizing gaps in the flow of the sequence and in the information.

Lambiotte, et al. (1989: 332) suggest that knowledge maps are "computationally efficient" in that they "facilitate faster search and recognition of relevant information" (p. 332). Efficiency is defined in terms of how the knowledge map representation assists attention focusing, knowledge assimilation and knowledge searching of new information. The presentation of the knowledge map to the SME may activate both the spatial and verbal systems thus increasing the processing efficiency of the information. The graphic nature of the knowledge map may allow spatial and verbal cross-cuing which in turn may assist the retrieval of appropriate content.

Transform the Knowledge Map into a Storyboard

When completing design on multimedia projects the author uses the knowledge map or concept map as a 'scaffold' for planning the micro-design of a multimedia module. After developing the knowledge map the designer will have developed a conceptualization of the content which can be utilised in subsequent phases of the design and development model (Keppell, 1998). When this conceptualization is dovetailed with the needs assessment (for the specific project) the storyboard can begin to be

developed. A specific form of storyboard or 'planning grid' has been developed to provide a 'communication tool' for interfacing between the designer, SME and graphic designer/programmer (Keppell & Buschgens, 1995). Figure 4 provides an example of one page of a completed planning grid for a project developed on congenital heart disease for the School of Dental Science at the University of Melbourne. (see <http://www.medfac.unimelb.edu.au/ascilite2000sme/>).

The planning grid provides a 'communication tool' for interfacing between the designer and graphic designer/programmer. This is important as harnessing the energy and expertise of team members (subject matter experts, instructional designers, graphic designers, programmers, audio-visual specialists, evaluators) into a common goal is often a juggling act for the project manager as the team members often approach the project from different perspectives. Instructional designers tend to focus on pedagogical issues whereas graphic designers and computer programmers tend to focus on the technical aspects of the media. It is not uncommon for a communication bottleneck to occur between the designer and technical staff due to their different background knowledge. Collaborative input, although essential for the multimedia project, is also problematic. The planning grid is useful in streamlining this communication and providing a common ground for discussing the design and development of the multimedia project. The planning grid is analogous to an architectural blueprint which can be applied or engineered by the graphic designer/programmer. It has proven successful as a means of communicating the instructional design blueprint to the graphic designer and programmer on a number of projects.

Conclusion

Interactions with SMEs represent a crucial aspect of multimedia design and development. In order to optimise this interaction this paper has focussed on a number of principles which may enhance the ability of the instructional designer to 'translate' SME knowledge into teaching and learning resources. In particular the knowledge map offers a great deal of promise in providing a means of communication with the SME.

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