

## What is Instructional Design Theory?

*"The film business is vaguely designed the way buildings are built. The architect does the blueprint and turns it over to the contractor. He then follows the instructions, and, if nobody goes in to change those orders, you end up with a building that's only sort of interesting. I'm of a carpenter mentality. I have a rough idea of what I want to do, but I'm going to start hammering. Then when I get along, I'll look at it and say 'We should move this wall here.'"*  
-- George Lucas, Film Director (quoted in *The Connection*, July 1997: 16)

## Introduction

Within the field of Instructional Design, there seem to be two constant refrains.

- On the one hand, it is said that designers rarely work according to theories. They merely work intuitively (Gros *et al.*, 1997: 49).
- On the other hand, it is maintained that much of Instructional Design theory is no longer applicable in the current context of rapid change, global communication and high technology (Reigeluth, 1996).

These two prevalent views seem to suggest that there is a tension between theory and practice. What, then, is the role of theory? What are its shortcomings? Wherein lies its salvation? How can it become a vital and valued aspect of design?

This essay considers the role that theory plays in Instructional Design (ID), outlines the basic theoretical approaches within the field, and discusses how theories come to prominence. It then describes the way the ID process is usually tackled, analyses some problems in current approaches, and suggests a way in which those problems can be overcome, suggesting how theory can contribute in a more positive manner to the development of quality learning experiences for students.

## The Role of ID Theory

Gros *et al.* (1997: 48) state that "Instructional design models have the ambition to provide a link between learning theories and the practice of building instructional systems." In contrast to the theory/practice tension mentioned above, they suggest that ID theory inhabits the space where this tension exists.

Winn's (1997: 37) approach is in keeping with this. He maintains that ID theory is based on Learning Theory, which is an aspect of Psychology. This forms the basic foundation of all the work that instructional designers do, much as a basic understanding of engineering undergirds the work of architects. More specifically, ID theory is what designers draw on when they need guidance to overcome problems in the design process.

This view is backed up by Reigeluth's (1997: 44) assertion that Instruction is "anything that is done to help someone learn", and ID theory is "anything that offers guidance for improving the quality of that help". He distinguishes (1997: 42) between **descriptive** sciences, which describe the way things function in the natural world, and **design** sciences which offer ways to do certain human-defined tasks. Clearly ID theory is a design science, as it provides guidance on the task of designing learning experiences. But, it also provides a bridge to the descriptive science of Learning Theory.

Seels (1997: 13) refers to Richey's (1996) categories of theory. She distinguishes between **conceptual** theories which explain the relationship between variables, and **procedural** theories which explain how to accomplish a certain procedure. This is similar to Reigeluth's dichotomy mentioned above. By combining the ideas of Seels and Reigeluth, one can say, perhaps, that descriptive sciences develop conceptual theories, while design sciences produce procedural theories. Since ID is a design science, the role of theory in ID, then, is to make theories which explain how various procedures work, and to link these theories back to the more conceptual theories of Learning Theory and Psychology.

Wilson (1997: 23) suggests how theory in ID fulfills the role discussed above.

- By providing a way of seeing the world, ID also provides a way of finding solutions.
- Theory shows how to go about tackling a problem in that it links the theoretical solution to the technology of practice.
- Theory provides a method of self-critique which ensures that the solutions arrived at are honest and coherent.

### Kinds of Theory

Seels (1997: 12) outlines three basic approaches to theorising, based on Trenholm (1991). These are fundamental orientations which are discernible in all intellectual domains. Each of these three, rather than being seen as opposing the others, should rather be seen as contributing a different role to the theory-building project. The three approaches are as follows:

- **Positivist** approaches have the role of determining laws of cause and effect.
- **Interpretative** approaches attempt to uncover the choices involved in human action.
- **Critical** approaches analyse the ways in which social structure constrain and direct human action.

These three general intellectual approaches form a continuum which can be used to place the more specific psychological and sociological theories used in the field of ID. Thus, Behaviourists fall towards the positivist end of the scale, while post-modernists inhabit the opposite, critical theory end. In the centre, cognitivists tend to combine positivism and interpretation, while constructivists tend to use interpretation and criticism. The following table sums up this way of organising these ideas:

### 3 Intellectual Approaches

<b>Positivist</b>	<b>Interpretative</b>	<b>Critical</b>
<b>Behaviourist -- Cognitive -- Constructivist -- Post-Modern</b>		

Wilson (1997: 24-25) argues for the complementarity of the positivist and critical approaches. He maintains that positivism "if not checked, would tend to see things in terms of their instrumental value" (25), whereas a post-modern critic "brings balance to the picture by closely examining the details" (25). Positivists look for a single, objective meaning, interpretative theorists look for subjective meanings and uncover how they are negotiated with others, while critical theorists examine how our meanings get ideologically fixed into apparent unchangeability when, in fact, they are flexible and open to negotiation.

## Where do theories come from?

Richey (1997) discusses the process of **Agenda Building** as a way to understand how theories come to prominence. She sums up this process as follows:

"...agenda-building is a problem definition process involving the creation and definition of issues, and the emergence of these issues as matters of general attention. The agenda-building process is *highly fluid* and is dependent upon its context; especially the people, the nature of the problems; the available solutions, and other competing pressures." (p.7; her italics)

She goes on to detail some of the current trends in ID theory. In the general intellectual context, there is a move away from Behaviourism to more Cognitive and Constructivist approaches, while Feminist thinking has come to be seen as relevant to the field. Within ID specifically, the prominent role of the computer as the solution of choice has influenced both problem definition and solution generation. Added to that, the rapid development of computer technology has made it possible for increasingly powerful software to be employed, thus making it more feasible for a constructivist approach to be followed. Design cycle time has come to prominence as an issue to be discussed due to the pressures of the market place, and learner control has become a prominent topic due to the increasing move to cognitive and constructivist approaches.

Richey's (1997: 10) conclusion from her discussion of current trends in ID is that, although the agenda-building process might seem to be chaotic and random, it is a rational and predictable process. The deciding factors, however, are not purely scientific: "Context and timing are more important than the specific nature of the problems, their solutions and the people involved" (1997: 10).

Building on Richey's discussion, Reigeluth (1997: 45) outlines a major shift in the social and intellectual context that is influencing ID theory. He maintains that there is a shift from Industrial Age to Information Age thinking. One of the key markers of this shift that is seriously influencing ID is the move from standardisation to customisation: designers are increasingly attempting to make possible a unique learning experience for each learner, rather than trying to produce a single, clearly-defined outcome for all learners. The combined power of new communication and computer technologies are aspects of the context which are driving this shift in approach.

## The Traditional ID Process

The process which has tended to guide ID is as follows (Main 1993: 38-39).

### Analysis

The aim of this stage is to determine training needs and produce a needs assessment document. Components include:

- **Goal analysis:** reducing abstract desired outcomes to specific performances that can be measured;
- **Performance analysis:** determining the reasons for and solutions to the differences between present behaviour and desired outcomes;
- **Target Population analysis:** finding out the relevant characteristics of the potential learners;
- **Task analysis:** specifying and determining the exact nature of the task the students must learn, analysing it into sub-divisions, and deciding which aspects can be assumed to be in place prior to the training;
- **Media Selection:** finding the best combination of media to carry out the training as determined in the other components;

- **Cost analysis:** determining the cost of the project, and tailoring the project to meet budgetary constraints.

## Design

The aim of the design phase is to develop a blueprint of how the finished product will look, and to produce a storyboard and flowchart of the whole structure of the finished product. There are several key design issues to be resolved at this stage, including:

- **Interface design:** developing a consistent, user-friendly, attractive layout for the basic controls and functions;
- **Sequencing:** deciding on the best educational order in which to place the different lessons and sub-components;
- **Lesson design:** developing the strategies to be followed within each lesson to best put across the teaching point, with the emphasis being on retaining motivation and maximising retention;
- **Learner Control:** deciding how much control the learner can have over the lesson flow, and identifying key decision points in the lesson sequence.

## Development

This phase involves the programmers, graphic artists, writers and subject matter experts filling out the specifications in the blueprint. During this phase, a working model is usually developed, and this is then formatively evaluated, with the feedback being integrated into the ongoing development process. The outcome of this phase should be the full learning programme.

## Implementation and Evaluation

The final two phases involve delivery of the completed programme to the learners, and evaluation of whether the goals as set out in the needs assessment are met. Strict controls are maintained in the delivery to facilitate a coherent summative evaluation.

## Problems with this Approach

There are many problems with the traditional approach to ID.

Rowland *et al.* (1994) distinguish between **rational** and **creative** approaches to design. The former, epitomised in engineering, emphasises the need for clearly defined concepts and skills, and prescribes a systematic method for approaching problems. The creative approach, on the other hand, is based on flexible, creative solutions to situations which are seen as unique. ID has tended to follow the rational route, but a move to a more creative methodology is necessary.

Reigeluth (1996) outlines the paradigmatic shift from Industrial to Information Age thinking. These changes happening in the world of work mean that the traditional ID approaches are no longer capable of delivering what is required. Traditional approaches have facilitated sorting of learners into standardised categories, thereby promoting conformity and compliance. This is in direct contrast to what is now vital in the business world, namely customised learning which allows individuals to develop their own unique potentials and creativity so as to promote initiative, diversity and flexibility within the organisation.

Gros *et al.* (1997: 51) criticise traditional approaches for two reasons. Firstly, ID theory has been either too specific in its prescriptions for it to be readily applicable to different situations, or it has

been too general, rendering its solutions vague and impractical. Secondly, ID models are linear in character. This makes the design process inflexible and less able to accommodate interactive changes, as is the case with rapid prototyping. What is needed, instead, is a model that promotes an iterative approach to ID.

Winn (1997: 36-37) points to the causal basis of ID theory. The linear design process assumes that human behaviour in instructional situations is predictable. He advances four arguments against the predictability of human behaviour.

- All individuals are different.
- Learners' metacognitive abilities mean that they can choose to use different methods of learning; this means that it is impossible to predict which method is best, and what outcomes will be achieved.
- The learning environment is very important in determining the outcome. The designer can never predict what all learning contexts will be like, and so cannot predict the learners' behaviour.
- People do not think logically. The designer cannot predict the lack of planfulness of the learner, and so cannot use a linear, predictable plan to design the learning programme.

Jonassen *et al.* (1997: 28) criticise the positivist basis of ID models. This basis in positivism has led to certain fundamental assumptions by ID about learning situations.

- Learning situations are closed systems.
- Knowledge is an object which can be "put into" a learner (i.e. it is the instructor's responsibility).
- Human behaviour is predictable.
- Processes in the educational setting can be understood according to the laws of linear causality.
- Certain interventions determine certain outcomes.

These assumptions are being challenged by a variety of sources from within the scientific community, the original parent of positivism. In contrast to the assumptions outlined above, Jonassen *et al.* (1997: 28) maintain that the elusive and complex nature of human consciousness make it impossible to describe, let alone predict, what will happen in learning situations. Knowledge is not a static object, but is rather distributed in society, constantly subject to revision and negotiation. Further, based on Heisenberg's Uncertainty Principle, they deny that causal relationships can ever be established, as the act of studying any phenomenon alters its nature. The best one can achieve is an estimate of probability. They also maintain that learning systems are open-ended. The number and complexity of the variables involved mean that any attempt to isolate specific variables is reductionist and simplistic, and cannot do justice to the "fluctuations and perturbations" (p. 28) found in the educational setting. Finally, the fact that over many years of research, there have been no clear findings of significant differences, indicates that ultimately educational settings are unpredictable and cannot be approached in a linear fashion.

## **Alternative Approaches to ID**

### **Jonassen and the New Sciences**

In contrast to the positivist approach criticised above, Jonassen *et al.* (1997: 29-33) suggest using Hermeneutics, Fuzzy Logic and Chaos Theory as a basis for ID. They describe each theory and outline the implications for ID.

**Hermeneutics** emphasises the importance of socio-historical context in mediating the meanings of individuals creating and decoding texts. This means that ID must strive to introduce gaps of understanding which allow the learner to create his/her own meanings. Another implication is that learners need to become aware of their own and others' biases. Exercises must problematise the world of ideas and values, rather than simplifying and codifying it. As Jonassen *et al.* (1997) express it, "Good learners are naturally sceptical learners" (p.30). A third implication is that other factors outside of the immediate learning situation play a role in the learner's creation of meaning. Designers need to work in a manner that allows the flexibility and openness that will enable these "external" factors a place in the instruction. Finally, the learning programme should facilitate understanding of different time periods, and other cultures, so that learners' understanding is not mediated only by their own unconscious biases.

**Fuzzy Logic** is based on the idea that reality can rarely be represented accurately in a bivalent manner. Rather, it is multivalent, having many varieties and shades which do not have to belong to mutually exclusive sets. In terms of needs assessment and design, the implication of this is that behaviour can only be understood probabilistically, using continua, rather than binary measures. Also, it means that problem areas, such as student perceptions of the efficacy of the educational programme, can be incorporated into the design.

**Chaos Theory** is useful for non-linear, dynamic situations where Newtonian physics is no longer applicable, where input and output are not in direct proportion. Chaos theory is also necessary where there is sensitive dependence on initial conditions (i.e. where a very small change in the initial situation leads to great changes later). Chaos theory finds order in the chaos of natural structures through looking for self-similarity and self-organisation, patterns that are repeated at different levels of complexity through a structure (e.g. a fractal). Since the linear, deterministic approach is inapplicable to educational settings, Chaos theory can offer ID some useful alternatives. Firstly, designers need to include metacognitive skills in their designs, to enable learners to deal with the complexity flexibly, rather than hushing it up through simplification, and thereby crippling the learner who will all too soon be faced by aspects of reality that do not fit the simplified scheme. Secondly, ID needs to take account of learners' emotions, and promote self-awareness on this level, not just the cognitive.

### **Reigeluth and the Information Age**

Reigeluth (1996; 1997) discusses the implications of the shift into the Information Age for ID theory. The most important aspect of this whole shift is that instruction needs to be customised rather than standardised (1997: 45). This implies that the instruction is learner-centred, and is based on authentic tasks (1996: 14). The teacher needs to become a facilitator, empowering the learners to construct their own knowledge, rather than being the sole source of direction and knowledge in the class. Reigeluth also suggests an alternative to the linear stages of the ID process. The entire process cannot be known in advance, so designers are required to do "just-in-time analysis" (p.15), synthesis, evaluation and change at every stage in the ID process. To fit in with the demands of the Information age, the designer will also need to become more aware of the broader social context within which the instruction takes place, and will need to consult more broadly with stakeholder groups so that a common vision of the final instruction and the means to develop it is arrived at. The final implication of this approach, is that learners should become "user-designers" (p.18), with much of the design happening at the point of delivery.

This is related to Winn's (1997: 37) assertion that "the activities of the instructional designer need to take place at the time the student is working with the instructional material". He maintains that ID decisions should be made on the fly as a response to student involvement in the learning process.

## Gros et al.: ID for Multimedia

Gros *et al.* (1997: 51-52) outline the characteristics of more powerful models of ID that will facilitate multimedia authoring. They maintain that ID models need to allow a more flexible design process that includes rapid prototyping, and that there must be a clearer link between skill and knowledge acquisition. Whereas much ID focuses on cognitive skills and ignores the multi-perspectival presentation of knowledge, multimedia authoring tends to emphasise the presentation of knowledge without due regard for developing cognitive skills. A new model of ID needs to combine the best of both worlds by using a more constructivist approach, one which starts with relevant, non-trivial scenarios (derived from a needs analysis) as situations within which the cognitive skills are developed and practised.

## Elaboration Theory and Hypermedia

Hoffman (1997) makes the link between Reigeluth's Elaboration Theory (ET) and hypermedia. ET is "a macro-strategy that focuses on the organisation and sequencing of subject-matter content" (p.59). The key idea in ET is that within a subject area there is an **epitome**, an overarching, organising concept. This is the first concept to teach, and then what follows is elaboration of the epitome. Each component of the elaboration also has its own epitome and sub-concepts. The elaboration of a an epitome could include **concepts** (which answer the question "What?"), **procedures** (which answer the question "How?"), and **theories** (which answer the question "Why?"). Further elaboration of these could include definition, examples and practice.

The key aspects of Hypermedia are that it should provide easy access to information within an interactive environment which can be customised. The web-like linking of ideas that characterises hypermedia is more akin to the functioning of human cognition than is the traditional linear structure found in much educational programming. It is this kind of structure that is proposed by ET also.

The advantages of this kind of model (ET/Hypermedia) for ID is that modularity and plasticity are possible. A modular approach makes it possible to easily make changes in response to learner needs without changing the overall structure. Plasticity is also possible as a web structure can grow and develop rapidly and easily, and can be easily customised from the user end, making learner control more feasible.

## Conclusion

To sum up this whole discussion, one can say that ID theory, in that it guides the practice of designers, is necessary and plays an important role. However, it needs to change in many respects if it is to fulfil this role adequately. In general, ID theory needs to move in the direction of flexibility and learner-empowerment if it is to allow ID to keep up with technological and institutional changes.

It is perhaps fitting to conclude this paper in the words of Jonassen *et al* (1997: 33). They conclude their article thus:

"Like the chiropractor who realigns your spine, we might become healthier from a realignment of our theories. If we admit to and attempt to accommodate some of the uncertainty, indeterminism, and unpredictability that pervade our complex world, we will develop stronger theories and practices that will have more powerful (if not predictable) effects on human learning."

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