RECENT DEVELOPMENTS IN INSTRUCTIONAL DESIGN

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Summary
Traditional instructional design theories and models are developed from behavioral theoriesand from general models how to solve an educational problem. Based on ideas and researchresults of cognitive science and the development of highly interactive, technology baseddelivery systems it became clear that the traditional design theories and models had somelimitations. The most important criticism is the analytical nature of instructional designtheories. All theories start with identifying the components and subcomponents of thesubjectmatter which then are used for designing and sequencing instructional frames. Especially incase of complex subject matter which contains several concepts, principles and procedures thestudent may be unable to integrate the components in organised wholes. The analyticalnatureof the traditional theories also causes an economic problem, because the designer ofinstruction needs to compose every instruction from the basic elements, which is laborintensive. Finally traditional instructional design theories mainly refer to tutorial instructionin which the student is supposed to be passive.
The symposium addresses the limitations and criticisms and will discuss how recentlydeveloped instructional design theories and models which are embedded in or derived fromcognitive science try to solve the instructional design problems. Attention is given to inquiryteaching, to the constructivist approach, to the use of contextual knowledge and to theintegration of knowledge and skills through problem solving techniques. The application ofcognitive orientations in designing exams also will be addressed.

Introduction

Traditional instructional design models are developed from behavioral theories and fromgeneral models how to solve an educational problem. Based on the ideas and findings ofcognitive psychology in the seventies and early eighty's new models and design rulesemerged, which roughly comprise four approaches: inquiry teaching (Collins, 1977,1983),instructional design strategies for concept teaching (Tennyson and Cocchiarella, 1986),constructivism (Brown, Collins and Duguid, 1989; Jonassen, (1992)) and the use ofcontextualknowledge (Brown, Collins and Duguid, 1989; Jonassen, (1990) & Tennyson (1992).

The purpose of the inquiry method is teaching students to reason from cases in order todevelop a knowledge network. The results of experiments on human memory and reasoningsupported the supposed structure of human knowledge as a rich semantic network whichcomprises declarative, procedural and metaknowledge. The knowledge base consists ofincomplete and inconsistent knowledge. The students use this knowledge in reasoning and indrawing conclusions. Collins, Warnock, Aiello and Miller (1975) analyzed the reasoning ofstudents, especially the negative and functional inferences and published the first results ofa method of inquiry teaching. Collins (1977, 1983) further developed the rules of inquiryteaching and presented a theory of inquiry teaching. The theory had three parts: the goals ofteachers; the strategies teachers use and the control structure that governs their teaching. Themethod of inquiry teaching was described independent of the content of the subject matter,but several publications make clear that subject matter which shows causal structures isoftenused to illustrate the method of inquiry teaching.

Tennyson and Cocchiarella (1986) presented an empirically based instructional design theoryfor teaching concepts. The theory was un update of the Merrill and Tennyson (1977) model,which was based on the classical theory of concept learning. Evidence for this theory wasmainly derived from carefully designed laboratory experiments with artificially constructedstimuli which could be categorized with certainty once the concept was learned. In theseventies the classical theory faced several problems such as the existence of disjunctiveconcepts, the existence of unclear cases and the failure to specify defining features for mostconcepts. In research attention was given to the learning of natural concepts and conceptswithless "well-defined" attributes. The results indicated that the process of concept learning hastwo phases: the formation of conceptual knowledge (prototype formation) and thedevelopment of procedural knowledge. Conceptual knowledge is formed by the integratedstorage of meaningful dimensions (defining and variable attributes) selected from knownexamples and by the connection of this information to a given domain of knowledge. Theinstructional design model which was developed by Merrill and Tennyson emphasized theinstruction of the defining attributes and the instruction of an isolated concept. TennysonandCocchiarella however elaborate on prototype formation by defining a "best example" in theirinstructional design strategy. They also pay attention to attribute characteristics (constantandvariable) and to the relational structure of concepts (successive and coordinate). Thesefactorslead to attribute elaboration and to the successive and simultaneous presentation of examplesas components of the instructional strategy. The importance of prerequisite knowledge isunderlined for which embedded refreshment is a necessary instructional design component.

Current cognitive theory emphasizes that learning is a process of knowledge construction,notknowledge absorption. Learning occurs by interpreting information and by checking whetherthe supposed consequences will happen. Effective learning depends on the intentions, self-monitoring and representational constructions of the learners. Thus the Instructiveenvironments should be designed in such a way that they provide information and questionsfor the knowledge construction processes of the students. They should support multipleperspectives of reality, knowledge construction and context-rich

experience based activities(Jonassen, 1991). The important application of the constructivistic view of learning is theprovision of instruction in relevant contexts. Learning should occur most effectively incontext. The context becomes an important part of the knowledge base associated with thatlearning. Brown, Collins and Duguid (1989) stressed the distinction between authentic andschool activities. When authentic activities are transferred to the classroom, the context ischanged and the tasks become classroom tasks instead of real tasks. As a result, they state,conceptual and problem-solving knowledge acquired in school remains largely unintegratedor inert for many students. Learning should be adjusted to the situation in which it takesplace. Instruction should provide for a relevant context. The contributions of the symposium elaborate on the changes in instructional design theoriesand how the changes influenced the actual design of instruction. The results of the researchaddresses the effects of the instructive environments, both retention and transfer.

THE INSTRUCTIONAL DESIGN, STUDENT ACTIVITY, DISCOVERY LEARNING AND TEACHING TO SOLVE PROBLEMS

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Summary

Recently traditional instructional-design theories and models, which are developed frombehavioral learning theories and from general educational problem-solving models, arecriticized. The traditional theories and models were too analytic and unable to teachintegratedwholes. The analysis of the subject matter or the target behavior of the students usuallyresulted in different outcomes of instruction such as facts, concepts and principles. For eachof these categories a further analysis was made and the components of the outcomes wereformulated such as attributes and relations. The results of the analysis were used to designand sequence the instructive frames. The emphasis was on the presentation of information orexternal conditions for learning rather than on what the student should do. Thereforetraditional or first generation instructional design was only seen as a tutorial approach whichsupposed the students to be passive and which was insufficient to design the teaching ofproblem solving activities. This paper will try to link the knowledge of human problem solving with recentdevelopmentsin instructional design. It will address the issue of the analysis of the target objective, howdetailed this should be done and how the resulting components can be used to formulatequestions and problems which stimulate the student's activity, enhance the formation ofcognitive networks or schemata and in some situations lead to discovery of problem-solvingprocedures. The tutorial approach will be compared with an experiential approach that fordifferent types of content can realise continuous transactions with subject matter. Attentionwill be paid to understanding and applying knowledge in solving complex problems.