# Instructional Design for Learning

## Theoretical Foundations

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# INTRODUCTION AND OBJECTIVES

Over the past decades, numerous textbooks on *Instructional Design* have been published, especially in North America. They substantiate the fact that instructional design savors a perfect appreciation of the scientific community. Furthermore, instructional design has very good reputation within the realm of vocational training and higher education where it is considered as a central part of strategic planning and management. Currently, such a trend is also observable in Europe, Asia, and in Russia where several universities have installed programs of study in the field of instructional design and technology.

Although the societal and economical importance of instructional design seems to be relatively uncontested, often the scope and range of this educational discipline is often not sufficiently clarified. Indeed, the topic of instructional design is complex and contains many facets so that it is difficult to keep track of the diversity of mainstreams and to integrate them in a more comprehensive theoretical framework. Actually, instructional design can look back on more than 60 years of success. In the course of its history, instructional design has advanced continuously its theoretical foundation and range of applicabilities, albeit various misleading mainstreams.

This textbook communicates the basics of the theoretical understanding and the purpose of instructional design. By the end, the reader should be able

- to specify the basic intentions underlying instructional design understood as scientific discipline for planning and developing learning environments,
- to sketch the historical progression of this discipline as well as to characterize the mainstreams (or generations) of instructional design,
- to identify the steps of procedural models of instructional design and to specify their scope,
- to integrate the steps of procedural models of instructional design into the ADDIE framework,
- to expose the congruence and incongruence of the various instructional design models against the background of ADDIE,
- to describe recent developments of instructional design, such as Cognitive Load Theory and the 4C/ID-model against the background of the objectivist tradition,
- to identify different conceptions of constructivist models of instructional design and to distinguish them from traditional approaches with regard to their theoretical foundation and levels of ambition,
- to specify the steps of the R2D2-model and to evaluate the feasibility (of implementation) in comparison with procedural models of instructional design,
- to describe the approach of creative instructional design and the particular role of rapid prototyping,

- to expose the "philosophy" and strategy of constructivist approaches of instructional design by referring to the instructional model of model-based learning and teaching,
- to explain the approach of technology-based instructional design,
- to elaborate the core and scope of design experiments and their benefits for instructional design,
- to explain how design experiments can be used for both research and development,
- to desribe the structure and functions of synthetic learning evironments within the realm of higher education and online courses,
- to compare models of instructional design with models of General Didactics with the aim to expose the similarities between the two fields of education,
- to argue why the critical-constructive didactics corresponds with constructivist approaches of instructional design,
- to show the congruence between the approach of eclectic didactics and the ADDIE framework,
- to explain the importance of instructional design for higher education and schooling,
- to describe innovative approaches, such as participatory design and communities of inquiry in the field of higher education,
- to describe principles of the design and development of blended learning environments, and
- to describe the mission and vision of Universal Design for Learning.

CHAPTER 1

# WHAT IS INSTRUCTIONAL DESIGN?

## INTRODUCTION

*Instructional Design* (ID) is commonly defined as a systematic procedure in which educational and training programs are developed and composed aiming at a substantial improvement of learning (e.g., Reiser & Dempsey, 2007).

Usually, such definitions are associated with the assumption that certain models of instructional design can serve as a frame of reference and a regulation of the development of courses and lessons (1) aiming at the improvement of learning, and (2) influencing the learners' motivation and attitudes in such a way that they can achieve a deeper understanding of the subject matters to be learned. Evidently, the starting point of instructional design consists in the clarification what students should learn. Thus, Gagné (1965, 1985) has identified five major categories of learning: *verbal information, intellectual skills, cognitive strategies, motor skills, and attitudes*. Each type of learning is characterized through different internal and external conditions. For example, for cognitive strategies to be learned, there must be a chance to practice new solutions to a class of particular problems, or to learn attitudes, the learner must be exposed to persuasive arguments.

## LEARNING AND TEACHING: THE CENTRAL CONCEPTS OF INSTRUCTIONAL DESIGN

Prior to Gagné, Roth (1963) has specified eight categories of learning that will serve as the point of reference throughout this textbook:

1. Learning in which the *emergence of an ability* is the main goal as well as the automation of abilities to form motor and mental skills.
2. Learning centers on *problem solving* (thinking, understanding, "insight")
3. Learning, which aims at *construction, retention, and remembrance of knowledge.*
4. Learning in which the main goal is *to learn a procedure* (learning to learn, learning to work, learning to do research, learning to look things up, etc.)
5. Learning in which *transfer to other domains* is the main point, i.e. the heightening of abilities and efforts (learning Latin as an aid for learning other Romanic languages).
6. Learning in which the main goal is to *develop one's social positions, value positions, and attitudes.*
7. Learning in which the main goal is to gain an *increasing and heightened interest in a topic* (differentiation of motives and interests).
8. Learning in which the goal is a *change of behavior*.

Scholars in the field of education commonly agree on the point that there is a strong relationship between learning and instruction. A long time ago, Willmann (1889) introduced the notion of "teaching as the making of learning" and about 60 years later Skinner (1958) distinguished between the "science of learning and the art of teaching." Correspondingly, traditional approaches of instructional design start with a clarification of learning objectives and then identify instructional events that are suitable for achieving the learning objectives. Gagné's "nine events of instruction" provide a well-known example for this combination of learning and instruction (Gagné, Briggs, & Wager, 1992).

*Gagné's Nine Events of Instruction*

1. Gain attention of the students
   Methods for gaining the learners' attention include stimulating with novelty, uncertainty and surprise, as well as thought-provoking questions.
2. Inform students of the objectives
   to help them understand what they are to learn during a course: Describe required performance and criteria for standard performance.
3. Stimulate recall of prior learning
   Help students make sense of new information by asking questions about previous experiences and their understanding of them.
4. Present the content
   Organize the content in a meaningful way, provide explanations and present multiple versions of the same content.
5. Provide learning guidance
   Provide instructional support when needed (as scaffolds, hints), model varied learning strategies (e.g., concept mapping, visualizing, role playing), use examples and non-examples, provide case studies, analogies, visualizations and metaphors.
6. Elicit performance by practices
   Help the students to internalize new knowledge and skills and confirm correct understanding of the concepts, elicit recall strategies, facilitate student elaboration.
7. Provide feedback
   Provide immediate feedback on learners' performances to facilitate learning.
8. Assess performance
   In order to evaluate the effectiveness of instruction, test the expected learning outcomes.
9. Enhance retention and transfer
   with the aim to help learners in developing expertise.

According to Gagné et al. (2005), these nine events of instruction create a general framework for preparing and delivering instructional contents. The authors suggest defining the course goals and learning objectives before implementing the nine events. From the perspective of traditional instructional design, instructional events are assigned to learning objectives to make sure that learners will be able to know or do something that they had been not able to know or do before instruction. Shortly said instruction is the “stimulus” and learning the “response”.


In the 1990s, this behaviorist (or objectivist) perspective was attacked and contrasted with a constructivist perspective (e.g., Jonassen, 1991). Combined with the idea of social constructivism and situated cognition, the so-called *objectivist-constructivist-debate* in the field of instructional design evoked, in terms of Gage (1989), a “war of paradigms.” It took only short time for recognizing that the objectivist-constructivist-debate was more confusing than helpful in clarifying the “philosophical foundation” of instructional design (Cronjé, 2000). Now, it could be argued to let bygones be bygones and to consider the objectivist-constructivist-debate as finished. But this would only be half the truth because the debate gave rise to alternative approaches of instructional design. Among them, the idea of *Learning Design*, or as some argue the *Design for Learning*, plays an important role (Koper, 2006; Laurillard, 2013; Mor & Craft, 2012). According to this approach, the role of instruction is “not to transmit knowledge to a passive recipient, but to structure the learner’s engagement with knowledge, practicing the high-level cognitive skills that enable them to make that knowledge their own” (Laurillard, 2008, p. 527).

> A *learning design* is defined as the description of the teaching-learning process that takes place in a unit of learning (e.g., a course, a lesson, or any

> other designed learning event). The key principle in learning design is that it represents the learning activities and the support activities that are performed by different persons (learners, teachers) in the context of a unit of learning. (Koper, 2006, p. 13)

When we replace the term "learning design" through "instructional design", the definition of Koper is correct, too. Basically, both terms refer to the same universe of discourse, and consonantly they aim at the same product: a *learning environment* as a specific arrangement or setting of teaching and learning. The only difference is that the focus of instructional design is on teaching activities aiming at the improvement of learning, whereas learning design focuses on learning activities initiated and facilitated through instruction. In other words: *Instructional design and learning design are the two sides of the same coin*! With reference to the necessary procedures and steps of the design, there are practically no differences.

The purpose of both instructional and learning design is the creation of learning environments that provide the learners with opportunities to learn in accordance with the categories of learning introduced by Gagné (1965) or Roth (1963). It is plausible to assume that the idiosyncrasy of a learning environment depends to a large extent on the type of learning and the related learning objectives. For example, a learning environment aiming at problem solving will differ from an environment aiming at the proceduralization of skills. And a learning environment aiming at the construction and retention of declarative knowledge will differ from an environment, which aims at the development of social attitudes or morality.

*Learning Environments*

Learning is considered as a constructive process of organizing available cognitive resources in such a manner that new knowledge or new skills are placed at the disposal for mastering new learning tasks. The basic assumption is that learners do not possess a priori the knowledge and skills that are necessary for solving problems (Kozma, 1991). Thus, the given *environment* provides an essential cognitive resource to attain information that can be assimilated into the knowledge bases.

Based on this argumentation the idea of *learning environments* advanced to a central concept of educational psychology and instructional design (Collins et al., 1994). The point is to organize the environment of learners by means of well-designed teaching materials and the social conditions in such a way that intended processes of learning are initiated and facilitated. Thus, the "Florida Commission on Education Reform and Accountability" (1992) stated shortly: "The school authorities care for learning environments, which are beneficial for teaching and learning." – Well spotted! However, it remains open what kind of learning environment is beneficial.

Everyday experiences with schooling indicate that there is a great variety of learning environments concerning the degree of guidance by instructors. In educational practice, the spectrum of possible learning environments might range from highly restricted and supervised learning (*tutelage*) to a both largely unrestricted and weakly supervised learning.

At this point, the "philosophical orientation" of education and instruction makes the difference. The behaviorist tradition (e.g., programmed teaching and learning) favors a rigid tutelage, whereas constructivists argue that learning cannot be externally forced but rather only supported by the environment. Aiming at learning support, the environment must be designed in such a way that it provides learners with optimal conditions for the development of their own initiatives. Instructional interventions must be reduced to a minimum (Farnham-Diggory, 1972).

This corresponds with Stolurow's (1973) concept of *transactional instruction* aiming at the creation of learning environments that provide opportunities for reflective thinking. Learning environments must organize the external conditions of a maximal cognitive and motivational evolvement; they should operate with minimal interventions in order to offer a wide space for learning and thinking.

Accordingly, Hannafin (1992, p. 51) proposed the following definition of learning environments: "Learning environments are comprehensive, integrative systems that promote engagement through student-centered activities, including guided presentations, manipulations, and explorations among interrelated learning themes."

In accordance with the previous argumentation, we can specify some general requirements for effective learning environments:

1. Learning environments have to motivate the learners by means of provoking expectations that initiate reflective thinking about the objects to be learned.
2. Based on an appropriate preparation of the teaching materials as well as specific instructional activities (presentation, interpretation, explanation, development of lines of thought, and scaffolds), learning environments eventually aim at self-organized learning. This presupposes a continuous feedback about the learning outcomes.
3. Learning environments aim at those learning processes that contribute to the development of the abilities of cooperation and communication, exploration and identification of social relations within peer groups.

The implications for the design of learning environments are obvious: First of all, learning environments have to provide an appropriate context or organizing issue for learning activities; then they have to provide assistance and scaffolds as well as other resources among which the learner can choose the very best for a more thorough comprehension.

The development and organization of learning environments is a complex task, which demands the simultaneous consideration of numerous components and their relationships. This can be illustrated with reference to the "Larnarca Declaration on Learning Design" (see Figure 1.1).

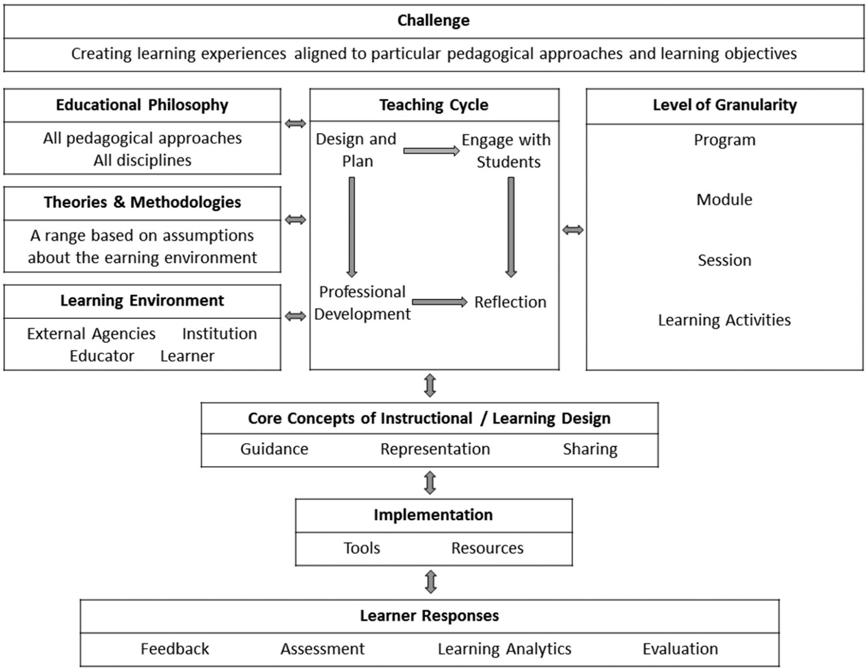


*Figure 1.1. The "Larnarca Declaration on Learning Design"*
*(adapted from Dalziel et al., 2013)*

Up to now, we have referred to instructional/learning design as a *tool* for the development of learning environments. However, instructional design is more than the concrete planning and arrangement of learning environments. In fact, instructional design also denominates a *scientific discipline* concerned with educational planning.

## INSTRUCTIONAL DESIGN: A SCIENCE OF EDUCATIONAL PLANNING

> The field of instructional design […] encompasses the analysis of learning and performance problems, and the design, development, implementation, evaluation and management of instructional and non-instructional processes and resources intended to improve learning and performance in a variety of settings, particularly educational institutions and the workplace. (Reiser, 2001, p. 57)

Instructional design is a scientific discipline primarily concerned with the generation of detailed and precise prescriptions for the development, implementation, evaluation and maintenance of situations that aim at the initiation and facilitation of learning processes within subject areas. Instructional design contains both scientific and technological theories on the design of learning environments.

*Scientific theories* provide a basis for the description, explanation and prediction of particular issues, while *technological theories* provide a fundamental basis for the exploitation of rules or prescriptions aiming at the optimization of practical actions. In other words, technological theories provide a concrete guidance of actions aiming at the transformation from theory into practice (Bortz & Döring, 2002).

In instructional design, scientific and technological theories are equally important: A scientific theory represents the necessary fundament for a technology, which on its part is nothing else than the transformation of a scientific theory into practice.

It is all very well to say that, but looking ahead to the year 2000, Gustafson, Tillman, and Childs (1992) have suggested that "we shall eventually find ourselves on the path toward a theory of instructional design" (p. 456) if it is able to expand its intellectual basis in the not too distant future. Eight years later Gordon and Zemke (2000) concluded that instructional design in its current form is as good as dead because its foundation is not suitable for facing new societal and technological demands. Fifteen years later, instructional design is still alive – according to the proverb that "there's life in the old dog yet."

Actually, several paradigm shifts of education and psychology as well as new societal and technological demands have challenged instructional design as both a discipline and a technology in the past decades. As a result, we could, from time to time, observe a substantial uncertainty in the field with regard to epistemological, psychological and technological foundations of instructional design. On the other side, over the decades, instructional design has continued to evolve, assimilating and advancing theories from psychology, systems theory and communication technologies. Recent additions have been influenced by constructivism, situated cognition, e-learning approaches to distance education, and information theory. Thus, Ritchie and Earnest (1999) conclude that "with each iteration, we enhance our understanding of how to impact the performance of individuals and organizations" (p. 35). Later we will sketch the history of instructional design to verify this conclusion. Prior to this, we want to clarify the main constituents of instructional design as an educational discipline. As a first step, we have to define the central theoretical terms of instructional design.

### *Basic Theoretical Terms*

Let us start with the term "design." *Design* (Latin: designare = to adumbrate sth.) bears the meaning of drawing and drafting. Accordingly, a design can be defined as "in due form" and functional representation of any commodity or object of utility. Correspondingly, we have to distinguish between

- design as draft, plan or blueprint, and
- design as forming, composing and modeling of an object of utility.

That means, design is both a process and product.

In general, *design* primarily can be considered as a comprehensive *process* of forming, composing and modeling that presupposes multiple working steps carried out by several people. The process of design entails a particular *product* that has to serve the specific interests of a particular target group. Commonly, a designer is someone who composes objects of utility or convenience goods. This activity is often considered as the expression of artwork – in contrast to an engineer who develops technical products in accordance with practical convenience. Willingly, technology and design or engineer and designer, respectively, are considered as counterparts. A stereotype attributes “rationality” to the engineer whereas “aesthetics” and “emotionality” are considered as main characteristics of the designer. Sometimes, design is conceived as an effort to show the technology’s true colors (Reese, 2006). For a long time, this cliché determined the self-concept of engineers and designers whereby the design was subordinated to the question “what a product technically can perform.” In the meantime, it has changed because the design of products has developed to a decisive factor of marketing in the global competition. As a side effect, however, there is an inflationary trend to use the term design for all sorts of things. In view of the history of instructional design, we can assume that the use of this term is not considerable as vogue. Nevertheless, a central question remains: *What actually is the object of utility formed by instructional designers*? The answer to this question lies in the term of instruction.

Beyond the everyday understanding of *instruction* as an explicating and informing guide for the use, interpretation and realization of something, *instruction denotes the act or process of imparting knowledge or skills to another person*. Synonyms of instruction are schooling, teaching, training, tutoring, and tutelage. This corresponds with the original meaning of didactics (greek: διδάσκειν (didáskein)) in sense of teaching, training and learning being taught. However, similarly to instructional design, the term didactics usually is not used in its original meaning but rather serves the denotation of an educational discipline discussed as a science of teaching and learning at all levels and in all forms (Dolch, 1965). In a narrower sense, didactics is understood as theory of schooling. This makes the difference to instructional design, which is primarily concerned with teaching and learning outside school, such as vocational training and higher education.

The term of instructional design refers to a North American tradition of educational planning that differs, to some extent, from the German tradition of didactics (Seel & Hanke, 2011; Zierer & Seel, 2012). A major difference to didactics also exists with regard to the emphasis of instructional design on technology-enhanced learning environments. Finally, the application of the term instructional design expresses an educational program, which is not only concerned with the “construction” of instruction but rather also with the aesthetical arrangement of learning environments. Thus, it seems likely to compare an instructional designer with an architect: *The instructional designer is the architect of learning environments in terms of the constructive arrangement of settings of teaching and learning.* Similar to the design of a building or a bridge on the basis of verifiable calculations, the design of instruction grounds on verifyable requirements and regularities of human learning.

Instructional design is concerned with planning and composing of instructional systems in general, but there traditionally has been a strong tendency to incorporate information and communication technologies. This tendency has affected some people to use synonymously the term of *Instructional (Systems) Technology*. According to some authors (e.g., Schwartz & Beichner, 1998) this theoretical term refers to the systematic application of theoretical and practical knowledge onto the intentional development of instructional systems. Seels and Richey (1994) define instructional technology as "the theory and practice of design, development, utilization, management and evaluation of processes and resources for learning" (p. 1). This definition emphasizes the necessity of finding a balance between the theoretical foundation of instructional design and its use in the educational practice.

In a broad sense, the term *technology* conceives any systematic application of scientific knowledge onto practical issues. Accordingly, *instructional technology* can be defined as the systematic application of theories on learning and teaching onto the practical issue of developing instructional systems. Thus, *Instructional Systems Development* (ISD) refers to the design of specific arrangements of resources and methods in order to improve learning.

According to the previous argumentation, the term *instructional design* refers primarily to operative processes of forming and composing effective learning environments in order to serve the educational needs of adressees and clients.

*General Strategies of Instructional Design*

The major intention of instructional design is the development of learning environments on the basis of suitable theories of learning and teaching that ensure the quality of teaching and educational interventions. In accordance with this basic understanding, instructional design contains the complete process of planning – starting with the analysis of needs and objectives along the development of instructional materials until the point of implementation and evaluation of the effectiveness. For this purpose, different strategies are applied (Reigeluth, 1983):

- *Organizational strategies* concerned with both the gross and detailed planning of settings of teaching and learning in order to determine how a course of lesson should be arranged and sequenced.
- *Delivery strategies* concerned with decisions on how information can be transmitted to the target group of learners.
- *Execution strategies* concerned with decisions on methods to assist the learner to deal effectively with instructional materials.

Instructional design is a dynamic process aiming at the development of effective instructional systems within a different range of coverage. According to a narrow interpretation, instructional design refers to the planning of a small instructional unit within a short time period. A wider interpretation is related to the planning of lengthy courses, and the most comprehensive interpretation refers to a long-term implementation of educational programs and their evaluation.

Almost any planning occurs under predetermined conditions, such as incomplete information. Therefore, a thumb rule says that a larger time frame of planning reduces the reliability of available information. In consequence, it seems likely to operate long-term with a rough and aggregated plan, whereas a short-time perspective requires a more detailed planning. Long-term planning covers a period of two and more years, mid-term planning takes a few months up to 2 years, and short-term planning refers to days, weeks or a couple of months (Klein & Scholl, 2012). With regard to the factual contents of decisions and their educational consequences, a distinction should be made between *strategical, tactical and operative planning*. In general, strategical planning runs rather long-term, tactical planning runs mid-term, and operative planning is short-term (see Figure 1.2).

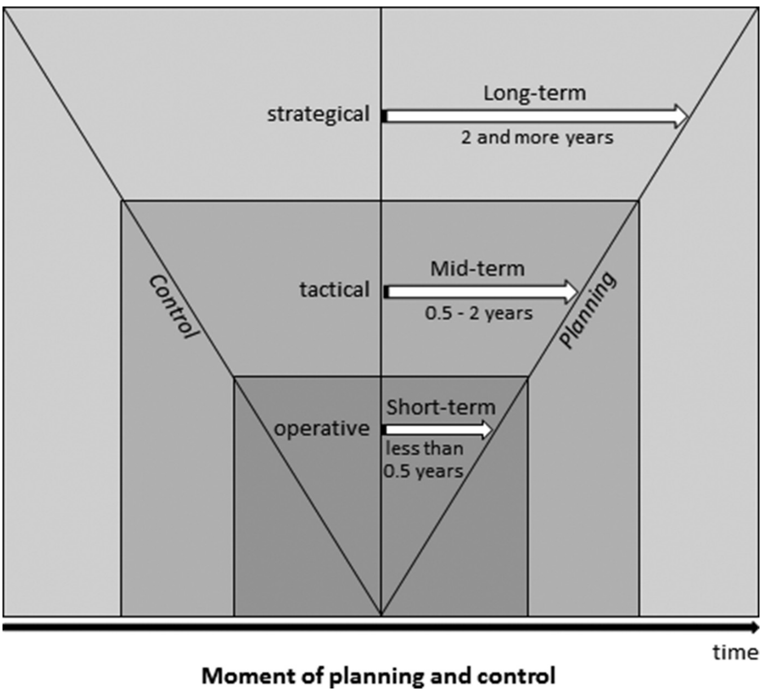


*Figure 1.2. Scopes of planning (adapted from Klein & Scholl, 2012, p. 19)*

Correspondingly, in instructional design different levels of planning are distinguished: At the micro-level, the planning and design of single instructional units are in the foreground, whereas planning on a meso-level refers to the design and development of more comprehensive instructional systems and training programs that may last several weeks and months (e.g., a course on change management). At the macro-level, instructional design can be involved with the planning and implementation of comprehensive educational systems over months and even years. This corresponds a large scale of instructional design and can be illustrated by the example of curriculum development. Indeed, there are several examples for the successful application of instructional design at the macro-level of educational planning in developmental countries (Fretwell et al., 2001; Morgan, 1988, 1989). Thus, the spectrum of instructional design ranges from planning of single instructional events to the planning of educational systems of nations.

Clearly, a long-term planning cannot be a highly detailed plan that precisely determines what actions will be effective in two and more years. However, this holds true with regard to short-term planning, too. Therefore, a naïve devoutness to educational planning is probably not the best solution for educational practice because numerous practical problems of educational planning actually result from the fact that any planning is oriented onto "future knowledge" that is afflicted with considerable uncertainties. They grow bigger the longer the periods of planning are, and any prediction of the effectiveness of planning gets worse the more detailed the matters of fact are.

### *Topics of Educational Planning*

In the first instance, the *object of planning* must be determined in combination with the distinction between the level and the domain of planning. The *planning level* contains the overall specification of objectives as well as the agreement on strategies, tactics, and operations of planning. On the other hand, the *scope of planning* encompasses the different components and phases of planning, such as the composition of a learning environment and its evaluation.

Another essential topic of educational planning consists in the *organization of necessary decisions* in accordance with the precept that any decision made at a certain phase of planning can strongly affect decisions in other phases. Every decision exhibits different premises: *Normative and evaluative premises* include the educational objectives as well as the societal and organizational constraints of education. *Factual premises* refer to the given educational context and the physical and psychological constraints of a particular setting and the expected results of action. *Methodical premises* comprise suitable methods for solving decisional problems whereby the quality of a chosen method depends on the quality of its result.

Closely related with methodical premises is the *determination of planning instruments* discussed in terms of systematic procedures for the exploitation and processing of information that aim at the support of planning processes. In the field of educational planning, we can find, for example, analytical instruments of project management as well as heuristic procedures aiming at the identification of alternatives by means of creative techniques and prognostic procedures, such as the Delphi method.

With regard to the *planning process,* we can record that education planning usually occurs along a sequence of phases and multiple steps. Accordingly, the planning process essentially contains the phases of analysis, evaluation, comparison and decision-making related to the development of drafts or blueprints and their recursive evaluation. Thus, the process of educational planning must be understood as a comprehensive and cyclical discourse with many elements. The implementation necessarily belongs to the central topics of educational planning, because only the realization of a plan informs about success.

In general, educational planning should be SMART, that is, it must be specific, *m*easurable, *a*ccepted by the participants, *r*ealistic and *t*imely (Doran, 1981). In other words, educational planning must be strategical (Kaufman et al., 1996). Correspondingly, educational planning and instruction design often are discussed with regard to their contributions to human performance improvement (Morrison et al., 2011).

The performance improvement model expands and encompasses ID models to provide methods and techniques for solving human performance problems. According to the *International Society for Performance Improvement*, human performance improvement is understood as "a systematic approach to improving productivity and competencies, and it uses a set of methods and procedures and a strategy for solving problems. More specifically, it is a process of selection, analysis, design, development, implementation, and evaluation of programs to most cost-effectively influence human behavior and accomplishment" (www.ispi.org).

Most definitions of human performance improvement share the following main features (e.g., Conn, 2003; Pershing, 2006; Stolovitch & Keeps, 1992):

1. Using a systematic approach to identify human performance problems and solutions,
2. Making a foundation in scientifically derived theories and empirical evidence,
3. Taking a systemic view of human performance gaps,
4. Being open to all means, methods, and media to implement both instructional and non-instructional solutions, and
5. Focusing on achievements that value both individual workers and organizations.

Obviously, the conceptual relationships between instructional design and human performance improvement are so obvious that Aziz (2013) asked the question for (the) true similarities and differences between instructional (systems) design, organization development, and human performance technology/improvement. The answer is that human performance improvement presents an overarching framework for selecting and measuring instructional systems design or organization development interventions.

*Summary*

Corresponding with the distinction between *design as draft or plan* and *design as forming and composing* an object of utility, instructional design denotes the process of systematic planning and shaping of learning environments. In addition, instructional design denominates an educational discipline that is concerned with the development of theories of effective teaching and learning as well as with their conversion into educational practice. Thus, instructional design is both a science and a technology of planning. The latter is also named *Instructional Systems Development (ISD)*, which aims at the design of learning environments in order to initiate and organize specific learning processes. In the case of a strong emphasis on technological aspects, the term *Instructional Technology* is used in the field.

Adjunct Questions:
*Q 1.1:* *What is the difference between instructional design and learning design?*
*Q 1.2:* *What are the most prominent fields of application of instructional design compared to didactics?*
*Q 1.3:* *What is the difference between instructional design, instructional system development and instructional technology?*
*Q 1.4:* *Which phases of instructional design can be distinguished?*

*A Short History of Instructional Design*

Some authors (e.g., Dick, 1987; Reiser, 2001) relocate the emergence of instructional design in the time of the Second World War but the roots can be traced back to the very beginning of the 20th century when systematic planning of instruction became a scientific topic (Seel & Hanke, 2011). A milestone in this movement was Tyler's (1949) conception of curriculum-based learning objectives and the systematic control of their realization on which the concept of formative evaluation builds. Later, this became a central issue of instructional design. The 1940s were characterized by an enormous demand for training in the military. Among others, one option was the use of instructional motion pictures. Subsequently, *educational technology* advanced to the hallmark of this period. According to Saettler (1968), the *Division of Visual Aids for War Training from 1941 to 1945* produced 457 talkies, 432 silent movies, and 457 manuals for military training.

In the 1950s, Skinner (1958) distinguished between the "science of learning and the art of teaching" and propagated a technological turn of instructional planning by emphasizing programmed instruction in accordance with the principles of operant conditioning. Subsequently, programmed instruction found a worldwide distribution until the mid of the 1960s. Although programmed instruction had been criticized again and again, it cannot be ignored that this movement brought some essential innovations of instructional planning, such as the operationalizing of learning objectives and task analysis. Parallel with programmed instruction, *cybernetics* and *systems theory* produced a paradigm shift, which influenced also the field of educational planning. The application of cybernetic principles onto education and instruction can be illustrated with the textbook of Smith and Smith (1966), who explicitly used the term of *educational design*. In the 1960s, some German pedagogues (e.g., Frank, 1962; von Cube, 1965) emphasized the application of cybernetics on education in general, and in the 1970s, König and Riedel (1970, 1973) formulated a didactics based on systems theory that exhibited many commonalities with models of instructional design developed at the same time in the U.S.A.

Behaviorism and cybernetics prepared the "birthday" of instructional design as a discipline for instructional planning, but it was a political crisis, which turned the balance: In 1957, the Soviet Union shot Sputnik into the space. Today, it is hardly imaginable which shock the Sputnik evoked in the U.S.A. The self-assurance of the American nation had been sensitively damaged, and as a result, the American educational system had been criticized. In the course of this, new curricula in the fields of mathematics and science had been developed, as well. At the same time, the need of empirical research on teaching and learning was being emphasized. In 1966, Glaser summarized the existing results of this research. For the first time, he connected the analysis of the conditions of learning with the development and design of instruction for what he coined the term *Design of Instruction*. Simultaneously, Gagné (1965) published a textbook on the *Conditions of Learning*, for which he distinguished different human ccapabilities such as verbal learning, intellectual skills, cognitive strategies, and attitudes. In addition, he assigned essential principles of effective teaching to the conditions of learning. Therewith, Gagné not only developed the fundamental basis for the emergene of instructional design as an educational discipline, but also provided the psychological foundation of instructional design (Dick & Carey, 2009; Gagné et al., 2005).

The third originator of instructional design was Patrick Suppes who started research on Computer-Assisted Instruction (CAI) in the 1960s (e.g., Suppes, Jerman, & Brian, 1968; Suppes & Morningstar, 1969). Based on a systematic analysis of the curriculum, CAI provides the learners with feedback, intersections and answers to questions, i.e., aspects that characterize learning software until today.

Already at the end of 1960s, numerous models of instructional design alluded to Gagné, Glaser and Suppes. Later in the 1970s and 1980s, much more models proliferated (Reigeluth, 1983; Tennyson et al., 1997). Altogether these models are called the *first generation* of instructional design. Beyond the most influential model of Gagné and Briggs (1974), the *Component Display Theory* of Merrill and the *Elaboration Theory* of Reigeluth can be listed. According to Stolurow (1973, p. 361)

> The design of learning environments is a developing technology […]. This process contains multiple stets. A task analysis is a typical first step. Based

> on this analysis, a series of behavioral objectives will be developed. Then test items are prepared in order to generate a criterion-referenced test through which the effectiveness of instruction can be assessed and the gaps in the learner's learning progression can be determined. A hierarchy will be generated to illustrate the structured baseline of learning objectives and to prioritize those objectives, which must be observed as guidelines of the development of the instructional program or the teaching materials […]. The development of teaching materials must take into account that they can be learned at different levels of skills.

The *second generation* of instructional design resulted from efforts to automatize processes of instructional design, or at least, parts of them, by means of tools that had been generated in the field of Artificial Intelligence (Merrill et al., 1991). Even for the approach of *Automated Instructional Design* (AID) the impetus came from Gagné, who propagated the idea to generate computer-based expert systems that should be capable to automatize parts of ID and ISD in order to assist non-experts in making appropriate decisions in the course of the development of instructional systems. Examples for the first attempts of AID are the tutorial advisory systems GAIDA (Guided Approach to Instructional Design Advising) und XAIDA (Experimental Advanced Instructional Design Advisor). In Germany, Flechsig (1990) developed the prototype of the computerized knowledge-based system CEDID, which did not survive the first tests. Nevertheless, the literature on *Intelligent Tutorial Systems* and *expert systems* reports a variety of activities in the research and development of AID-tools (e.g., Spector & Ohrazda, 2003).

From today's view, the idea of AID was not as successful as its advocates believed at the beginning. Certainly, one reason was that the possibilities of intelligent tutoring systems and expert systems remained limited, another reason was the missing business market. However, probably the biggest obstacle was that most approaches of the second generation of instructional design were based on traditional models of the first generation. More recent approaches of AID, such as *Designer's Edge* (2003) provide interesting alternatives for instructional design on the basis of object-oriented programming. We describe this tool in Chapter 3.

The partial failure of AID, as well as the unflinching conventionalism of the traditional models of the first generation of instructional design, caused a substantial crisis of instructional design in the 1990s that often is denominated as *objectivism-constructivism-debate* (Dick, 1993; Merrill, 1992). In view of the paradigm shift in psychology – the so-called "cognitive revolution" (Bruner, 1990) – the metatheoretical fundamentals of instructional design had been challenged. On the one side, this produced a far-reaching uncertainty with regard to the epistemological foundation of instructional design, on the other side *cognitive theories of learning* advanced to the leading rationale of instructional design and, in consequence, focused on complex problem solving and the design of corresponding learning environments (Jonassen, 1997, 1999).

In a nutshell, the new approaches constituted the *third generation* of instructional design that is not only characterized by the orientation onto the cognitive-constructivist paradigm but also through the intentional moving away from the traditional ID models of the first generation. However, not every new approach of instructional design of the third generation is constructivist by nature. For example, *Cognitive Load Theory* (Sweller et al., 1998) or the *4CID-Modell* (Merriënboer, 1997) still stick to the objectivist perspective, although they incorporate cognitive theories of learning. The same holds true for the DO-ID model of Niegemann et al. (2008).

Positive examples of constructivist approaches of instructional design are the concept of *constructivist learning environments* (Jonassen, 1999), the comprehensive conceptions of *generative leaning and teaching* (Kourilsky & Wittrock, 1992), *anchored instruction* (Pellegrino, 2004), *goal-based scenarios* (Schank et al., 1993/94), *learning by design* (Kolodner et al., 2004; Kafai & Ching, 2004) and *model-centered learning and instruction* (Gibbons, 2001; Seel, 2003a). In addition to their basic orientation to the constructivist paradigm, these conceptions are characterized through a strong combination of research and development. In contrast to the ID models of the first generation, conceptions of the third generation do not prescribe the proceeding in planning of learning environments but rather they operate on the basis of research-based principles aiming at the facilitation and optimization of cognitive learning and complex problem solving. Thus, at the first time in its history, instructional design realizes a theoretically sound research on the effectiveness of pedagogical conceptions and instructional systems.

The historical retrospection on instructional design supports the conclusion of Merriënboer, Seel and Kirschner (2002) that theories and models of instructional design exist in a diversity of types and variants, and they represent essentially different "worlds" (of knowlegde, learning, work). In these worlds, prospects to help individuals to learn better result in different answers to questions *what to teach* and *how to teach*. In reply to these fundamental pedagogical questions, the models of the different generations of instructional design complement one another but they are deposited at different phases of the process of instructional design. From our point of view, models of the first generation can provide an invaluable service in case of systematic planning and design of instructional systems and learning environments, whereas models of the third generation can generate a fundamental basis for the necessary combination of research and development related to the effectiveness of learning environments that aim at complex problem solving. Momentarily, we can observe a trend in instructional design to emphasize the aspect of *creativity* in generating instructional systems. In addition, the emphasis is on pragmatic procedures of design, such as rapid prototyping (Desrosier, 2011), that intend to convey flexility of planning and "discourage a linear, sequential and mechanistic approach to design" (Moore & Knowlton, 2006, p. 59).

*Summary*

The start of instructional design can be traced back to the beginning of the 20th century and the emerging behaviorism. Then, instructional design was booming in the time of World War II and later in the 1960s when the "Sputnik shock" resulted in a strong emphasis on empirical research on instruction and the development of instructional design as a discipline of educational planning. Four scholars exerted a significant influence on this development:

(1) Skinner (1958), who contrasted the science of learning with the art of teaching and campaigned for the transformation of behaviorist principles of learning to programmed instruction. (2) Glaser introduced the term *design of instruction*, and (3) Gagné assigned nine events of instruction to different conditions of human learning. (4) Suppes introduced information technologies as a constituent of instructional design.

Subsequently, numerous models of instructional design have been generated that can be summarized as first generation of instructional design. A main feature is their foundation on systems theory and cybernetics. Prominent examples of this generation are the models of Gagné and Briggs and of Dick and Carey that dominate the field of instructional design until today.

A second generation of instructional design resulted from the efforts to automatize, at least to some extent, processes of instructional design by means of intelligent tutorial systems and expert systems.

The third generation of instructional design distinguishes from the former generations not only due its orientation to the cognitive-constructivist paradigm but also through an intentional move from the traditional models of instructional design. A major characteristic of the third generation is the combination of research and development as well as the integration of pragmatics and creativity in the process of instructional planning.

Adjunct Questions:

*Q 1.5:* *What are the most important differences between the ID models of first and third generation?*

*Q 1.6:* *Why it is justified to attribute a failure to the second generation of instructional design?*

*Q 1.7:* *Ritchie and Ernst (1999) conclude, "with each iteration, we enhance our understanding of how to impact the performance of individuals and organizations" (p. 35). Please, clarify this conclusion by referring to the objectivism-constructivism-debate.*