TABLE 5.2 Instructional design phases with objectivist and constructivist design activities

Instructional Design Phases	Objectivist Design Activities	Constructivist Design Activities
Analysis	• Content • Learner • Instructional need • Instructional goal	• Context • Learner • Problem described • Key concepts identified
Design	• Instructional objectives • Task analysis • Criterion-referenced assessment	• Learning goals • Identify learning sequences (group and/or individual) • Context-driven evaluation
Development	• Develop instructional materials	• Construct learning resources/artifacts
Implementation	• Teacher: conveying, directing • Learner: receiving, acquiring • Focus: objective attainment	• Teacher: consulting, facilitating • Learner: directing, controlling • Focus: problem-solving
Evaluation	• What a learner knows • Knowing that, knowing how	• How a learner knows • Knowing your way around

organize them into coherent chunks, and integrate new with existing knowledge and skills (Hannafin, Hannafin, Land, & Oliver, 1997).

Formal education and training have largely reflected objectivist approaches to instruction consistent with behavioral and cognitive psychological foundations and assumptions (Silber, 1998). Objectivist learning environments are generally structured and prescribed to facilitate the acquisition of knowledge and skills that teachers and/or subject matter experts deem important. The emphasis is placed on the product (e.g., specific knowledge or skills) resulting from the instruction and on the tasks and activities used to move the learner toward creation of the product. Objectivists focus on design according to discrete stages (Cennamo, Abell, & Chung, 1996).

How are objectivist approaches grounded? Consider how we might develop instruction for a weather unit. Consistent with Table 5.2, the designer *analyzes* the content to be taught, the instructional setting itself, and the learners' prior knowledge. On the basis of this analysis, an instructional need will be identified and a goal established (e.g., "The learner will develop a better understanding of weather forecasting."). Next, the designer will move into the *design* phase, during which instructional objectives will be defined (e.g., "Given a list of terms related to measuring moisture, the learner will be able to define the terms with 95% accuracy" or "Given a list of weather forecasting instruments, the learner will be able to identify the purpose of 90% of the tools."). The objectives are then broken down into sequences and hierarchies denoting what needs to occur to attain the objective. The designer might then use each objective to establish specifications for criterion-referenced assessments of relevant content (e.g., "A barometer is used to measure (a) precipitation, (b) humidity, (c) atmospheric pressure"), materials related to the objectives, and instructional activities (e.g., "Students will read a chapter in text; small groups will complete a worksheet on the procedures for recording temperature and wind.").

The materials *developed* for the unit (e.g., worksheets, PowerPoint presentations) will help to facilitate the learners' achievement of the objectives and goals. When the unit is *implemented,* the learning environment will convey the information and guide students in attaining the prescribed objectives by having them read the instructional materials, engage in instructional activities, produce responses, and receive feedback. Finally, *evaluation* will focus on the learner demonstrating "knowing that" or "knowing how" (Ryle, in Perkins, 1996) as specified in the objectives and reinforced in the materials and activities. The objective signifies the knowledge or skill to be learned; the system design methods draw on significant psychological research and theory to prescribe and execute materials and activities that are designed to ensure that knowledge or skill has been acquired and standards have been met.

Constructivism and Constructional Design Practices

For constructivists, objects and events have no absolute meaning; rather, the individual interprets each and constructs meaning based on individual experience and evolved beliefs. Individuals construct knowledge as they attempt to make sense of their experiences. They come to an "acceptable" understanding of truth within a particular context. Models of how things work (e.g., gravity, the solar system, learning) do not necessarily reflect reality; rather, they represent the best construction of current experience (Driscoll, 1994). Whereas objectivists emphasize decomposing and external control, constructivists tend to eschew the breaking down of content into component parts in favor of environments wherein knowledge and skills are inextricably tied to context and the need to know. The individuals assume responsibility for constructing personally relevant understandings and meanings.

To *construct* is "to form by assembling or combining parts; to build"; *construction* is "the act or process of [building]" (*American Heritage College Dictionary,* 1993, p. 299). Constructional design, then, focuses on the creation of learning environments that enable and support individual construction by engaging in design and invention tasks. The design task is to create an environment in which knowledge-building tools (affordances) and the means to create and manipulate artifacts of understanding are provided, not one in which concepts are explicitly taught. An underlying assumption in constructional design practices is that the learner is an active, changing entity. Therefore, there is a need for "layers of negotiation," among the teacher, learner, and/or designer of the learning space (Cennamo, Abell, & Chung, 1996). According to this model, the varied aspects of the learning environment are defined and redefined continually to accommodate an individual's evolving needs. Neither the meaning of the knowledge and skills embodied in a learning environment nor the means through which they are engaged by the individual are fixed. Rather, as beliefs and understandings emerge or questions and uncertainties surface, both the meaning of the learning resources and the environment's support features evolve. Constructivist learning environments create "a place where learners may work together and support each other as they use a variety of tools and information resources in their pursuit of learning goals and problem-solving activities" (Wilson, 1995, p. 27). Constructivist learning environments are process-based (e.g., weather forecasting), question driven (e.g., "How does the weatherperson forecast weather for a week?"), and cyclical (e.g., "I thought I wanted to know about forecasting, but I really am more interested in calculating humidity levels."). They undergo continual revision and evolve as the learner engages the environment (Jonassen, 1991; Resnick, 1998).

Constructional design is linked closely to constructivist epistemology; there are, of course, many other design methodologies adhering to this framework. (See Wilson [1996] for constructivist learning environment case studies.) Constructional design involves four learning-by-design design principles (Papert, 1980):

1. Individuals are active learners and control their own learning process.
2. Individuals create concrete, tangible evidence (artifacts) that reflect their understanding.
3. Artifacts are shared collectively as well as reflected upon individually to extend one's understanding.
4. The learning problems and contexts are authentic, that is, they focus on solving a practical problem.

The design task for the constructionist therefore is one of providing a rich context within which meaning can be individually negotiated and ways of understanding can emerge and evolve.

Systems approaches are also important to the design of grounded constructivist learning environments (Honebein, 1996; Wilson, 1996). Context is the principal organizer, not content. During analysis, the designer focuses on a vision of the learning environment and then determines how to create it (Dick, 1997; Wilson, 1996). This involves analyzing how the problem under study might be encountered. To guide the creation of the context, the designer may focus on the description of a problem (e.g., "People are interested in weather, but many do not understand the forecasting process."), and/or identification of key concepts related to the problem (e.g., temperature, atmospheric pressure, measuring moisture) (Duffy & Cunningham, 1996). The designer's task, however, is to create a learning environment within which the individual can explore and construct, not to impose a particular "correctness."

According to constructionists, the learner is also a designer, not merely a receiver of designed material and activities. During the design phase, the learner establishes individual learning goals (e.g., "Understand how to use a barometer," or "Understand the influence of dew point on relative humidity."), evaluates and decides whether to engage in potential sequences of learning activities (including group interactions and individual work), locates and evaluates potential resources, and chooses methods to assess the solution to the problem posed (e.g., establishing a backyard weather station).

Learning resources are developed and/or made available on an as-needed basis. Some development will be done by the designer, but development in its purest sense is what individuals do as they construct and create artifacts and refine meaning (e.g., a spreadsheet used to compare one's body weight on planets in our solar system). During implementation, learners will decide what to do, when to do it, and whom to consult (e.g., experts, peers, teachers) as they engage in problem solving and artifact construction. The designer or other facilitators will serve as consultants as learners manage their own learning needs. Evaluation will focus on articulation (Collins, Brown, & Newman, 1989) and the learner's knowing her or his way around (Perkins, 1996) the learning object (e.g., weather forecasting), as exemplified by the assessment method determined by the learner (e.g., the successful creation of a backyard weather station to track weather for a month). The learning goal and problem being studied drive the learning environment. Working toward understanding the process, asking questions, and assessing work and progress guide the individual in pursuing learning goals.

Can Both Perspectives Be "Right"?

The debate over the elusive "best" approach has been lively and occasionally rancorous, if not always productive. Some have questioned the very legitimacy of constructivist approaches for instructional designers (Merrill et al., 1996). Others have suggested that the presumed differences may simply reflect different mind-sets rather than fundamentally different approaches (Lebow, 1993). Still others note that the perspectives represent such fundamentally different core foundations and assumptions and philosophical differences as to render them potentially incompatible with one another (Hannafin, Hannafin, Land, & Oliver, 1997). Finally, some suggest pragmatically that the perspectives are complementary, expanding the designer's toolkit (Rieber, 1993; Winn, 1997; Young, 1993).

Is each approach valid, even where vastly different learning environments are developed and implemented? They certainly can be valid, different underlying foundations and assumptions notwithstanding. Both perspectives *can be* considered valid provided that the tests of groundedness are addressed—that is, *if* they employ methods that are consistent with the underlying epistemological frame. The differences in underlying frames *require* associated differences in approaches and methods. We should not only recognize approaches reflecting different underlying foundations and assumptions—We should *expect* them.

Still, not all supposed instruction adheres to the tenets of objectivism, and not all purportedly student-centered learning reflects the core values of constructivism. Calling an activity instruction because it uses objectives, or an activity constructivist because it claims to be student-centered, misleads designers and subverts the values of grounded design. We should not tacitly accept a designer's claims as valid simply because they are consistent with our beliefs and values; nor should we categorically reject them because of their differences with our beliefs and values. Learning systems need to manifest the core values on which they are based regardless of those values. We need designs and procedures that optimize and genuinely support important differences, not materials and approaches that either diminish or marginalize them.

The Emerging Design Landscape

Instructional designers need to both recognize and support a range of client needs, contextual factors, and perspectives on the nature of learning, knowing, and understanding. It seems both unwise and counterproductive to reject (or remain oblivious to) the design revolution that is underway in learning environments rooted in nontraditional epistemological perspectives. Significant efforts have been advanced in a variety of fields, some of which have transformed teaching and learning practices in very fundamental ways (see Tobin [1993] for a compilation of constructivist learning environments in the sciences). We need to better understand these approaches—the materials and methods as well as the core foundations and assumptions—if we are to benefit from them. The extent to which we, as a field, learn and expand our role may well determine the extent to which the field survives, grows, and prospers.

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Application Questions

1. Collect ten goals, objectives, or other student expectation statements from three or four different sources (e.g., textbooks, course syllabi, instructional materials). Using the descriptive information in the chapter, classify each as representative of an integrative learning goal or instructional objective. (Make whatever revisions are needed so that it best fits as either an integrative learning goal or instructional objective.) Then revise each to create a new version of each that is consistent with the other epistemological perspective. You should have each of the ten original statements stated in the form of both an instructional objective *and* an integrative learning goal.
2. Select two instructional objectives and two integrative learning goals from the above activity. For each, identify two or three grounded teaching-learning activities and describe why you believe that they represent grounded design practices.