And what are the implications of this philosophy of knowledge for the design of instructional tools? Traditional designers first attempt to analyze content and prerequisites (see Gagne and Briggs, 1979) to identify a course sequence. A constructivist course designer knows that content cannot be prespecified. Although a certain amount of content may be available for students to use, they are encouraged to seek out as many alternate sources of knowledge as they can find which will deepen their perspective of the topic they are working on. And the notion of situated learning is important, where students are encouraged to consider what real life people in a particular environment would do. Traditional theory focused on the typical learner and what he would know when the course was completed. A constructivist learner is not described. Instead, through metacognition, all learners are encouraged to reflect on how and what they are learning and how it fits into what they already know. Traditional theory specifies objectives for knowledge acquisition in advance. Constructivism attempts to identify the culture of a knowledge domain. For example, a constructivist learner would be encouraged to learn how to think like a historian, as opposed to learning dates in history.

The synthesis, or design phase of traditional instruction would involve the design of a sequence and message which would achieve specified performance objectives. Prespecified content and objectives are not congruent with the constructivist worldview. Substituted for these activities would be: learning based on situating cognition in real world contexts; cognitive apprenticeship and modelling; and negotiation of meaning through collaborative learning which emphasizes multiple perspectives of analysis. Another emphasis in constructivism is to make available an array of cognitive tools which can scaffold the learner within this rich, sometimes confusing, environment.

Wilson, et al (1993) provides some interesting insights into how instructional design must change in a constructivism environment. Below are some excerpts from a web article entitled "The Impact of Constructivism (and Postmodernism) on ID Fundamentals". Wilson, Teslow, & Osman-Jouchoux

Who Does the Design?

A key element in effective ID is the nature of the design team. Instead of a designer and subject expert working in relative isolation, constructivist ID suggests that all major constituencies be
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represented on the design team, including teachers and students. These end users' the "consumers" of the instructional "product" should contribute directly to the project's design and development. Greenbaum & Kyng (1991) refer to this as participatory design, and Clancey (1993) recommends "we must involve students, teachers, administrators, future employers, and the community as participants in design..., working with students and teachers in their setting not just calling them into the...lab to work with us" (pp. 9, 20).

We can hear the comment now: "But we've always incorporated the end user in our ID models; this sounds like warmed-over formative evaluation." We respond: "If formative evaluation got done a tenth as much as it gets talked about, ID practice would be in much better shape."

Accommodating Multiple Perspectives

In a pluralistic world, more flexibility must be built into the instruction; after all, even experts disagree on optimal solutions to problems. Not all students share the same learning goals; not all students' learning goals converge completely with instructional goals; students have different styles of learning, different background knowledge. Rather than ignore these differences, instruction should acknowledge the evolving nature of knowledge and encourage students to engage in a continuing search for improved understanding. This plurality of content, strategies, and perspectives typifies postmodern approaches to instruction. Such a pluralistic approach to instruction follows a clear trend toward accommodating multiple goals, styles, and perspectives in instruction (Collins, 1991). But is pluralism the exception or the rule? What one views as "typical" may depend more on one's philosophical and value orientation than on any actual conditions found in schools and training environments. And that relates to a continuing theme of the chapter constructivism is a theory about how things are, about what the mind is like; then, through the lens of that theory, one begins to see ID in new terms.

Guidelines for Doing Constructivist ID

This section is composed of a laundry list of tips for viewing ID from a constructivist perspective, organized according to generic ID phases. For scope reasons, issues of implementation are not addressed. Some of the tips are abstract and conceptual; others are simple and practical. Some depart radically from current practice; others reflect how most practitioners already view their jobs. Collectively, they provide a clearer picture of what it means to do constructivist ID.

General Methodology

- Apply a holistic/systemic design model that considers instructional factors (learner, task, setting, etc.) in increasing detail throughout the development process. A number of key factors are systemically related in any instructional situation. Rather than doing a
learner or task analysis once early in the process, return to these factors and their interactions continuously through the project cycle (see Wilson, Teslow, & Osman-Jouchoux, 1993, for an example).

- Use fast-track (Smith, Miles, Ragan, & McMichael, 1993) or layers-of-need models (Wedman & Tessmer, 1990). Adapt ID methodology to the constraints of a given situation. A single generic ID model is not appropriate for all situations. Identify key principles underlying ID methods; such as consideration of the learning environment; then use those principles in determining a procedures that fits the situation.
- Include end users (both teachers and students) as part of the design team. Incorporate participatory design techniques, with design activity moving out of the "lab" and into the field.
- Use rapid prototyping techniques to model products at early stages. Rapid prototyping is particularly useful in testing out the feasibility of innovative methods or user interfaces (see Tripp & Bichelmeyer, 1990).

Needs Assessment

- Consider solutions that are closer to the performance context (job aids, just-in-time training, performance support systems, etc.). This is consistent with situated models of cognition and with the notion of distributed cognition (Perkins, 1993).
- Make use of consensus- and market-oriented needs assessment strategies, in addition to gap-oriented strategies. Not all instruction is designed to improve performance in a specific work setting. Schools may develop curriculum based on a consensus among political constituencies; Tom Snyder Productions may develop a Carmen Sandiego adventure based on market considerations.
- Resist the temptation to be driven by easily measured and manipulated content. Many important learning outcomes cannot be easily measured.
- Ask: Who makes the rules about what constitutes a need? Are there other perspectives to consider? What (and whose) needs are being neglected? These questions arise out of the postmodern notion of the ideological base of all human activity.

Goal/Task Analyses

- Distinguish between educational and training situations and goals. Acknowledge that education and training goals arise in every setting. Schools train as well as educate, and workers must be educated not just trained in skills to work effectively on the factory floor. Discerning different learning goals in every setting provides a basis for appropriate instructional strategies.
- Use objectives as heuristics to guide design. Don't always insist on operational performance descriptions which may constrain the learners' goals and achievement. Pushing goal statements to behavioral specifications can often be wasted work. The "intent" of instruction can be made clear by examining goal statements, learning activities, and assessment methods. Goals and objectives should be specific enough to
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serve as inputs to the design of assessments and instructional strategies.

- Allow for multiple layers of objectives clustering around learning experiences. Instruction need not be objectives-driven. A rich learning experience may embody a whole cluster of meaningful learning outcomes.

- Don't expect to capture the content in your goal- or task analysis. Content on paper is not the expertise in a practitioner's head (even if you believed expertise resided in someone's head!). The best analysis always falls short of the mark. The only remedy is to design rich learning experiences where learners can pick up on their own the content missing between the gaps of analysis.

- Allow for instruction and learning goals to emerge during instruction. Just as content cannot be fully captured, learning goals cannot be fully pre-specified apart from the actual learning context. See Winn (1990) for a thorough discussion of this issue.

- Consider multiple stages of expertise. Expertise is usually thought of as having two levels: Expert or proficient performance and novice or initial performance. Of course, a two-level model is insufficient for accurate modeling of student growth over time. A series of qualitative models of expertise may be needed for modeling students' progression in learning critical tasks (White & Frederiksen, 1986). Be prepared to confront learners' naive, intuitive theories and to scaffold their learning.

- Give priority to problem-solving, meaning-constructing learning goals. Instead of rule-following, emphasize problem solving (which incorporates rule-following but is not limited to it). Instead of simple recall tasks, ask learners to make sense out of material and demonstrate their understanding of it.

- Look for authentic, information-rich methods for representing content and assessing performance (e.g., audio, video). High-resolution methods for representing content can be useful throughout the ID process. Whereas we usually associate audio and video representations only with presentation of material to students, the same representation tools may be useful for documenting expertise and assessing student understanding.

- Define content in multiple ways. Use cases, stories, and patterns in addition to rules, principles, and procedures. Rich cases, stories, and patterns of performance can be alternative metaphors for finding and representing content.

- Appreciate the value-ladenness of all analysis. Defining content is a political, ideological enterprise. Valuing one perspective means that other perspectives will be given less value. One approach is given prominence; another is neglected. Somebody wins, and somebody loses. Be sensitive to the value implications of your decisions.

- Ask: Who makes the rules about what constitutes a legitimate learning goal? What learning goals are not being analyzed? What is the hidden agenda? Twenty years ago, a designer using "understanding" in a learning objective would have been laughed out of the office. "Understanding" was fuzzy; it was forbidden. Are there other expressions of learning outcomes that remain taboo? Are there other dimensions of human performance that remain undervalued? Good postmodern ID would pursue answers to these questions and be unafraid of re-examining current practice.

Instructional Strategy Development
• Distinguish between instructional goals and learners' goals; support learners in pursuing their own goals. Ng and Bereiter (1991) distinguish between (1) task-completion goals or "hoop jumping," (2) instructional goals set by the system, and (3) personal knowledge-building goals set by the student. The three do not always converge. A student motivated by task-completion goals doesn't even consider learning, yet many students' behavior in schools is driven by performance requirements. Constructivist instruction would nourish and encourage pursuit of personal knowledge-building goals, while still supporting instructional goals. As Mark Twain put it: "I have never let my schooling interfere with my education."

• Allow for multiple goals for different learners. ID often includes the implicit assumption that instructional goals will be identical for all learners. This is sometimes necessary, but not always. Hypermedia learning environments almost by definition are designed to accommodate multiple learning goals. Even within traditional classrooms, technologies exist today for managing multiple learning goals (Collins, 1991).

• Appreciate the interdependency of content and method. Traditional design theory treats content and the method for teaching that content as orthogonally independent factors. Postmodern ID says you can't entirely separate the two. When you use a Socratic method, you are teaching something quite different than when you use worksheets and a posttest. Teaching concepts via a rule definition results in something different than teaching the concept via rich cases. Just as McLuhan discerned the confounding of "media" and "message," so designers must see how learning goals are not uniformly met by interchangeable instructional strategies (see Wilson & Cole, in preparation).

• Resist the temptation to cover material at shallow levels. Constructivist ID may throw away half the ostensive content and focus on deeper learning of less material. This attitude is not unique to constructivism of course programmed instruction theorists made a similar argument 30 years ago.

• Look for opportunities to give guided control to the learner, encouraging development of metacognitive knowledge. Encourage growth in students' metacognitive knowledge, what we often call "learning how to learn." Don't assume that students know how to exercise effective learning control; instead, establish metacognitive skills as a learning goal for instruction to achieve.

• Allow for the teaching moment. Situations occur within instruction where the student is primed and ready to learn a significant new insight. Good teachers create conditions where such moments occur regularly, then they seize the moment and teach the lesson. This kind of flexibility requires a level of spontaneity and responsiveness not usually talked about in ID circles.

• Consider constructivist teaching models such as cognitive apprenticeship, minimalist training, intentional learning environments, and case- or story-based instruction. Seek out instructional strategies and systems that use authentic problems in collaborative, meaningful learning environments (see Wilson & Cole, 1991b, for examples).

• Think in terms of designing learning environments rather than selecting instructional strategies. Metaphors are important. Does the designer "select" a strategy or "design" a
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learning experience? Grabinger, Dunlap, and Heath (1993) provide design guidelines for what they call realistic environments for active learning (REAL); these guidelines reflect a constructivist orientation:

- Extend students' responsibility for their own learning.
- Allow students to determine what they need to learn.
- Enable students to manage their own learning activities.
- Enable students to contribute to each other's learning.
- Create a non-threatening setting for learning.
- Help students develop metacognitive awareness.
- Make learning meaningful.
- Make maximum use of existing knowledge.
- Anchor instruction in realistic settings.
- Provide multiple ways to learn content.
- Promote active knowledge construction.
- Use activities to promote higher level thinking.
- Encourage the review of multiple perspectives.
- Encourage creative and flexible problem solving.
- Provide a mechanism for students to present their learning.

- Think of instruction as providing tools that teachers and students can use for learning; make these tools user-friendly. This frame of mind is virtually the opposite of "teacher-proofing" instructional materials to assure uniform adherence to designers' use expectations. Instead, teachers and students are encouraged to make creative and intelligent use of instructional tools and resources.

- Consider strategies that provide multiple perspectives and that encourage the learner to exercise responsibility. Resist the temptation to "pre-package" everything. Let the learner generate her own questions or presentation forms.

- Appreciate the value-ladenness of instructional strategies. Sitting through a school board meeting is enough to convince anyone of this. Instructional strategies grow out of our philosophies of the world and our value systems. Not only the content, but the strategy can be a threat to particular ideological positions or to learner motivation. Good designers will be sensitive to the "fit" between their designs and the situation.

Media Selection

- Consider media factors early in the design cycle. Practical and cost constraints typically dictate that tentative media decisions will be made relatively early in the design process. Media then becomes one of the instructional factors that receives increasing attention through iterations of analysis.

- Include media literacy and biases as a consideration in media decisions. Different media send different "messages" to an audience, independently of the instructional content. Look for any "hidden curriculum" elements in different media choices. Avoid negative stereotypes and cultural biases. Consider the rhetorical goodness of fit between media choice and overall instructional purposes. Also, design messages that are sensitive to an
audience's media sophistication and literacy, paying particular attention to humor, media conventions, and production values.