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INTRODUCTION

Collaborative learning with technology is more than the use of some tool; rather, it requires careful design of not only tools, but also the learning activities and settings in which those tools take place. Computer-supported collaborative learning is distinguished by the use of technology to support collaborative learning, as well as by a history of examining not only the design of technology tools but also by the design of learning environments, including such aspects as curriculum or even more emergent aspects such as facilitated student-driven inquiry. In this chapter, we discuss theories, principles, and techniques for designing computer-supported collaborative learning environments. In the next section, we examine the role of instructional theories and provide several examples. Following that, we examine some of the designed elements of CSCL and the settings in which it may be implemented. Finally, we discuss some of the design models used in creating CSCL environments.

THEORETICAL UNDERPINNINGS OF COLLABORATIVE LEARNING DESIGN

The first section of this volume has focused on understanding learning theories that attempt to explain collaborative learning. In this chapter, we acknowledge the role of these theories in designing CSCL, but we also begin to focus on instructional theories. Unlike learning theories, instructional theories may be silent on what learning involves or how a set of conditions leads to learning, but they must make a strong statement on what is to be done in order to foster a particular type of learning. Bruner (1966)
initially proposed theories of instruction as requiring a mode of motivating a learner, a current instruction structure, and an incentive structure for learners. However, in more recent work, especially in collaborative learning, the idea of a theory of instruction has evolved away from predefined content structures and sequences, and instead toward systems in which content is explored through defined processes, prioritizations of key generative concepts which might be realized differently when driven by knowledge-building principles (Scardamalia & Bereiter, 2006), or knowledge integration processes (Bell & Linn, 2000). Indeed, collaborative learning poses a challenge in some sense for the term instruction if, instead, the goal is to construct an environment where students learn from and with each other instead of through direct instruction by a teacher. The field of instructional systems design has broadened the sense of the term instruction explicitly to encompass some of these ideas (Reiser, 2012).

Collaborative learning design strategies are not contingent upon one specific learning theory. Designers may have theoretical preferences, but just having a theory is not adequate and design considerations are needed. In any instructional experience, it is likely that the participants are learning in a way that contains elements explained by a variety of learning theories. While a sociocultural learning theorist might explain the learning here in terms of Vygotsky’s zone of proximal development (Vygotsky, 1978) or a sociocognitivist might explain it in terms of cognitive apprenticeship (Collins, Brown, & Newman, 1989), the information-processing theorists may focus on attention, memory, and cognitive load. It is unlikely that any one learning theory is the best way to explain every aspect of a learning situation. Even if one particular learning theory offers the most comfortable fit to explain some aspect of learning, other theories can often be used to explain the same outcomes and processes.

Although there are many instructional theories and approaches, it is useful to examine a few examples in order to better understand the role of instructional theories for designing collaborative learning. Below, we discuss four instructional theories as examples with relevance to design: Reciprocal teaching and the jigsaw approach; the problem-based learning model, the communities of practice model, and the knowledge-building communities model. Each of these models provides a vision for how to structure a collaborative learning environment such that it will lead to learning.

The jigsaw method (Aronson & Yates, 1983) and reciprocal teaching (Palincsar & Brown, 1984), both used extensively in the communities of learners model (Brown & Campione, 1996; see also Bielaczyc, Kapur, & Collins, chapter 13 this volume), are methods used to structure collaborative learning. In the jigsaw method, learners are given a problem requiring information that they themselves do not possess. The problem is broken down into different parts, and individual students from different groups are assigned to different areas in which they work in “expert” groups. Finally, the group reconvenes to share expertise across team members, and the problem can be solved only with the contributions of each member. Because each person’s contribution is essential to the shared solution, learners are both motivated to develop their expertise and respected for that expertise.

Reciprocal teaching also involves students teaching other students in collaborative groups. In reciprocal teaching, students engage in cooperative activities in learning from text and employ four key strategies including summarizing, question generating, clarifying, and prediction. Initially, the teacher models the use of these reading strategies for students, and then the students take on the role of the teacher, leading the group to use these strategies to construct the text meaning. Students take turns leading the group with different pieces of text; the learners model, observe, and practice, working collaboratively with the teacher and peers.

Problem-based learning, first popularized by Barrows and Tamblyn (1980; see also Hmelo-Silver & DeSimone, chapter 21 this volume), is an instructional model in which students are expected to learn through group work in attempting to solve real-life problems with the support of a facilitator. A key part of the model is the idea that if students iteratively identify knowledge gaps required to solve the problem, and then attempt to mediate those gaps with reference to authoritative sources, the students will not only become exposed to content but will internalize it in a way that is highly practical and not inert. In addition, PBL attempts to support the development of high-level lifelong learning skills and other appropriate problem-solving strategies that might be more transferable (Hmelo-Silver, 2004). PBL relies on collaboration among learner-peers as a key part of helping assemble problem-relevant information, identifying and negotiating strategies, and identifying knowledge gaps. In the PBL model, the teacher models problem-solving processes, supports knowledge finding and gap identification, and facilitates a process of not only problem solving but also reflection and knowledge construction (Hmelo-Silver, 2004; Hmelo-Silver & De Simone, chapter 21 this volume).

Communities of practice are social communities of individuals who share a set of core practices, rather than an interest or a background (Lave & Wenger, 1991; Orr, 1990). Lave and Wenger identified naturally occurring communities of practice, and demonstrated how individuals move from peripheral to central participation in the practices of the community, and used this notion to define learning as the adoption of social practices. Moving from naturally occurring communities of practice to deliberate ones, often fostered by technology, is a process Wenger, McDermott, and Snyder (2002) called “cultivation,” in which learning is fostered by connecting individuals with similar problems to solve; sharing, documenting, and validating what they know and do; and applying these ideas to shared or individual problems, only to repeat the cycle again. Wenger advocated seven dimensions important for communities of practice: designing for evolution (allowing the community to evolve rather than trying to micromanage it), beginning dialogues between “inside” and “outside” perspectives, inviting multiple levels of participation, developing both private and public community spaces, providing incentives or value for participants, combining familiarity and excitement (or routine and novel practices), and establishing regular rhythms of activity within the community. The goal of a community of practice does not focus on supporting knowledge application; collaboration is for developing shared practice and for accelerating participants to become members of the community.

Another model focusing on community is the knowledge-building community (Scardamalia & Bereiter, 1994; 2006; see Chan, chapter 25 this volume). Rather than solving problems collaboratively or developing shared practices, like communities of practice, knowledge-building communities emphasize collective cognitive responsibility in which all participants share responsibility for advancing the community’s collective knowledge, often mediated by Knowledge Forum, a computer-supported collaborative learning environment. Knowledge-building environments support intentional learning and epistemic agency as students collectively pursue knowledge (Scardamalia & Bereiter, 2006). Unlike traditional classrooms, knowledge-building communities are driven by the problems generated by the learners and the results described previously.
levels of collective epistemic agency among learners. Student-generated problems are objects of inquiry as students work collectively to generate explanations, supported with authoritative information, to continually improve their theories. For example, a learner could post a computer note with the scaffold, "I need to understand," followed by another student posting a note with the scaffolds "my theory" and "new information" to tackle the problem. Different computer notes may consist of questions, theories, results of an experiment, and additional questions, and students may put a scaffold "putting our knowledge together" to track how the community has made advances (see Chan, chapter 25 this volume). Knowledge-building communities have been explored in a wide range of school settings, in which teachers serve as co-investigators and set broad parameters for the inquiry processes. The goal is to help learners work on creating and improving their knowledge, similar to scientists working on creating new knowledge; students are to become more responsible for managing their collaborative learning and democratizing knowledge, rather than focusing on authoritative sources for knowledge (Scardamalia, 2003).

What these four examples show is a variety of approaches for developing instruction, using collaborative learning in a way that might be supported by technology (though not all of these examples necessarily use technology). Typically, instructional designers are concerned with validating learning needs, learning goals, and objectives; with sequencing content and determining optimal presentation and engagement strategies for the content; and with providing learners with predefined assessment feedback to drive their learning. In contrast, these four examples demonstrate an openness toward learning goals and objectives; a willingness to let different forms of collaboration determine the sequence of ideas, usually building on prior conceptions of learners; and on using more social or open-ended forms of assessment. For example, assessment in a jigsaw classroom might rely on being able to explain a concept to peers or use it to help solve part of a joint problem; in a PBL classroom, sequencing might come from aspects of a particular authentic problem, and so on. Thus, one way to examine how to design CSCL environments is not to focus on the particular recommendations of one instructional theory (though a general of these theories are covered in much greater detail elsewhere in this handbook). Importantly, the design of CSCL is not to define specific learning theory or a content domain to be covered and the optimal way to cover it. Instead, CSCL instructional theories often specify roles, norms, values, or other process-oriented aspects of the learning environment. The CSCL designer gives up control of many instructional choices that would be normal in the traditional design of a noncollaborative learning environment. In exchange, the designer can tap into powerful (if unpredictable) social processes to help drive learning. Below, we discuss some of the types of decisions that are within the purview of a designer of CSCL.

DESIGNED ELEMENTS OF COLLABORATIVE LEARNING

Collaborative learning designers, whether instructional designers and technologists creating materials and programs to be used by others, or classroom teachers who are preparing lessons for their own students, must consider various elements of the learning experience during their design process. Some of these are the standard elements one might expect to be designed for any instruction, whereas others are specific to the collaborative process and are intended to help ensure it is a productive and effective one. Although discussed separately for the sake of clarity, the elements are systemic and synergistic in nature; changes to one will impact the others, and the best designs are those that are able to make the elements work in harmony with each other. Below, we consider several designed elements of CSCL environments: (a) the learning goals, (b) the collaborative premise, (c) group assignment and composition, (d) assigned or emerging roles, (e) discourse norms or values, (f) collaboration scripts or sequences of activity, and (g) types of facilitation and motivational inputs such as incentives.

Learning Goals. Learning goals set the stage for the rest of the learning experience. Without clear learning goals, the rest of the learning experience is difficult to design. Ideally, learning goals are stated in terms of learner outcomes, not activities. From learning goals develops a sense of alignment for the rest of the learning experience; each subsequent element may be checked against the goals to ensure that the element—whether an activity, resource, or instruction—remains consistent with the goals. In CSCL goals that go beyond the acquisition of fixed skills or propositional knowledge are important; for example, goals such as developing a capacity for inquiry, or content goals that may be more flexible than those a fixed curriculum would produce. A CSCL learning goal might be to understand systemic connections in ecosystems generally, as opposed to a more inflexible and objectively measurable learning goal such as being able to recall a list of the predators of one species in one specific ecosystem on a test.

Sometimes learning designers begin with a stated goal around which they must plan instruction, but at other times designers will begin with an idea for an activity that is interesting or compelling to them and may not have a stated goal. However, within any activity, implicit learning goals can be found. By making those implicit goals explicit, a designer can determine if the goals truly represent their intent and the needs of their learner audience, and whether or not a particular design is succeeding.

Collaborative Premise. The collaborative premise is the very reason for engaging learners in a collaborative process and should be made clear to the learners, who need to know why they are supposed to collaborate. The premise should express clearly what value might emerge from their collaborative work, why their interdependence will be an important part of the learning process or their personal incentive structure in what ways learning will be interdependent, and how the very act of collaboration relates to the learning goals. If these things cannot be articulated to the learners, then the collaborative premise is likely to be weak. Some approaches, such as PBL, gaming, and scenario-based learning, lend themselves directly to a premise; the collaboration might lead directly to a shared outcome or goal. Other instructional approaches might require more direct or intentional premise development; for example, if a teacher directs students to discuss a reading in an online discussion board without giving further guidance, the learners may wonder whether their goal is to summarize their thoughts, have their own questions (if any) answered, or create a shared understanding of key features of the reading. At times learners may be resistant, feeling that they could be more successful or efficient on their own. The collaborative premise, however, should motivate them to work together. This is related closely to other elements, such as group assignments, designed roles, and work processes.

Group Assignment and Composition. A group assignment should be a deliberate decision, typically specifying both the size and composition of collaborative groups. Size is critical because too small a group may result in limited opportunities for collaboration or too much work and too large a group may make it difficult for learners to...
form a collaborative vision (Strijbos, Martens, & Jochems, 2004). Additionally, group size may vary during the course of a collaborative learning project, with larger groups forming or smaller ones splintering off (and even individual time being encouraged or provided) as appropriate to the specific activity or task (Dillenbourg, 2002).

Group composition—specifically, the relative homogeneity or heterogeneity of a collaborative group—is also necessary to consider. Certain activities will work better when groups are of similar ability levels, while others will benefit from diverse abilities or talents (Blumenfeld, Marx, Soloway, & Krajcik, 1996; Webb, Nemer, Chizhik, & Sugrue, 1998). Even in a homogeneous ability group, the zones of proximal development for individual learners will vary somewhat, and learners will need to be able to support each other’s learning via peer scaffolding in order to collaborate successfully (Berkman & Jones, 2003). Other group composition factors to consider include age, gender (Dillenbourg, 2002), and even self-efficacy beliefs, which have been found to impact group motivation (S.-L. Wang & Lin, 2007).

If designers anticipate or plan for cross-cultural collaborative groups then this aspect of group composition should be considered during the design process. Cross-cultural groups may face initial challenges on the path to successful collaboration (Liu, Liu, Lee, & Maglika, 2010; C. M. Wang, 2011). In particular, groups composed of culturally diverse learners may need specific guidance regarding roles, expectations, and how the group members might best work together.

In some circumstances a designer may decide not to specify group assignments for specific reasons (e.g., if one important learning goal is for learners to develop skills in leadership or team formation), but even within this realm, the decision to not specify group assignment will undoubtedly impact upon the collaboration, and the instructor will need to convey the parameters in which the group assignment is to take place.

Roles. Designed roles can provide learners with a structure or direction to guide their collaboration by telling learners what part each will play in the collaboration. Imagine five people placed in a group and provided with a general outcome, such as a written document. Given such an assignment, with no additional oversight or direction, the learners may embark on any number of paths to completion. They could take a divide and conquer approach, each working alone on a section of the end product. They might work on each part together, negotiating every decision along the way. Or they might have one or two group members take over and do the entire assignment, controlling the process and not providing opportunities for, or encouraging participation of, their fellow learners. These approaches vary in their efficiency as well as their degree of collaboration and the evenness of learning experience for different group members. A study by De Wever, Schellens, Van Keer, and Valcke (2008) showed that students, by and large, do take up roles as assigned to them, and the previously mentioned reciprocal teaching model has demonstrated some of the power of assigning teacher roles for supporting learning. Even when learners are not given differentiated roles, the teacher’s overall expectations for their roles should be made clear.

Norms. Also important is stating expectations or establishing norms for the types of interactions learners are supposed to have. Interactions among learners should not be assumed, no matter how structured or supportive the learning tools may be (Kreijns, Kirschner, & Jochems, 2003). Left to their own devices, without explicit expectations, learners may focus quite narrowly on their own contributions to the outcome and fail to engage fully or collaborate with their peers (Wheeler, Yeomans, & Wheeler, 2008). These participation expectations are best stated by the instructional designer, who holds the initial vision for the collaborative activity. An instructor may then alter them as necessary to fit a given context, but will at least be working from a plan.

Collaboration Scripts. One method that designers use to structure collaboration is the use of collaborative scripts (see Fischer, Kollár, Stegmann, Wecker, & Zöllmann, chapter 22 this volume). Scripts vary in their specificity, but what they describe is an ordering of events or activities, usually implying roles that are to be taken during those events or activities. Some scripts are quite linear, specifying a fixed sequence of activities or tasks, sometimes even with gate-keeping functions that control when one activity may give way to the next; for example, the jigsaw teaching sequence. On the other hand, very loose scripts may allow spiral or looping orderings of activities or events, where learners may at any time decide to move in and out of information-gathering activities or agenda-setting activities or reflection activities. A general notion of a cycle of inquiry may be present, but it is not rigidly linear or even a cyclical sequence of tasks in time.

Facilitation and Motivation. Collaborative learning, although focused heavily on learner–learner interactions, is not teacherless learning. Teachers play an important role in the collaborative process, facilitating learners by monitoring their progress and providing support, guidance, and feedback as needed. Collaborative learning designs need to include guidance for teachers on how best to facilitate the learning process for their students and how to adapt the learning tools and activities as needed in their own context (Dillenbourg, Bervel, & Fischer, 2009). Interactions among learners need to be fostered (Kreijns et al., 2003), and the learning designer specifies what these interactions should look like and makes recommendations for how collaborative learners might be supported.

Designers also should consider motivational elements of the learning situation, both intrinsic motivation and extrinsic incentives. Motivational elements are not separate unto themselves, but rather may be integrated into various other elements of the design. For example, allowing learners to engage in self-selection when forming groups may be motivating (Q. Wang, 2009), although other grouping variables and how group composition might impact upon collaborative success should be considered as well. Competitive versus cooperative reward structures can be considered (Johnson, Johnson, & Stanne, 1986). Grading, of course, is not the only extrinsic motivator; students may also be motivated by the intrinsic satisfactions of intellectual work. For example, allowing collaborative groups to have some choice in the topics they work on can help increase their motivation (Q. Wang, 2009). Additionally, reputation is often cited as one of the motivators of participants in open-source communities. Finally, the instructors also play an important role in motivating learners, and they must be sufficiently able to support learners as they interact with and through collaborative technologies (Dennen & Bonk, 2007).

One last point bears emphasis: the choices made by the designer may be applied uniformly across learners, or applied differentially, but, regardless, learners differ from each other, and therefore variability should be expected in the impacts of design choices. Learning control is one such consideration. Not all learners should be able to have a high degree of control; the appropriateness and degree of learner control may vary according to the learner’s age and expertise (Lowryck & Pöysä, 2001). In this case, variable levels of control might help to accommodate the needs of a wide range of learners, but even customizing the level of control is unlikely to produce homogeneous outcomes. In short, variation among learners needs to be considered when designers make decisions about the collaboration aspects we have described above.
DESIGN FOR DIFFERENT SETTINGS

Designing collaborative learning requires a departure from more traditional instructional design in a variety of ways. Historically, instructional design has focused on learners as individuals and consequently has been concerned with individual outcomes, whereas collaborative learning also requires consideration of the group and its outcomes (Gros, 2001). These two processes need not be at odds. The collaborative process has necessitated a shift from thinking about instructional design as an activity with causal outcomes to an activity with probabilistic outcomes (Kirschenr, Strijbos, Klijn, & Beers, 2004). The uncertainty about outcomes is necessary given the uncertainty of human interactions.

Whatever one is designing and for whatever setting, context is a critical factor to consider. As Tessmer and Richey (1997, p. 88) pointed out, "Instructional designs can accommodate context, but cannot control it." In other words, the task at hand requires flexibility, as the designer negotiates between instructional ideals and real-world users and conditions. Further, what works in one setting may not work in another, creating what Alvino, Asensio-Perez, Dimitriadis, and Hernandez Leo (2009) termed the script instantiation problem. This problem occurs when one designer tries to adopt another's CSCL scripts—although really the problem could affect the reuse of any designed instructional element—and fails to consider the differences fully in context from one setting to the next. This adoption process, in effect, recontextualizes the instruction and may result in a less effective learning experience from the learning objectives unless context-appropriate modifications are made.

This issue of control is not to be underestimated. Instructional designers may wish to feel that they have control over their designs, but the design cycle is not truly complete until the design is implemented and evaluated. Hoadley (2010) discussed this issue in the context of CSCL scripts, noting that the enactment of a design may not match the initial intent. In the end teachers and learners will adapt lesson plans, software programs, and learning materials to suit their own specific goals and purposes.

For designers, the most practical approach is probably to focus but not fixate on their goals. The end function that a collaborative learning design needs to have been stated quite clearly by Dillenburg, Järvelä, and Fischer (2009, p. 6), "to create conditions in which effective group interactions are expected to occur." This statement collaborative learning in any setting, and thus across settings the designer must determine how the medium will impact or shape group interactions.

Face-to-Face Collaborative Settings

In a face-to-face setting, collaborative learning requires, at a minimum, a plan that details what should be learned (learning objectives), ground rules for how learners should interact, what types of activities may be used to achieve these objectives, and desired outcomes. The specification of process (activities) and product (outcomes) may vary in detail depending on the objectives, the learning domain, the learners, and the facilitator.

Computer-Supported Collaborative Settings

In the context of designing learning, computer-supported collaborative learning is a broad category. Although learning with (i.e., in face-to-face settings) and through (i.e., in computer-mediated settings) computers are both means through which CSCL may occur, they are sufficiently different practices and require separate discussion.

Learning with Computers. CSCL in face-to-face settings is dependent on the interplay of rules, roles, and tasks; collectively these elements should elicit a desired interaction among the learners (Zurita & Nussbaum, 2004). An additional actor in the collaborative context is the computer, and designers need to consider how interactions will be changed or shaped by the technology. For instance, technology may be used to attempt to enhance or heighten the face-to-face interaction, or may be used to try to subvert it in specific ways; for instance, technology might permit anonymity even in face-to-face settings (Hsi & Hoadley, 1997). The designer should specify when and how learners will make use of the computer, noting if they will need to share or take turns, select a person to use it, or if each learner will each have his or her own computer.

CSCL-specific tools are often designed to support the social processes on which successful collaborative learning is dependent. However, in practice, their designs often fall short (Kreijns et al., 2003). While tool design and features are important, they must be aligned effectively with a task, with learners following role-based guidelines and facilitated at a context-appropriate level.

Mobile computer supported collaborative learning (MCSCIL) builds on the original concepts of CSCL with the addition of portability, allowing CSCL activities to take place in the field rather than just in classrooms and computer labs (see Looi, Wong, & Song, chapter 24 this volume). Mobile devices have been used to facilitate collaboration in a wide variety of contexts, with examples ranging from classrooms at all levels (Evans & Jokhi, 2008; Roschelle, Rafanan, Estrella, Nussbaum, & Claris, 2010) to museums and field experiences (Sharpe, Arnedillo-Sánchez, Milrad, & Vavoula, 2009). Mobile devices have been suggested as a technology that might alleviate some of the limitations found in face-to-face CSCL activities (Roschelle & Pea, 2002; Zurita & Nussbaum, 2004). Of particular note is that all learners can have their own devices and, as a collaborative group, engage simultaneously with their devices and in face-to-face interactions with each other. Within a design context, this contrast between shared computer, individual computer, and mobile face-to-face CSCL activities once again highlights the key question for consideration: How will the technology impact upon interaction?

Learning through Computers. Designing for computer-mediated collaborative learning requires anticipating the needs of learners who may not be colocated and who may not be working in real time. These geographic and temporal differences result in slightly different design considerations, suggesting that computer-mediated learning requires more structure than any other form, particularly when it occurs asynchronously.

Social connectedness is a concern when learners are separated geographically from each other and do not know each other in another context. Their initial tendency may be to take on a strict task focus, although doing so may ultimately hurt their ability to succeed. Learner communication should not be limited to task-based discourse, and learning designs may need explicitly to encourage social interactions or let learners know that such interactions are acceptable (Kreijns et al., 2003). Sufficient exchange of personal information is necessary so that learners can establish a sense of each other and overcome the online environment's lack of nonverbal communication cues. Social interactions also help learners to establish online group norms (Slagter van Tryon & Bishop, 2009).


Computer-based interactions generate a tremendous amount of information that can be used within a learning design to help facilitate or encourage collaboration. Janneke (2010) recommended using tools to highlight parts of interactions that get lost in the online environment. For example, in a classroom learners can tell if others are paying attention, but online settings are typically bereft of such indicators. Providing information about who has accessed (and presumably read) a given message will help mimic some of the information available to face-to-face learners. Janneke also recommended against the heavy use of push technology, because providing learners with easy access to notifications and updates can encourage the development of reactive behavior as a norm.

A final point about learning through computers is that computer mediation may not be simply about mediating communication acts. Computers can mediate other important aspects of the learning environment in CSCL. For instance, Q. Wang (2009) suggested that CSCL tools should now include space for sharing files, extending their collaboration abilities beyond just discussion space to include shared artifacts as a core function. Similarly, other tools such as activity awareness, reputation or recommender systems, or adaptive scaffolding, might have great impact on CSCL environments with out directly routing communication acts through the computer.

Trends and New Technologies. Looking ahead, collaborative learning designs must continue evolving to accommodate new technologies and learning modalities. For example, learners are being connected increasingly through smart phones (see Looi et al., chapter 24 this volume). The ubiquity of mobile phones worldwide suggests that it is a technology ready to be leveraged to support collaborative learning in a wide variety of contexts (Evans & Johri, 2008), and in particular to mediate collaboration among distance learners. Researchers are beginning to examine how CSCL scripts might be run on mobile phones (Dillenbourg & Crivelli, 2009), and how mobile phones might be leveraged to introduce CSCL into new settings. Similarly, the worlds of gaming and CSCL have found points of overlap (see Kafai & Fields, chapter 27 this volume). Various multiplayer games rely on collaborative principles and support informal learning, providing the inspiration for the development of collaborative learning games (Jong, Shang, & Lee, 2010; Monahan, McArdle, & Bertolotto, 2008; Scacchi, Nideffer, & Adams, 2008). With each of these advancements comes a potential new set of parameters, conditions and parameters to be considered when designing collaborative learning.

OTHER DESIGN PROCESSES AND MODELS

Collaborative learning designers may draw upon a variety of design processes and models to help guide and support their efforts. An instructional design approach to designing collaborative learning has been mentioned throughout this chapter, but participatory design and interface design also merit a mention in this context.

Historically, instructional design models such as Analysis, Design, Development, Implementation, Evaluation (ADDIE) (see Molenda, 2003 for a discussion of this model's origins and use) or the Dick and Carey model (Dick, Carey, & Carey, 2001) focused heavily on analyzing users and their needs, then meeting those needs through the design of materials, and, finally, by evaluating the designs (either formatively or summatively). However, other models for instructional design emphasize a more opportunistic or less top-down process. Merrill's Pebble in the Pond design method (Merrill, 2002) starts with a prototypical problem that learners should be able to solve, then generalizes to other similar problems, and finally works backwards to determine learning goals from the problems, instructional strategies for the learning goals, and finally designs intended to deliver those strategies.

While traditional instructional design processes consider the learner as the end-user, they do not typically involve the learner directly in the instructional design process as a collaborating designer (Carr-Chellman & Savoy, 2004). Participatory design processes purposefully involve stakeholders, in particular learners, in the design process. Carr-Chellman and Savoy spread design processes along a continuum, with traditional instructional design involving the least control, and emancipatory design at the other end described by Giroux or Friere as the most user control. Participatory design falls short of emancipatory design in that its designers are not the sole and most privileged members of the design team, but they are not the sole and most privileged members of the design team. Representative learners may be members of a design team that plans learning activities in advance, or the design process can unfold over the course of the instruction with all learners serving as codesigners. Participatory design requires both time and trust within the learner-design team members, and thus is probably best undertaken on larger learning projects (Carroll, 2009). However, one can consider extended agenda setting, similar to the agenda set by knowledge-building communities, as a form of participatory learning design.

Instructional design and interface design are complementary processes, with people with expertise in both areas are needed when designing collaborative learning tools. Although traditionally the domain of programmers or ergonomists, interface design has become increasingly important for learning designers to understand. The best designed instruction and interactions may fail if embedded in a confusing interface (Kirschner et al., 2013). When designing tools that support or mediate learning it is important to draw upon the principles of interface design discussed by people such as Schneiderman (1997) and Cooper (1995; Cooper, Reimann, & Cronin, 2007) and even the multimedia design principles supported by Mayer (2009) along with engaging in cycles of usability testing (Dumas & Redish, 1999; Nielsen, 1999; Nielsen & Loranger, 2006). Many of the design processes used in human-computer interface design have wide applicability to learning design, such as value-sensitive design (Friedman & Kahn, 2000), scenario-based design (Bardram, 2000), or rapid prototyping design (Hartson & Hix, 1989). Further, maintaining a focus on the technology and its affordances can help designers work toward the recommendations made by Resta and Lafreniere (2007) to focus on CSCL that is not benchmarked against face-to-face learning but rather takes full advantage of the unique offerings of the computer-based environment.

CONCLUSIONS

Collaborative learning design is a necessarily complex process; to treat it otherwise would be to neglect some of the core elements necessary to promote fruitful learning interactions. CSCL provides many important leverages for designers to use to shape the learning environment, but it also introduces complexity (Table 22.1). Designers need to consider the full context—pedagogical, interpersonal, environmental, and technological—of the settings in which their learning activities, tools, and materials may be used. While the designer may espouse a particular learning theory or theories, this rarely provides much guidance for what is to be designed or how. Designers must select and carry out a design process through which they will select appropriate instructional strategies and make decisions regarding designed elements in the learning environment. In
Table 22.1: Summary of Design Issues for CSCL

<table>
<thead>
<tr>
<th>Considerations</th>
<th>Design Models or Processes</th>
<th>Instructional Theories</th>
<th>Designed Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting: Learning with or through computers, synchronous vs. asynchronous</td>
<td>Learning design methods or techniques (e.g., PBL, jigsaw, reciprocal teaching)</td>
<td>Learner roles</td>
<td>Learning goals</td>
</tr>
<tr>
<td>Existing culture or norms</td>
<td>(for more CSCL-relevant strategies, see Bonk &amp; Dennen, 2003, pp. 338–340, Table 23.5 and Table 23.6)</td>
<td></td>
<td>Collaborative premises</td>
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<tr>
<td>Prior knowledge and individual differences</td>
<td></td>
<td></td>
<td>Group assignment and composition</td>
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<td></td>
<td></td>
<td></td>
<td>Learner roles</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>(assigned or emergent)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Discourse norms or values</td>
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<td></td>
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<td></td>
<td>Collaboration scripts or sequences of activity</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Types of facilitation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Motivational inputs such as incentives</td>
</tr>
</tbody>
</table>

the end, most design processes will involve negotiation and trade-off among these elements and any practical constraints surrounding the learning situation. Outcomes in the design of CSCL are more varied and unpredictable than they would be with more traditional forms of instruction. However, a designer who is well versed in a variety of design processes and models and who approaches design with flexibility will be well prepared to handle the multifaceted decisions that may be required.

REFERENCES


23

**COLLABORATION SCRIPTS IN COMPUTER-SUPPORTED COLLABORATIVE LEARNING**

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Information and communication technologies are being used increasingly to support collaboration in formal and informal educational settings. Research on computer-supported collaborative learning (CSCL; Stahl, Koschmann, & Suthers, 2006) has investigated methods of employing computer technologies to facilitate collaborative processes in groups of learners, and are typical for the realization of advanced instructional approaches such as inquiry learning (Linn, Lee, Tinker, Husay, & Chic, 2006) or knowledge building (Scardamalia & Bereiter, 2006). Although research has suggested the greater potential for such challenging scenarios to increase the attractiveness and effectiveness of learning experiences (Scardamalia & Bereiter, 1996; Stahl, 2002; Stribijn, Kirschner, & Martens, 2004), many learners have difficulty exploiting these opportunities when simply assigned to groups and left to their own devices (e.g., Barron, 2003). This especially applies when learners have little knowledge of how to collaborate effectively with one another; that is, when they have low-structured internal collaboration scripts (Kollar, Fischer, & Skotta, 2007). In such cases, learners may be supported effectively by external computer-supported collaboration scripts, which specify, sequence, and distribute learning activities and roles among the learners of a group (Kollar, Fischer, & Heese, 2006). Thus, collaboration scripts can be regarded as specific instances of collaboration-related scaffolds that provide interaction-related support rather than content-related support, which makes them a special kind of scaffold for collaborative learning. As an example of early face-to-face collaboration script approaches, the scripted cooperation approach (ODonnell & Dansereau, 1992) first assigns the task of reading and summarizing a paragraph to one learner, second asks the other learner to review the summary, and third rotates these roles for the next paragraph. Further examples for collaboration scripts that