https://doi.org/10.28990/jaid2018.072003

The Instructional Design Studio as an Example of Model-Centered Instruction

Jason McDonald, Brigham Young University

Abstract: This study describes how instructional design (ID) educators can better understand and implement design studio pedagogy, by comparing the approach to the principles of model-centered instruction (MCI). I studied this issue through a focused literature review of recent cases of ID studio implementations, comparing features and activities in each case to the conceptual principles of MCI. In aggregate, this analysis provides seventeen individual options for how educators can structure the ID studio. Additionally, comparing studio practice to MCI may also help ID educators experiment with their own studio improvements in a more systematic manner.

Keywords: studio pedagogy; design studio; instructional design; model-centered instruction; case studies; literature review

In recent years, the pedagogy known as the design studio has been explored as an emerging form of instructional design (ID) education (Knowlton, 2016). Developed in fields such as architecture and industrial design, the design studio is a form of project-based learning, consisting of activities such as having students complete authentic project work, under the direction of instructors who model meticulous design thinking, and where they receive rigorous feedback from instructors, fellow students, and outside experts (Schön, 1985). Conceptually, the design studio is also characterized by what Cennamo and Brandt (2012) identify as its surface structures, pedagogical activities, and epistemological understanding:

> *Surface structures* refers to the easily observable components of studio: the space, furniture, time blocks, assignments and so forth, roughly equivalent to the tools available for the teachers' and students' use; *pedagogical activities* include activities and interactions, such as iterative cycles of design, hands-on investigations, and group discussions of work in progress, roughly equivalent to the practices of the studio; and *epistemological understanding* describes the beliefs that guide studio activities such as the nature of design knowledge and how it is constructed. (p. 844; emphasis in original)

The studio is not defined by any of these dimensions in isolation of the others, however. What makes the studio unique is that all its components work together to reinforce a distinctive culture of learning and teaching that is meant to prepare students for professional work in a chosen discipline. This is where the studio differs from other forms of project-based learning—the environment is meant to enculturate students into the "tools, practices, and beliefs" of their chosen profession, and so acts "as a bridge between [their] academic and professional communities" (Brandt et al., 2013, pp. 336-337).

It is purposes such as these that have drawn attention from ID educators. In the interplay between modeling, discussion, practice, and feedback, students in a studio begin to experience what it means to be an instructional designer, and start to develop competencies that are difficult to identify but almost universally recognized as attributes of the skilled professional (Clinton & Rieber, 2010). This is important because so many design skills are tacit, and difficult to explicitly teach. As Hoadley and Cox (2008) stated, "the paradox of teaching design is that designers know things, but they can't tell others about them in a way that novices will understand" (p. 19).

Some evidence suggests, however, that educators could benefit from support as they integrate the studio approach into ID curriculums. Traditionally, people learn to teach in a studio through their experience as students in a studio. If ID educators do not have this

background, they "may operate on vague notions of studio instruction, or on long-standing misconceptions" of how the approach works (Boling & Smith, 2014, p. 53). Even those with background in a studio (as teacher or student) can unconsciously replicate their prior experiences without reflection on whether their actions will be effective in a new context (Gray & Smith, 2016). Additionally, research on the ID studio does not yet provide "solid practical . . . guidance on how [to] maximize the studio experience toward learning" (Knowlton, 2016, p. 352). What is needed are ways of assisting ID educators when they are making tactical and strategic decisions about matters such as:

- The role the studio will play in their curriculum;
- What features of the studio will lead to outcomes they desire;
- How to shape traditional studio structures to fit the culture, constraints, or opportunities found in local situations; or,
- How to take advantage of their knowledge of learning and instruction to improve on what the studio offers.

To summarize, what support can be offered to ID educators, to assist them in thinking critically about options for structuring their own studio implementations?

In this paper I address this issue. I do so by framing the ID studio in terms of the instructional theory of model-centered instruction (MCI), and exploring what possibilities this reveals for making decisions about the forms that studio structures could take. MCI proposes that "effective and efficient instruction takes place" when people interact with dynamic representations (or models) of real-world environments, supplemented by "a variety of instructional augmentations designed to facilitate learning from the experience" (Gibbons, 2001, p. 512). This theoretical statement aligns with the purpose of the ID studio, which can be viewed as a model of authentic design practice where novices experiment with the complexity and unpredictability found in professional environments, under the guidance of experienced mentors who supplement the model with various forms of instructional support. The central question, then, guiding my inquiry is: what possibilities for shaping the ID studio are generated by viewing it as an example of model-centered instruction?

Literature Review – Background on the Design Studio and on Model-Centered Instruction

The design studio. Design studio teaching has a long history in many engineering and artistic disciplines. Dating back to at least the 19th century, it is considered the "signature pedagogy" in fields where the historic form of inquiry is "experimenting and collaborating, building things and commenting on each other's work. . . . [and where] the focal point of instruction is clearly the designed artifact" (Shulman, 2005, p. 54). The traditional studio grew out of the apprenticeship system, allowing master professionals to oversee the work of more than one student at a time. It has become accepted as the way students develop tacit abilities that are difficult to define but almost universally identified as attributes of the skilled designer, such as judgement, artistry, and the forms of thinking that designers apply to professional problems (Schön, 1985).

The studio cannot be considered a uniform, unalterable approach to education, however, and is more accurately described as a confederation of related instructional practices and forms. What unites various types of studio teaching is a shared commitment to the value of immersing students in an environment where they are guided through meaningful design projects, under the direction of experienced mentors (Brandt et al., 2013). Other common studio structures include: intense project work concentrated into long class sessions; both individual student workspaces along with some form of communal gathering space; the public display of student projects; and rigorous critique of student work by instructors, other students, or outside experts (Cennamo, 2016b). But individual studios, even within a discipline, will implement these structures at different levels of rigor, perhaps even eliminating some entirely and replacing them with others. Consequently, because "each studio faculty member [interprets] 'studio' a bit differently," beyond general descriptions it can be difficult to develop a consensus of what, exactly, defines the approach (Brandt et al., 2013, p. 332).

Despite such variability, it is clear that studio environments encourage a unique culture of learning, and can be the defining feature of students' educational experience (Gray, 2014; Koch, Schwennsen, Dutton, & Smith, 2002). This is the case in both positive and negative studio cultures. On the negative side, the studio can place heavy emotional burdens on students who are sometimes unprepared to cope with the intense levels of personal investment required (Anthony, 1991; Austerlitz & Aravot, 2007). Students may also be encouraged to develop such extreme commitment to studio activities that they neglect other dimensions of a healthy and balanced life (Gray & Smith, 2016). But when the culture is positive, the experience can be thrilling, and acts as an accelerant to students' formation of design identity (Gray, 2014). At its best, the studio "offers tremendous potential for creative discovery, exploration of ideas, critical discussions, and risk-taking" (Koch et al., 2002, p. 4). Of course, most studios are an amalgam of positive and negative traits. But even given possible drawbacks, those who learned in a studio often look back on it as formative to their design education—an irreplaceable experience that "likely [provides] the most memorable and influential" memories of their training (p. 3).

It is this generally positive reputation that has facilitated the design studio's adoption in disciplines beyond those in which it has been traditionally employed. Some of these fields include human-computer interaction (Brandt et al., 2013), engineering (Kuhn, 2001), and, most relevant for this paper, instructional design (Clinton & Rieber, 2010). Research on studio teaching in these fields is typically encouraging, although perhaps conducted "with little critical attention" towards some of the difficulties that can accompany the approach (Gray, 2014, pp. 12-13). Even so, as favorable reports of design studio pedagogy are disseminated within a discipline, the likely effect is that more educators are becoming disposed to try it themselves. This seems to have been the case in instructional design, as measured by reports of studio environments that have

been published in recent years (Knowlton, 2016).

It is my assertion that understanding how these ID studios have been implemented can become an asset to other instructional design educators adopting the approach. As has been noted, educators in disciplines where studio teaching is not the norm may not be aware of common critiques of the studio, nor be prepared to respond if they experience complications themselves (Gray & Smith, 2016). But educators who study the diversity in design studio environments can find other's experiences to be a source of practical wisdom when developing their own studio implementations (Boling & Schwier, 2016). To date, however, there has not been systematic study of variances among actual design studio practice, as it exists within the discipline of instructional design specifically.

Model-centered instruction. In model-centered instruction (MCI), learning is supported by creating representations of real-world systems or environments, that are intentionally constructed to simplify the complexity and unpredictability found in authentic situations (Gibbons, 2001). These representations can be conceptual, physical, or digital. What matters is that through interaction with these simplified models, learners can investigate, experiment, and practice skills important for their real-world action, without the risk that can accompany engagement with an actual system or environment. A typical example of MCI is a flight simulator; learning in a simulator allows pilots to prepare for new or unusual flight conditions, or refine their technique, without the hazards of attempting maneuvers for the first time in the air.

It must be noted that MCI uses the term model in a different way than is commonly used by instructional designers. MCI uses the term to describe the actual artifact of instruction—the product or situation with which learners interact—whereas instructional designers often use the word model to refer to a design process or methodology, like the ADDIE model. While a common form of MCI is the instructional simulation, this is not the only form. Any system or environment that represents a more complex environment could be considered a model, in the terminology of MCI.

When designing model-centered instruction, one considers the following principles (Gibbons, 2001):

- Experience with models – Learning happens as people observe, and interact with, models of systems, environments, or expert performance, and should be supplemented by learning companions that help learners interpret the models (e.g., teachers, or guides like digital assistants). The first task in MCI is to specify models with which learners will interact, and companions that will assist them.
- Problem solving – Problems are selected for learners to solve, or to observe being solved, with a model; problems are the primary means through which learners interact with the learning environment.
- Denaturing – Models are modified to support learning purposes. Their fidelity to the systems/environments on which they are based is decreased, to make them simpler or safer, to highlight processes otherwise difficult to observe, or to make uncommon phenomena occur more frequently. Generally, more concrete and simpler models are better for novices, while more abstract and complex models can be used with experienced learners.
- Sequence – Problems are ordered by task, size, or other characteristics, to support learning of a model's attributes or behavior.

Table 1. *Model-Centered Instruction (MCI) Compared with Studio Pedagogy*

Principles of MCI	Characteristics of studio pedagogy
Experience with models, augmented by learning companions	Studios model the environments in which professional designers work, as well as model the thinking and behavior of expert designers (Hooper, Rook, & Choi, 2015). Students in studios receive intense feedback on their work from instructors and others (Salama, 1995).
Problem Solving	Studio learning is focused on students engaging with authentic design problems; "they learn *about* design while *doing* design" (Cennamo, 2016b, p. 256).
Denaturing	The range of design activities in which professionals engage is simplified, shortened in time/complexity, or otherwise scoped for novices to complete on their own (Kendall, 2007; Rich et al., 2015).
Sequence	Problems within a studio are ordered to account for various goals, capabilities, or interests that exist at different phases of students' developing identity as designers (Salama, 1995).
Goal orientation	Instructional goals for a specific studio implementation influence the types of problems chosen for students to complete (Knowlton, 2016).
Resourcing	Studio educators often supply students with the material and equipment needed to solve the problems they are given (Brandt et al., 2013).
Instructional augmentation	Instructors can supplement studio problem solving with additional activities or instructional strategies to facilitate student learning (Salama, 1995).

- Goal orientation – Problems are chosen to support the particular instructional goals of a situation.
- Resourcing – As appropriate for specific instructional goals, "resources, materials, and tools" can be provided to help learners solve a problem with a model (Gibbons, 2001, p. 514).
- Instructional augmentation – Models can be can supplemented with additional instructional materials, to assist learners and learning companions during the problem-solving process.

Conceptual alignment between MCI and the design studio. Comparing the principles of MCI with common structures found in the design studio indicates conceptual alignment between the two. This comparison is summarized in Table 1.

MCI is meant to organize learning in any situation where the goal is for people to develop the skills needed to interact with a real-world system or environment; this is also the primary goal of design studio teaching. Based on this conceptual alignment, it is reasonable to conclude that MCI is an appropriate and useful means by which options for the ID studio can be analyzed. I propose, then, that ID educators can use the principles of MCI to shape studio features into forms that fit the constraints and opportunities of their circumstances—both in how they create a model of design practice with which their students engage, as well as how they generate effective types of instructional augmentation.

Method

Case selection. The purpose of this study is to understand what possibilities exist for shaping the ID studio when it is viewed as an example of model-centered instruction. I studied this issue through a focused literature review of ID studio case implementations, comparing features of each case to the conceptual principles of MCI. I selected possible cases of ID studio practice to study in three ways. First, I examined a recent collection of design studio teaching cases, to find reports that described ID studios (Boling, Schwier, Gray, Smith, & Campbell, 2016). Second, I examined reviews of the studio approach in ID education to find additional reports (Knowlton, 2016; Rich, West, & Warr, 2015). Third, I searched educational research databases, including ERIC and Google Scholar, for the combination of the terms *instructional design* (along with equivalents like *instructional technology*), and *design studio* (along with equivalents like *studio pedagogy*). Combined, the literature review and database searches returned 36 individual reports.

These 36 reports were then narrowed for actual inclusion in the study according to the following criteria:

- Primary focus – reports were included that focused on an ID studio, as opposed to those only mentioning an ID studio while reporting something else;
- Detail – reports were included that provided details about how the studio functioned, or what activities were engaged in by students and/or instructors;
- Uniqueness – some ID studios have been studied multiple times; for these cases, only the most recent report was included in my analysis;
- Bias – to avoid bias in my cross-case comparisons, I only included reports from institutions other than my own.

Based on these criteria, nine ID studio cases were chosen for analysis. Of the initial 36, 19 reports were removed because they did not include detail about studio activities. Six were removed because they were

Table 2. *Instructional Design Studio Cases Chosen for Analysis*

Reference	Studio context
(Boling, 2016)	Course in media production; part of a Master's program in instructional design.
(Boling & Smith, 2014)	Course in instructional graphics production; part of a Master's program in instructional design.
(Cennamo, 2016a)	Graduate course in applied theories of instructional design.
(Nelson & Palumbo, 2014)	Three graduate courses in an instructional technology program – instructional design; software development; and project management.
(Rieber, Clinton, & Kopcha, 2016)	Three related, graduate courses in educational multimedia.
(Rook & Hooper, 2016)	Graduate-level course in the development of learning technologies.
(Schwier, 2016)	Graduate course in instructional design, emphasizing product development.
(Tracey, 2016)	Graduate course in basic instructional design.
(Wilson, 2016)	Graduate course in advanced video design.

Table 3. *Surface Variability in ID Cases*

Dimension	Variety among cases
The type of skills taught in the ID studio	• Media development (Boling, 2016) • Introductory instructional design (Tracey, 2016) • Application of theory (Cennamo, 2016a)
How studio courses are organized in the curriculum	• Stand-alone studio courses (Boling & Smith, 2014) • Studio courses organized into a sequence (Rieber et al., 2016)
How course sequences are organized	• Structured around different levels of production expertise (Rieber et al., 2016) • Structured around different skillsets involved when developing a project (Nelson & Palumbo, 2014)
How student projects are organized	• Students complete one major project, perhaps with milestones evaluated at various points throughout the semester (Boling, 2016; Rieber et al., 2016; Schwier, 2016; Wilson, 2016) • Multiple, discrete projects on which students work throughout the course (Boling & Smith, 2014; Cennamo, 2016a; Nelson & Palumbo, 2014; Rook & Hooper, 2016; Tracey, 2016)
How students work with external clients	• Students are provided at least a simulated experience in designing for a client (Nelson & Palumbo, 2014; Rieber et al., 2016; Schwier, 2016; Tracey, 2016) • Students focus on learning design skills, without including a client (Boling, 2016; Boling & Smith, 2014; Cennamo, 2016a; Rook & Hooper, 2016; Wilson, 2016)

multiple reports of the same studios. Two were removed because they were from my own university. Table 2 lists the nine reports included for study, along with summary information about the context of each case.

Case variability. Before beginning analysis of these cases using MCI, I first examined the surface variability in how each studio was structured and organized. Even without applying the theoretical framework of MCI, variety within the practice of ID studio education is evident. This variety is summarized in Table 3.

While documenting this variability may be helpful to ID educators even without additional inquiry, its value in this study was to determine whether enough surface variability exists to justify additional analysis using the principles of MCI.

Analysis. The cases were analyzed in four steps. First, I studied each report, comparing phrases/sections that described studio activities with the definitions of each key principle of MCI. Sections of each report that correlated with an MCI principle were collected into lists. Second, I coded each section identified in step one, based on significant features of the studio or studio activities reported by the original author. After coding was complete, my third step was to compare and contrast the individual codes, looking for relationships between them that indicated codes could be merged, or placed into a more inclusive category. Fourth, I prepared a matrix based on the final codes, which gathered the options of how ID studios have been configured into a table that summarized possible studio structures that other ID educators can use when shaping their own studio implementations.

Findings

Comparing cases of ID studio practice to the principles of MCI reveals differences in how studios have been implemented, that are not easily observable when making surface comparisons. Across the nine cases analyzed, each MCI principle yielded between two and seven configurations for ID studio features or activities, with the exception of the principle of Resourcing (the cases either did not include details of how studios were resourced, as the term is used in MCI, or only implied

information about resourcing). In aggregate, the cases provide seventeen individual options for how ID studio features or activities could be structured. Organized by each MCI principle, these options are:

- **Model experience**: Working within models of authentic design practice could be:
    1. The integral learning experience for students in a studio course; or
    2. Included as one learning experience among many.
- **Problem solving**: Solving authentic design problems could be:
    3. The central activity around which student learning is organized; or
    4. Included as one learning activity among many.
- **Denaturing**: Models of design practice could be modified to:
    5. Simplify the problems students solve;
    6. Have students repeat the same problem over time, with change in one of the variables;
    7. Simulate features of an authentic design environment;
    8. Provide more structure for novices than for experts;
    9. Personalize design problems based on students' prior experience;
    10. Limit the scope of a problem to fit the time available in a course; or
    11. Isolating students from distractions so they can focus on learning activities.
- **Sequencing**: The order of problems in a course could be:
    12. Intentionally shaped by the instructor; or
    13. Implicitly shaped based on the nature of the problems themselves.
- **Goal orientation**: Instructors can pursue specific learning goals by:
    14. Intentionally shaping models of design practice, or the problems solved in a course; or
    15. Implicitly pursuing goals, implied by the nature of design practice or design problems themselves.
- **Instructional augmentation**: Supplementary materials could be:
    16. Integrated as a required component of course activities; or
    17. Provided on an as-needed basis, if students needed additional support in solving a problem.

These categories and options are summarized in Tables 4 and 5. Table 4 describes how each option was reported by the original ID studio case author(s), and may be most helpful to those seeking to understand in more depth how ID studio configurations actually work. Table 5 only includes abbreviated descriptors of each option, and may be most helpful to those interested in an overview of the entire matrix of studio configurations.

Discussion and Implications

These findings indicate that viewing the ID studio as an example of model-centered instruction does provide ID educators with options for shaping studio features and activities. One form this takes is that MCI helps give vocabulary to the practical, concrete features and activities found in studio implementations, as found in the cases studied for this paper. For example, while all nine cases described how students worked in a studio to develop ID expertise, by using MCI one's attention is drawn to variations in the forms given to different models of design practice across the cases. Specifically, in seven of the reports, working in a model of authentic design practice was the integral learning experience for students, while in two (Cennamo, 2016a; Rook & Hooper, 2016) working with a design model was included alongside other learning experiences (such as course readings or in-class discussions). Distinguishing between these variations can be useful to ID educators who are interested in experimenting with the studio but are either not ready or not yet able to implement it as the dominant educational form in their course. Recognizing that there are viable examples of ID studios that combine traditional features of the approach with other educational activities can give them confidence to pursue the same route themselves. They could then examine the details of how these studios functioned for ideas about how to combine their own studio features with additional instructional events.

As another example, if ID educators need to adapt how their students solve problems in a studio curriculum, the MCI principle of denaturing helps them identify that in the cases analyzed in this study, there are at least seven alternatives they can consider. If it does not align with their goals to make the problem itself simpler, they could evaluate the possibility of providing additional structure to support students through problem complexity, or perhaps having students repeat a problem multiple times, as potentially more viable alternatives. After considering these possibilities, educators can use details from the case reports to analyze how the different forms of problem denaturing could actually be adapted for their own circumstances.

Comparing the ID studio with MCI could also provide other means for shaping features and activities of the approach, by helping educators experiment with studio improvements in a more systematic manner. Consider the matrix of studio options as found in Tables 4 and 5. ID educators might compare the options described in the tables to their own studio implementations, using them to help identify how their studios currently function (each column in the tables representing a parameter that describes studio features/activities). As they then consider how to adjust studio components to improve their functioning, the tables also draw attention to individual issues related to studio operations, and gives them a vocabulary by which they can discuss those issues meaningfully. Should they decide to adapt a component, the tables also help them specify what they are actually adapting, and how their adaptations might interact with, or integrate into, the rest of their studio environment.

One practical way this might take place could be

to examine the full description of ID studios in Table 4, and imagine how a studio in an individual row might function differently if a feature or activity were replaced with the configuration found in an adjacent row. For example, the studio reported in row eight (Tracey, 2016) used a model of design practice to solve problems as one type of instructional event among many. What if this studio were redesigned so model-centered problem-solving became the central learning activity, as found in the rows immediately above and below? How might the instructor begin redesigning the studio to account for such a change? How might this change be evaluated? How might the instructor judge whether the change impacts other activities in the studio, such as the type of denaturing that should occur to support novices in problem-solving, or the forms of instructional augmentation available to students? Although these questions are posed as a thought experiment, ID educators can ask themselves similar questions during the practical work of evaluating and improving a studio, by comparing details of their own environments to those already provided.

Finally, it is notable that neither the options reported in these nine cases, nor the guidelines suggested by MCI, provide a strict definition of what must be included in an ID studio for it to be considered an orthodox example of the approach. This is similar to Brandt et al.'s (2013) observation that "each studio faculty member [interprets] 'studio' a bit differently" (p. 332). What this study additionally indicates is that different interpretations of the studio need not relate to minor or superficial details of how the environment functions. While some studio configurations were more common than others in the case reports analyzed in this study, overall they also describe major differences in the types of studios in which students learned while developing ID expertise. Additionally, the interpretive framework suggested by the principles of MCI allows (perhaps even encourages) ID studio educators to develop more variability in studio configurations beyond what has already been reported in the literature.

This is consistent with two other observations made by scholars examining design studio teaching. The first is Boling and Smith's (2014) note that instructors adopting the studio in disciplines where the approach is not widespread do not have the same expectations for what the experience should be, as do those whose initial training took place in a studio. In other words, ID educators likely feel less attachment to traditional studio norms than do those whose formative learning experience took place in the studio, if they are even aware of what those norms are. This interpretation is strengthened by Clinton and Rieber's (2010) description of the ID studio developed at the University of Georgia (one of the cases studied in this paper), when they stated, "the founding designers of this Studio curriculum were less interested in specific studio-based learning models than in using the general metaphor of a studio as a vehicle for implementing constructivist and constructionist learning experiences" (p. 763). The ideal of the studio, then, was attractive to the extent it helped these educators shape a curriculum that was consistent with a broad range of ideals they held about learning and education, and not as an end goal in itself.

Although Boling and Smith's (2014) observation suggested a note of caution—that it is possible for ID educators to believe they are implementing the studio approach when they are really not—I am optimistic about the possibilities that could be opened by ID educators experimenting with studio forms. This is the case even if those forms are not always recognizable to those trained in studio traditions. Ultimately, the objective is not to remain true to the studio approach for its own sake. Rather, the objective is to help students develop higher levels of ID expertise. While ID educators should learn from what traditional studio educators know about developing this expertise, established studio methods are not above critique (Gray & Smith, 2016). It may also be that the context of instructional design demands unique flavors of customary studio features or activities. Or, ID educators may find that their expertise in creating instructional events can improve on even those studio forms that have traditionally been successful.

This study has some limitation of which readers should be aware. First, the sample is small—nine cases of ID studio practice. The options found in this set certainly do not exhaust the range of possibilities available in ID studio configurations. However, the study's purpose was not to achieve this goal, but rather to compare enough cases to the principles of MCI so that ID educators can better understand what kinds of possibilities for shaping the studio are available to them in their own adaptations of the approach. A second limitation derives from the literature review methodology used in the study. I defined these nine cases as examples of ID studio practice because that is how the original authors described their own practices. But I recognize that some readers may disagree with those authors' evaluations of the instructional approach they were implementing. But while this could limit the study's usefulness in defining the studio approach more precisely, as noted above I do not consider it a significant limitation for accomplishing the purpose of generating possibilities for shaping ID studio forms using the principles of MCI.

Conclusion

In this paper, I compared cases of instructional design studio practice to the theoretical principles of model-centered instruction. My goal in doing so was to understand what possibilities this opens for shaping ID studio forms in the variety of contexts in which the studio teaching may be implemented. Across the nine cases analyzed, six of the seven MCI principles yielded between two and seven configurations each for ID studio features or activities (one principle did not yield any possibilities, due to lack of detail in the studied cases). In aggregate, the analysis provides seventeen individual options for structuring ID studio features or activities. Combining just these seventeen options in different ways could allow for dozens of possible ID studio environments. Additionally, the matrix of ID studio options can also be used to help educators experiment with other studio forms, beyond those reported in this study. I conclude, therefore, that MCI does provide fertile and energetic ideas for educators to consider, about how to shape their own implementations of the ID studio.

I also conclude, however, that ID educators should not end their examination of the studio approach with this comparison to MCI. Other theoretical frameworks

Table 4. An Expanded Description for Describing Instructional Design Studio Cases Using Model-Centered Instruction

Studio reference	Experience with models, augmented by learning companions	Problem solving	Denaturing
(Boling, 2016)	Integral: Students work in a model environment for developing a multimedia product; instructor role is to give feedback on student work in the environment.	Central: All class work focused around one realistic problem.	Simplified: Instructors simplify the scope the problem so it can be realistically completed in the time allowed.
(Boling & Smith, 2014)	Evolved from Included to Integral: A model of expert performing for producing instructional visuals was initially included as one environment among many, over time becoming the central component of the course; instructor role is to give feedback on student work in the environment.	Central: All class activities centered around solving visual problems.	Simplified: Assignments simplified and de-contextualized from full design practice to focus on visual production.
(Cennamo, 2016a)	Included: Students are exposed to a model of expert performance for applying learning theory, which is one learning experience in the course among many; instructor role is to give feedback on student work on the performance.	Included: Students use different learning theories to solve instructional problems, among other class activities.	Repetition: Students repeat the same problem-solving exercise multiple times, with variation by using different theories in successive exercises.
(Nelson & Palumbo, 2014)	Integral: Students work in a model environment for producing instructional products for a client, spread across three courses; instructor role is to give feedback on student work in the environment.	Central: Multiple problems are chosen to give students experience with different aspects of expert performance.	Simulated reality: Although problems were presented as being for real clients, sometimes this was simulated if a client could not be found.
(Rieber et al., 2016)	Integral: Students work in a model environment for developing multimedia products; instructor role is to give feedback on student work in the environment; more advanced students given feedback to beginning students.	Central: Multiple courses, each with a central problem to develop a multimedia product.	Structured for novices: More structure and support is provided when students are novices.
(Rook & Hooper, 2016)	Included: Students are exposed to a model of expert performance for developing an instructional software product, which is one learning experience in the course among many; instructor role is to give feedback on student work in the environment.	Included: The course includes multiple software development problems students complete both individually and as teams, among other class activities.	Personalized: Problems can be personalized based on students' prior experience.
(Schwier, 2016)	Integral: Students work in a model environment for producing an instructional product for a client; instructor role is to give feedback on student work in the environment, in the role of a project manager.	Central: Course organized around problems to create individual product components, ultimately delivered to a client.	Bounded scope: Instructor negotiates with a client before class begins, to ensure they act in ways that provide learning value for students; projects scoped to be completed in a 13-week semester.
(Tracey, 2016)	Integral: Students work with a model of expert performance for producing an instructional product for a client; instructor role is to give feedback on student work in the environment.	Included: Students are given a problem created by another student in the class to solve as the culminating class activity, among other activities.	Simulated reality: The client is another student in the class.
(Wilson, 2016)	Integral: Students work with a model of expert performance for developing a video product; instructor role is to give feedback on student work in the environment.	Central: Students are given the problem of producing a video in the course.	Isolation: For part of the course, students are isolated from outside distractions so they can focus on their project work.

Sequence	Goal orientation	Resourcing	Instructional augmentation
Implicit: One problem occupies the work of the class, with sub-problems sequenced by the order in which they happen during production.	Intentional: The problem in the studio focus on media development, not the full range of instructional design activities.	Implied: Not stated explicitly, but the case implies that software and hardware tools are provided for student use.	Available as-needed: Online tutorials in media production tools.
Not discussed: Multiple problems in the class, but no discussion on how they are sequenced.	Intentional: Problems in the studio focus on visual production, not the full range of instructional design activities.	Implied: Not stated explicitly, but the case implies that software and hardware tools are provided for student use.	Available as-needed: Visual examples provided for students to use as precedent in assignments; design books provided as resources.
Intentional: Problems are sequenced based on theories to be learned, with a culminating project to synthesize class experiences.	Intentional: Problems in the studio focus on applying learning theories, not the full range of instructional design activities.	Not discussed in the case.	Integrated: Readings on learning theories.
Implicit: One problem occupies the work of the three classes, with sub-problems sequenced by the order in which they happen in professional practice.	Implicit: Problems were selected based on the availability of clients; no discussion of whether problems were shaped for more specific instructional goals.	Not discussed in the case.	Not discussed in the case.
Intentional: Problems are sequenced across multiple studio courses to support students' growing expertise.	Intentional: Problems in the studio focus on media development, not full range of instructional design activities.	Implied: Not stated explicitly, but the case implies that software and hardware tools are provided for student use.	Integrated: Class discussions on how to learn in studio environments; video tutorials on software skills.
Intentional: Small problems based on components of design processes feed into later problems that integrate all learned skills.	Intentional: Problems in the studio focus on software development, not the full range of instructional design activities.	Implied: Not stated explicitly, but the case implies that software and hardware tools are provided for student use.	Integrated: Readings and class discussion; software tutorials.
Implicit: One problem occupies the class, with sub-problems sequenced by the order in which they typically happen in professional practice.	Implicit: Problems were selected based on the availability of clients; no discussion of whether problems were shaped for more specific instructional goals.	Not discussed in the case.	Integrated: Reflection activities for students to consider what students they are learning about instructional design by working on the selected problems.
Not discussed in the case.	Intentional: Problem chosen to support the instructional goal of doing high quality work for a client.	Not discussed in the case.	Integrated: Readings in design and instructional design; in-class analysis of design examples; reflection assignments.
Implicit: One problem occupies the class, with a milestone assessed partway through the class; sub-problems sequenced by the order in which they typically happen in professional practice.	Intentional: Problems in the studio focus on video development, not the full range of instructional design activities.	Implied: Not stated explicitly, but the case implies that software and hardware tools are provided for student use.	Available as-needed: Many examples provided for students to use as precedent.

will likely reveal other options of how to shape ID studio forms, some of which will more closely approach the ideals that educators have for their ID curriculums, or the opportunities and constraints found in their local situations. I encourage readers, then, to be reflective in their implementations of design studio teaching, and use whatever tools are available to them in developing a studio that is closely aligned with the goals they hope to achieve. To the extent that the comparison in this study helps educators identify options they may not have been aware of before, they should be better able to create an instructional design studio where students develop more meaningful depths of ID expertise. Yet if this study also encourages educators to thoughtfully examine still other ways of framing and shaping their ID studio environment, I consider this to be an equally beneficial outcome. In either case, more students will be prepared to work the increasingly complex environments where instructional design practice takes place, which is the ultimate aim of the ID studio approach.

References

Anthony, K. H. (1991). Design juries on trial: The renaissance of the design studio. New York, NY: Van Nostrand Reinhold.

Austerlitz, N., & Aravot, I. (2007). Emotions of architecture students: A new perspective for the design studio. In A. M. Salama & N. Wilkinson (Eds.), Design studio pedagogy: Horizons for the future (pp. 233-245). Gateshead, UK: Urban International Press.

Boling, E. (2016). How I learned, unlearned, and learned studio again. In E. Boling, R. A. Schwier, C. M. Gray, K. M. Smith, & K. Campbell (Eds.), Studio teaching in higher education: Selected design cases (pp. 88-100). New York, NY: Routledge.

Boling, E., & Schwier, R. A. (2016). Curators' notes. In E. Boling, R. A. Schwier, C. M. Gray, K. M. Smith, & K. Campbell (Eds.), Studio teaching in higher education: Selected design cases (pp. 4-20). New York, NY: Routledge.

Table 5 A Summary Description for Describing Instructional Design Studio Cases Using Model-Centered Instruction

Studio reference	Experience	Problem solving	Denaturing	Sequence	Goal orientation	Resourcing	Instructional augmentation
(Boling, 2016)	Integral	Central	Simplified	Implicit	Intentional	Implied	As-needed
(Boling & Smith, 2014)	Evolved from Included to Integral	Central	Simplified	Not discussed	Intentional	Implied	As-needed
(Cennamo, 2016a)	Included	Included	Repetition	Intentional	Intentional	Not discussed	Integrated
(Nelson & Palumbo, 2014)	Integral	Central	Simulated reality	Implicit	Implicit	Not discussed	Not discussed
(Rieber et al., 2016)	Integral	Central	Structured for novices	Intentional	Intentional	Implied	Integrated
(Rook & Hooper, 2016)	Included	Included	Personalized	Intentional	Intentional	Implied	Integrated
(Schwier, 2016)	Integral	Central	Bounded scope	Implicit	Implicit	Not discussed	Integrated
(Tracey, 2016)	Integral	Included	Simulated reality	Not discussed	Intentional	Not discussed	Integrated
(Wilson, 2016)	Integral	Central	Isolation	Implicit	Intentional	Implied	As-needed

Boling, E., Schwier, R. A., Gray, C. M., Smith, K. M., & Campbell, K. (Eds.). (2016). Studio teaching in higher education: Selected design cases. New York, NY: Routledge.

Boling, E., & Smith, K. M. (2014). Critical issues in studio pedagogy: Beyond the mystique and down to business. In B. Hokanson & A. S. Gibbons (Eds.), Design in educational technology: Design thinking, design process, and the design studio (pp. 37-56). New York: Springer.

Brandt, C. B., Cennamo, K., Douglas, S., Vernon, M., McGrath, M., & Reimer, Y. (2013). A theoretical framework for the studio as a learning environment. International Journal of Technology and Design Education, 23, 329-348.

Cennamo, K. (2016a). Orchestrating learning. In E. Boling, R. A. Schwier, C. M. Gray, K. M. Smith, & K. Campbell (Eds.), Studio teaching in higher education: Selected design cases (pp. 152-163). New York, NY: Routledge.

Cennamo, K. (2016b). What is studio? In E. Boling, R. A. Schwier, C. M. Gray, K. M. Smith, & K. Campbell (Eds.), Studio teaching in higher education: Selected design cases (pp. 248-259). New York, NY: Routledge.

Cennamo, K., & Brandt, C. (2012). The "right kind of telling": Knowledge building in the academic design studio. Educational Technology Research and Development, 60(5), 839-858.

Clinton, G., & Rieber, L. P. (2010). The studio experience at the University of Georgia: An example of constructionist learning for adults. Educational Technology Research and Development, 58(6), 755 -780.

Gibbons, A. S. (2001). Model-centered instruction. Journal of Structural Learning and Intelligent Systems, 14, 511-540.

Gray, C. M. (2014). Living in two worlds: A critical ethnography of academic and proto-professional interactions in a human-computer interaction design studio. (Unpublished doctoral dissertation), Indiana University, Bloomington, IN.

Gray, C. M., & Smith, K. M. (2016). Critical views of studio. In E. Boling, R. A. Schwier, C. M. Gray, K. M. Smith, & K. Campbell (Eds.), Studio teaching in higher education: Selected design cases (pp. 260-270). New York, NY: Routledge.

Hoadley, C. M., & Cox, C. (2008). What is design knowledge and how do we teach it? In C. DiGiano, S. V. Goldman, & M. Choroset (Eds.), Educating learning technology designers: Guiding and inspiring creators of innovative educational tools (pp. 19-35). New York: Routledge.

Hooper, S., Rook, M. M., & Choi, K. (2015). Reconsidering the design of a learning design studio. In B. Hokanson, G. Clinton, & M. W. Tracey (Eds.), The design of learning experience: Creating the future of educational technology (pp. 63-76). New York: Springer.

Kendall, S. (2007). Teaching studio exercises to help students manage distributed design. In A. M. Salama & N. Wilkinson (Eds.), Design studio pedagogy: Horizons for the future (pp. 167-176). Gateshead, UK: Urban International Press.

Knowlton, D. S. (2016). Design studios in instructional design and technology: What are the possibilities? TechTrends, 60(4), 350-358.

Koch, A., Schwennsen, K., Dutton, T. A., & Smith, D. (2002). The redesign of studio culture. Retrieved from Washington, DC:

Kuhn, S. (2001). Learning from the architecture studio: Implications for project-based pedagogy. International Journal of Engineering Education, 17(4/5), 349-352.

Nelson, W. A., & Palumbo, D. B. (2014). When design meets Hollywood: Instructional design in a production studio environment. In B. Hokanson & A. S. Gibbons (Eds.), Design in educational technology: Design thinking, design process, and the design studio (pp. 75-88). New York: Springer.

Rich, P. J., West, R. E., & Warr, M. (2015). Innovating how we teach collaborative design through studio-based pedagogy. In M. A. Orey & R. M. Branch (Eds.), Educational media and technology yearbook (Vol. 39, pp. 147-163). Switzerland: Springer International Publishing.

Rieber, L. P., Clinton, G., & Kopcha, T. J. (2016). The studio approach at the University of Georgia: Always a work in progress. In E. Boling, R. A. Schwier, C. M. Gray, K. M. Smith, & K. Campbell (Eds.), Studio teaching in higher education: Selected design cases (pp. 37-59). New York, NY: Routledge.

Rook, M. M., & Hooper, S. (2016). Design thinking in action: Perspectives on teaching and redesigning a learning design studio. In E. Boling, R. A. Schwier, C. M. Gray, K. M. Smith, & K. Campbell (Eds.), Studio teaching in higher education: Selected design cases (pp. 235-247). New York, NY: Routledge.

Salama, A. M. (1995). New trends in architectural education: Designing the design studio. Raleigh, NC: Tailored Text & Unlimited Potential Publishing.

Schön, D. A. (1985). The design studio: An exploration of its traditions and potentials. London, England: RIBA Publications Limited.

Schwier, R. A. (2016). Hither and yon: Learning ID in a studio-based authentic ID context. In E. Boling, R. A. Schwier, C. M. Gray, K. M. Smith, & K. Campbell (Eds.), Studio teaching in higher education: Selected design cases (pp. 21-36). New York, NY: Routledge.

Shulman, L. S. (2005). Signature pedagogies in the professions. Daedalus, 134(3), 52-59.

Tracey, M. W. (2016). How I gave up ADDIE for design thinking, and so did my students. In E. Boling, R. A. Schwier, C. M. Gray, K. M. Smith, & K. Campbell (Eds.), Studio teaching in higher education: Selected design cases (pp. 195-205). New York, NY: Routledge.

Wilson, J. (2016). The lake course: A studio apart. In E. Boling, R. A. Schwier, C. M. Gray, K. M. Smith, & K. Campbell (Eds.), Studio teaching in higher education: Selected design cases (pp. 123-136). New York, NY: Routledge.