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Designing Innovative Education through Action Design Research: Method and Application for Teaching Design Activities in Large Lecture Environments

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Abstract:

Today's fast-changing global environment has created unprecedented challenges for the university sector worldwide. Consequently, educational innovation has become more important than ever before, especially in dynamic design-oriented disciplines, including information systems (IS). Action design research (ADR) offers great but yet-to-be-explored potential for designing educational innovations. In this paper, I present ADR as a method for educational innovation. I also showcase this method using the example of teaching design activities in large lecture environments. More precisely, I offer an innovative organization design solution, the team net-based learning (TNBL) model, which I designed and other educators later independently adopted. They continue to use the model to this day. In this paper, I report on the ADR project of initiating, designing, implementing, and evaluating the TNBL model in a large undergraduate MIS class over a two-year period in a real-life setting from the standpoint of a reflective practitioner/designer engaged in ADR in her own practice. Even though I implemented the project in the IS domain, the main design artifact is discipline and content agnostic, and, as such, could be used in any other design-oriented discipline. I also provide important directions for future research.

Keywords: Action Design Research, Educational Innovation, Information Systems Education, Organization Design Research, Large Lecture Instruction, Design-oriented Pedagogy, MIS.

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1 Introduction

In today's fast-changing global environment, more organizations have begun to recognize that they need cross-functional integration, collaboration, and, above all, a multidisciplinary approach to effectively manage their critical assets (i.e., business processes, data, knowledge, services, and relationships) (Gartner, 2007). Consequently, they are required to "break down internal boundaries and integrate up, down and across the extended value chain" (Gartner, 2006, p. 1), which also means that boundary-spanning roles have become more important than ever, especially in relation to creating business value (Gartner, 2007). Organizations now look for so-called T-shaped managers capable of facilitating cross-functional sharing of experiential knowledge across silos (Barile, Franco, Nota, & Saviano, 2012; Hansen & van Oetinger, 2001). T-shaped skills are needed "anywhere problem solving is required across different deep functional knowledge bases or at the juncture of such deep knowledge within an application area" (Leonard-Barton, 1995, p. 75). Moreover, in our increasingly inter-connected world, boundary spanning extends well beyond internal or even organizational boundaries. Consequently, "it is no longer sufficient, or even possible, to view the world within the confines of an industry, or a discipline, or a process, or even a nation" (IBM, 2011).

When it comes to educating future boundary spanners, the information systems (IS) discipline is well positioned to meet industry needs. For example, IS students are trained to bridge the still-present boundary between business and IT (Topi et al., 2014). Also, the IS discipline continues to place a strong emphasis on IS-enabled cross-functional integration, which one typically learns about by studying and applying concepts such as data integration, cross-functional business processes, and knowledge sharing.

Many other business disciplines (even those teaching specialized functional information systems, such as accounting IS, marketing IS, or financial IS) do not emphasize the same IS-enabled cross-functional integration to the same extent. Therefore, for many students majoring in other (non-IS) areas, their only chance to better understand cross-functional integration is in the introductory IS subject (course) also known as "management information systems" (MIS).

This subject's importance has been widely recognized by the IS academic community and is even reflected in the selection criteria for new IS staff (Everard, Jones, & McCoy, 2005) At the same time, the introductory MIS subject poses some unique challenges to educators and their students, especially when offered in large classes. In addition to pedagogical challenges of teaching any large foundational course in any discipline (Biggs, 1999), IS has specific challenges that its highly applied nature (that is design rather than didactic oriented) create (see Section 2).

In this project, I focus on the design challenge of teaching an applied discipline such as IS in large face-to-face lecture environments. Specifically, I focus on the *organization design* of large lectures rather than IS pedagogy. This type of design is also an important practical challenge because *design activities* (e.g., designing a conceptual data base model or a business process) remain at the core of IS education, even at the foundational level. However, in many environments, educators continue to deliver foundation IS courses in large lecture theatres (Holmes, 2003; Pridmore, Bradley, & Mehta, 2010), which, by design, provide limited opportunities for real-time, meaningful two-way feedback between students and their teacher/instructor/professor. Yet, students need this two-way feedback to learn *how to design by doing* (i.e., while engaged in design activities).

Therefore, following the principles of action design research (ADR), I contribute to addressing the following research design challenge (RDC):

> **RDC:** How can one organize design-oriented learning activities for a large face-to-face lecture environment?

With this applied research, I make three important contributions. First, I contribute to action design research by presenting ADR as a method for educational innovation and by showcasing the method through an example of teaching design activities in large lecture environments. More precisely, following the principles of ADR, I articulate the challenge of teaching design activities in a large face-to-face environment as a class of design problems and propose the main design artifact (i.e., an innovative model for instructing a large class) as a class of solutions. The resulting sets of design principles together with design artifacts constitute an important contribution to ADR and this class of design problems. These design principles for organizing design-oriented learning activities in large face-to-face environments represent "design knowledge emerging from the application of ADR" (Sein, Henfridsson, Purao, Rossi, & Lindgreen, 2011, p. 50).

Second, I contribute to innovative education in IS by designing, implementing, and evaluating an innovative model of instructing a large class, which I call the team net-based learning (TNBL) model. This model enables educators to conduct interactive design activities in a large face-to-face lecture environment. This paper describes how to design, implement, and evaluate the TNBL model from the standpoint of a reflective practitioner/designer engaged in ADR in the context of her own teaching practice. I originally designed the model and used it over two years (four semesters) with more than 2500 students in total and with up to 270 students co-located in the same large lecture room. Other IS colleagues subsequently and independently adopted the same model in their own contexts. These colleagues continue to use the foundations of this model to this day.

Third, I contribute to organization design research by considering education from the perspective of organization design rather than pedagogy or instructional design. As such, the outcomes of this research further advance the previous research by Romme (2003), Banathy (1999), and Lerner (1995) on organization design research in education. The research also strengthens the argument previously made by Romme (2003) that one can consider learning environments as a specific organization type that enables scholars researching organization systems and processes to use their knowledge to organize and manage student activities.

The paper proceeds as follows: in Section 2, I provide the relevant background of and motivation for the study using the related literature from the IS and organization science disciplines. In Section 3, I introduce the research method. In Sections 4, 5, 6, and 7, I describe my implementation of the ADR process. Specifically, I formulate the main design problem in Section 4 and describe in detail the three cycles of organization-focused BIE in Section 5. In Section 6, I summarize my reflections and lessons I've learned. In Section 7, I formalize these lessons into a proposed set of design principles. In Section 8, I summarize the ADR process and map the main stages mapped against ADR design principles that Sein et al. (2011) define. Finally, in Section 9, I describe the main conclusions and research limitations and outline the plans for future research.

Contribution:

This paper makes three important contributions. First, it contributes to action design research (ADR) by: 1) presenting ADR as a method for the design and implementation of innovative education and 2) showcasing the method using the example of teaching design activities in a large lecture environment. Second, it contributes to innovative education in information systems by providing an innovative model of large class instruction (i.e., the team net-based learning (TNBL) model) and by describing its main components. Third, it contributes to emerging organization design research by considering education from the perspective of organizational design rather than pedagogy or instructional design.

The paper describes how to use ADR to design, implement, and evaluate the TNBL model over two years from the perspective of a reflective practitioner/designer/ADR researcher using and refining a model in my own classroom. Other IS educators subsequently and independently adopted the foundations of this model in their own teaching contexts.

This paper may inspire other ADR researchers to consider innovative education as an interesting, challenging, but ultimately rewarding domain for their future research. IS educators interested in a systematic, research-driven method of innovation may consider using ADR to guide and evaluate their future educational innovations, beyond well-researched pedagogical methods. Finally, IS and other educators interested in innovative ways of teaching design activities in large classes may adopt the presented TNBL model in its entirety or use some of its components to create more interactive and engaging design learning activities.

2 Grounding in IS and Organization Science Literature

2.1 Information Systems Literature

After comprehensively reviewing the relevant literature in IS education and IS in general, I found a diverse set of issues that scholars have discussed predominantly in relation to the so-called IS enrolment crisis. Scholars have reported that university students and their parents still share numerous misconceptions and stereotypes about the IS discipline. For example, they believe that the IS discipline focuses on computers and technology (Firth et al., 2008) and, consequently, equate IS jobs with "coding" (Benamati, et al., 2010). They also think that there are no jobs available due to outsourcing and that the IS major is too difficult because IT is constantly changing (Granger, et al., 2007). University students and their parents do not perceive the IS profession as exciting (Benamati & Rajkumar, 2013; Benamati, Ozdemir, & Smith, 2010). In some environments, MIS courses focus on technology, but employers seek graduates with both business and IT knowledge (Lichtenstein, Abbott, & Rechavi, 2015). Further, many more men enroll in MIS majors than women, which further contributes the shared perception of IT-related professions as being male dominated (Topi et al., 2014; Benamati & Rajkumar, 2013).

Furthermore, many students perceive MIS as a "predominantly lecture course" and also as "a survey course that covers many topics" (Holems, 2003). Weekly topics are diverse, cover a wide range of IS related concepts, themes, and systems, and move across different levels of abstraction (Kroenke, 2005). Dynamic technological changes and rapidly evolving business experiences of using new technologies often render academic MIS courses' technical focus outdated (Lichtenstein et al., 2015). In those instances when courses use assessment items to test memory and recollection rather than comprehension, students' view of the whole discipline often deteriorates after completing the MIS course (Kroenke, 2005).

To address some of these challenges, scholars have devised a variety of recommendations related to different aspects of the student learning experience in MIS. They include updating content and exposing students to more interesting and contemporary technologies (George, Valacich, & Valor, 2005) or engaging them through e-business innovation (Lichtenstein et al., 2015). Universities also need to assign the most effective teachers (Looney & Akbulut, 2007), create a strong relationship with practitioners through advisory boards (Granger, Dick, Luftman, van Slyke, & Watson, 2007), and create more effective marketing efforts including peer networks to change the unfavorable image of the IS discipline (Grover, Straub, & Galluch, 2009).

Furthermore, leading IS scholars have issued a call for systematic approaches that deal with the problem holistically rather than via isolated interventions. As a result, the IS literature already includes new approaches that one could classify as holistic. For example, Street and Wade (2007) present a framework that categorizes different areas of innovation in IS/IT course development and delivery. In another example, Firth et al. (2008) propose a 12-step program that covers all aspects of the subject including faculty assignment and even tone and approaches used in class (including, for example, innovative ways of telling the IS story). Some scholars have also proposed strategies and holistic approaches originating in various IS theories and frameworks that are used in business to improve organizational efficiency in teaching the course. For example, Holmes (2003) argues that one could address the problems related to the nature of this introductory MIS subject and the way educators deliver it by using the principles of total quality management (TQM). Lichtenstein et al. (2015) use self-determination theory to guide their approach to teaching through ideation and innovation.

In summary, scholars have predominantly (if not exclusively) discussed the challenges of improving students' experience in IS in general and MIS in particular from the perspective of IS-related pedagogy and educational research rather than *organization design research*. In particular, the organization design of teaching in large lectures, which, in many cases, is the key component of student learning in MIS, remains unchallenged.

2.2 Organization Science Literature

According to Simon (1996), what distinguishes disciplines such as education, organization, and education from natural sciences is their design nature explained as follows:

> *Everyone designs who devises courses of action aimed at changing existing situations into preferred ones. The intellectual activity that produces material artifacts is no different*

> *fundamentally from one that prescribes remedies for a sick patient or the one that devises a new sales plan for a company or a social welfare policy for a state.* (Simon, 1996, p. 111)

Consequently, organization researchers have started to position organization studies as science for design (Jelinek, Romme, & Boland, 2012). For example, researchers such as Argyris, Putnam, and McLain-Smith (1985), Schein (1987), and Starbuck (2006) argue that we need clinical interventions (i.e., trying things out in reality) because one cannot really understand any human system without trying to change it. One then uses these interventions to inform organization research, which creates the ongoing creative tension between insiders' and outsiders' viewpoints (Argyris et al., 1985; Schein, 1987; Romme, 2003; Starbuck, 2006). Only through action do we start discovering new aspects of design as "we begin designing and creating, then discover in the interplay of ideas and constraints what can and cannot be achieved by what we start with, and adopt to create better designs that accomplish more of what we seek" (Jelinik et al., 2012, p. 320).

While organization design thinking and practice apply to any type of organization, researchers such as Romme (2003) argue that scholars in organization studies (and, in particular, organization design) are best positioned to make valuable contributions to their own teaching practices by drawing on their own research experience. The main idea here is that one can approach education similar to any organization "out there", and, therefore, scholars in management and organization studies can research their own education practices and those of others using organization theories and research methodologies (Romme, 2003). This approach offers an excellent opportunity for the so-called mode 2 research (van Aken, 2005) that aims to "produce knowledge for action" (Argyris et al., 1985). As van Aken (2005, p. 20) notes: "Mode 1 knowledge production is purely academic and mono-disciplinary, while mode 2 is multidisciplinary and aims at solving complex and relevant field problems". Mode 2 research of educational environments as organizations enables one to generate and use knowledge in ways that mutually enrich both academia and practice (Avenier, 2010, p. 1229).

However, organization design science is still in the early stage of its development with previous research focused primarily on questions of theoretical relevance (Jelinek et al., 2012). Although the same observation applies to the area of organization design of education, it does have some prominent studies. For example, Banathy (1999) promotes a systems view of education and argues that one could use systems thinking to organize what are essentially human activities in education. Rome (2003) offers two exemplary designs: the experience-based design of an organization behavior course and the thesis ring model used in thesis project supervision. Other researchers limit their focus to the context of teamwork in the classroom, such as Griffith (1999) and Lerner (1995).

Romme (2003) proposes four design principles for organizing education that are based on extensive action-oriented design research of innovative examples of organizational designs used in education. The first principle recommends organizing education as an authentic organization that includes real (learning and managerial) task interdependences between all participants in learning. This concept of task dependency is, in fact, one of the key concepts in the organizational design literature. As Romme (2003) states: "Without task interdependency, the learning process will become largely individual (as in instruction-centered education) rather than social and organizational. Without task interdependency, shared responsibilities can be created that give raise to 'organizational' processes, behavior and learning" (p. 698).

The second design principle recommends one to exploit the benefits of peer mentoring and assessment as two special types of task interdependencies that re-enforce the other types of interdependencies. The third design principle advises one to act and delegate as a "senior manager" who focuses on coaching and advising students. Finally, the fourth principle requires one to set vivid standards "to create constructive rather than destructive friction for newcomers, by means of written manuals as well as students enacting, modeling or explaining those standards" (Romme, 2003, p. 713). Finally, Romme (2003) calls for future studies to explore whether one can use these design principles to produce effective educational systems in other contexts. My project responds to Romme's call by exploring these four design principles for organizing education in the context of the IS discipline in general and its foundational MIS course in particular.

3 Research Method

For this project, I adopted Sein et al.'s (2011) action design research (ADR) method. This method extends a combined design research (DR) and action research (AR) method that Cole, Purao, Rossi, and Stein (2005) previously proposed. Cole et al.'s (2005) original combined DR and AR method included the following objectives: 1) to use scientific methods to solve a set of practical problems that researchers/practitioners experience in their own practice and 2) to contribute to the existing body of knowledge by creating new research artifacts. The same objectives also apply to ADR.

The first related research method (i.e., DR) is an applied research method that relies on applying rigorous methods in constructing and evaluating a design artifact (Hevner, March, & Park, 2004). Possible DR artifacts include systems (such as IT applications) and foundation concepts (such as new theories, frameworks, instruments, models, and methods) and *methodologies* (such as data analysis techniques, formalisms, measures, and validation criteria).

When used in the IS and IT disciplines, DR, also known as design science research (DSR), tends to focus on constructing and evaluating various information technology (IT) artifacts designed to solve practical problems. More recently, IS researchers have started to expand DR to include organizational and other non-IT design artifacts. For example, Drechsler (2013) focuses on the design of social systems and distinguishes between more traditional IT-centric DSR and DSR for IS/IT management or project management organizations. Beyond IS, other disciplines such as education and management, where DR artifacts include new models, organizational practices, or even new organizational forms (see March & Smith, 1995), continue to use DR principles.

The second related research method (i.e., AR) is fundamentally "a change-oriented approach in which the central assumption is that complex social processes can be best studied by introducing change into these processes and observing the effects" (Baskerville & Wood-Harper, 1998, p. 91). AR links theory and practice in a highly cyclic process where "the main intention is to create a synthesis with specific knowledge that provides actors in the situation, with the capability to act and the general knowledge that is suitable for similar situations" (Baskerville & Wood-Harper, 1998, p. 91). As Sein et al (2011) argue, AR investigates a research phenomenon through researcher intervention and focuses predominantly on generating theory with scant regard for design artifacts (including IT artifacts).

Because both DR and AR stress relevance, problem solving, and intervention for learning (Cole et al., 2005), many scholars have unsurprisingly tried to integrate them in various ways (Sein et al. 2011). For example, Cole et al. (2005) suggest adding a "reflection phase" to DR to augment learning and a "build phase" to AR to concretize the AR output as a DR artifact. Looking beyond IS, organization science researchers also combine AR and DR into the so-called design-oriented action research that focuses on new organization designs as the main design artifacts (Jelinek et al., 2008). For example, researchers have used a design-oriented action research method in educational settings (as is the case in our research) to create innovative educational systems by means of creative enquiry into such systems with researchers directly involved in the processes they research (Argyris, et al., 1985; Banathy, 1996; Simon, 1996).

However, as Sein et al. (2011) note, previous attempts at integrating and "cross-fertilizing" AR and DR, including the one that Cole et al. (2005) propose, continue to reproduce one of the key limitations of existing DR methods: that is, they separate building design artifacts from evaluating them. More precisely, they either sequence or interweave what are essentially self-contained steps (phases) (Sein et al., 2011).

In contrast, Sein et al.'s (2011) ADR includes highly intertwined phases of building, intervention, and evaluation (BIE). As such, ADR focuses on building an innovative design artifact in its organizational context and learning from the experience while addressing a problematic situation (Sein et al., 2011). Also contrary to DR methods that consider organization intervention to be secondary (Coles et al. 2005), ADR "recognizes that the artifact emerges from interaction with its organization context even when its initial design is guided by the researchers' intent" (Sein et al., 2011, p.40). ADR design artifacts may include IT design artifacts and organizational interventions. Consequently, Sein et al. (2011) consider the so-called research design continuum, which ranges from IT-dominant BIE to organization-dominant BIE.

As I state above, I follow Sein et al.'s (2011) ADR principles. Because I focus on the innovative organization design of education experiences in large face-to-face lecture environments, my research method involves an *organization-dominant* rather than technology-dominant BIE. The main design artifacts include an innovative model of large class instruction (the team net-based learning (TNBL)) and a set of design principles (see Section 7, Table 1).

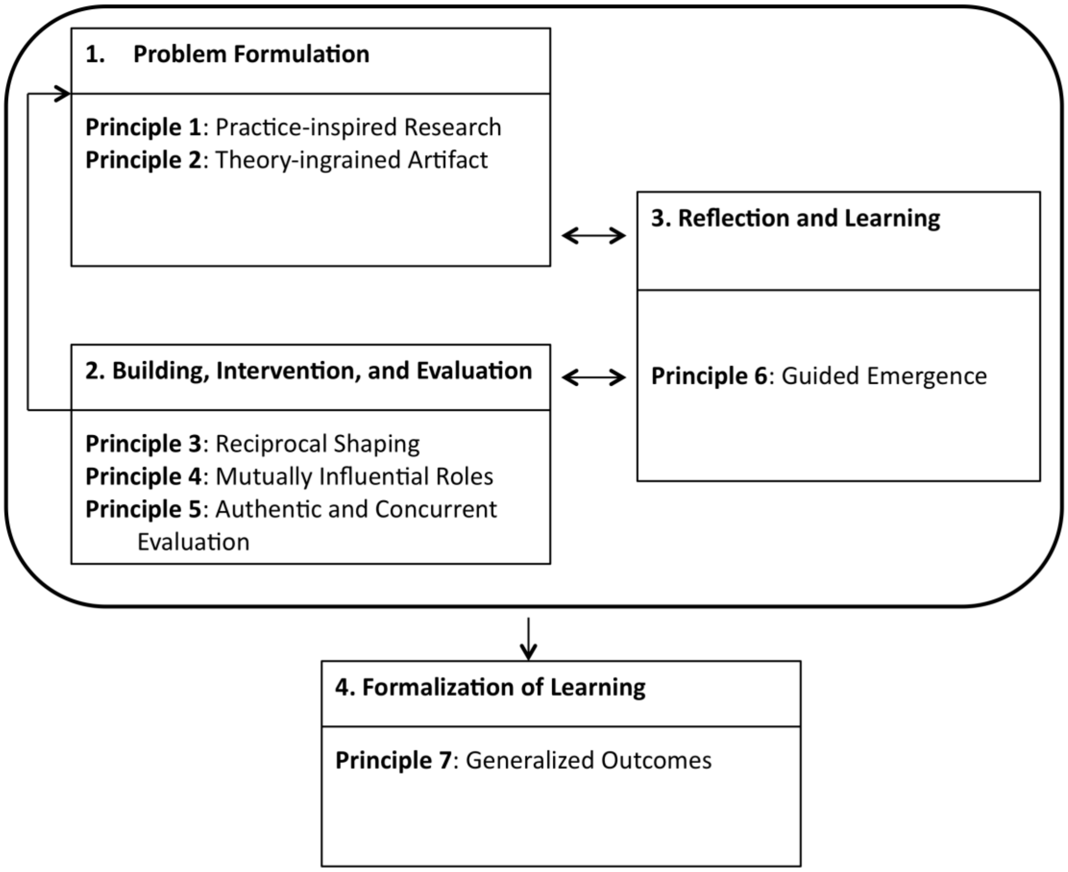

Figure 1. ADR Method by Sein et al. (2011)

Finally, I recognize that my main idea of using ADR to help design, implement, and evaluate an educational innovation is not new. Other IS researchers have also used ADR in the context of IS education. For example, Hustad and Olsen (2014) used ADR to design and evaluate a new teaching framework for educating reflective enterprise systems practitioners. My project also shares the same objective of extending "the research application context of ADR to include development of artifacts other than IT systems only" (Hustad & Olsen, 2014, p. 470). In Sections 4 to 7, I describe the main phases of my ADR project.

4 ADR Stage 1: Problem Formulation

I first observed (i.e., diagnosed) a problem of teaching and organizing IS design activities in large face-to-face lecture environments in my own practice of many years of teaching large introductory MIS classes. Design activities are an integral part of information systems education in most, if not all IS subjects. Even in a foundational undergraduate MIS class, students need to design simple conceptual models, such as entity-relationship models, data-flow diagrams, or "as-is" and "to-be" process models. By designing solutions for practical problems, IS students acquire knowledge in action:

> *We're a lot closer to the medical school than we are to the geology or physics departments…As graduates, our students need to solve problems – not to cure sick people, but to improve the business in which they work – increase competitive advantage, solve particular problems, improve decision making…It's knowledge in action and not sinking with PowerPoint*. (Kroenke, 2005, p. 1).

After I identified the problem in practice, I further confirmed its importance by extensively reviewing related literature in IS research, IS education research, education research, and organization science (as I outline later in this section and in Section 2). In initially evaluating the problem statement, I confirmed the lack of existing research on the organization design of large lecture environments in MIS. Following Sonnenberg and vom Brocke's (2012) classification of different evaluation patterns, one can classify this phase of my ADR project as Eval 1 (ex ante) evaluation.

Then, I articulated the observed practical problem as a class of practice-inspired organization design problems. I then used the related literature to conceptualize the key design requirements (DReq) for a new organization model that focused on the key challenges for design-oriented education in large-lecture environments as follows.

First, teachers need the ability to understand students' learning needs and assess their current progress while teaching is in progress. Consequently, there must be a meaningful, real-time, two-way feedback between students and their teachers (e.g., instructor, lecturer, professor). At the same time, this feedback is necessary for students to help them develop higher-order learning skills (Biggs, 1999).

Furthermore, as one's knowing emerges through one's actions, these actions require both "reflection-in-action" and "reflection-on-action" (Schon, 1983). The former inform one's actions in a situation as it unfolds, while the latter informs one's actions after a situation has already unfolded. Moreover, reflection-in-action also requires ongoing dialogue between students and their teacher who "can "immediately take action and explain difficult topics for students from a different angle" (Hustad & Olsen, 2014, p. 448).

However, large instructional environments make it hard for any teacher to provide non-trivial and real-time feedback to all students individually to guide their reflection-in-action, even when students are organized in small groups. It is equally difficult for any teacher to get instant non-trivial real-time feedback from most of their students in a large class. Educators have invented various technical solutions to solve that problem (e.g., using so-called "clickers" for answering multiple-choice questions), but they are helpful only if students' feedback comes in a simple and predefined form.

However, one cannot easily reduce design-oriented problems' possible solutions (both correct and incorrect) to pre-defined choices (e.g., one of four given options) as in multiple-choice questions without compromising student's ability to learn how to design while designing. In other words, *recognizing* a correct solution for a design-oriented problem is not the same as *designing* a correct solution, as per the extended Bloom's taxonomy by Andersen et al. (2011). Therefore, an appropriate (situational) feedback exchange during these design activities becomes quite complex and needs to be specific to student's particular needs to scaffold their learning. Thus, I propose the first design requirement as follows:

> **DReq1:** Enable immediate, meaningful, non-trivial ("closed-loop") feedback from every single student to their teacher and from the teacher back to each individual student regardless of class size.

Second, relevant industry reports confirm that even entry-level IS positions require higher-level skills (Benamati et al., 2010). These skills include an ability to identify and solve problems, critically evaluate dynamic situations, deal with complexity, and continuously innovate. Industry now recognizes the meta-skills of "learning how to learn" as critical for future careers in IS and business in general, due to rapidly changing technology and the yet-to-be-invented information-intensive environments of tomorrow (May, 2010).

Developing these high-level learning skills requires higher levels of interactivity, engagement, ongoing feedback, a challenging but highly supportive learning environment, and, above all, expert teaching (Ericcson, Prietula, & Cokley, 2007). At the same time, many years of educational research confirms that large lecture instruction often focuses on transmitting content and, as such, does not lead to developing advanced learning skills, including critical thinking, problem solving, and reflective skills (Biggs, 1999). Thus, I propose the second design requirement:

> **DReq2:** Design interactive learning activities to facilitate the development of higher-level skills, critical for design education.

Third, effective expert teaching is critical for MIS education (Looney & Akbulut, 2007; Firth et al., 2008), especially in the context of design-oriented learning activities. Yet, in many universities, the introductory IS subjects are delivered by IS doctoral students who are less-experienced (Firth et al., 2008) and often focused more on research and their doctoral studies than teaching (George et al., 2005).

Furthermore, while smaller tutorial environments provide more interactivity and engagement, tutors (i.e., teaching assistants, instructors) are often less-experienced educators. They may have mastered relevant content, but many may not have mastered or even been exposed to different teaching methods. It is also difficult to ensure consistency in teaching quality across a large number of tutorials. Based on these observations, I propose the third design requirement:

DReq3: Ensure consistent expert teaching in design-oriented learning activities across all student groups regardless of their number and size

In summary, the literature confirms the relevance and the challenging nature of the identified key design requirements. This process of using relevant literature to justify design objectives and requirements corresponds to Eval 2 (ex ante) evaluation (Sonnenberg & vom Brocke, 2012).

5 ADR Stage 2: Building, Intervention, and Evaluation Stage

To address the main design requirements that I identified in stage 1 of ADR, I proceeded with a cyclical process of building, intervention, and evaluation (BIE) in stage 2.Ffollowing Sein et al.'s (2011) recommendations, I repeated this highly integrated phase through three main cycles of "design-artifact-in-use". Figure 2 depicts the resulting organization-dominant BIE I used in the project.

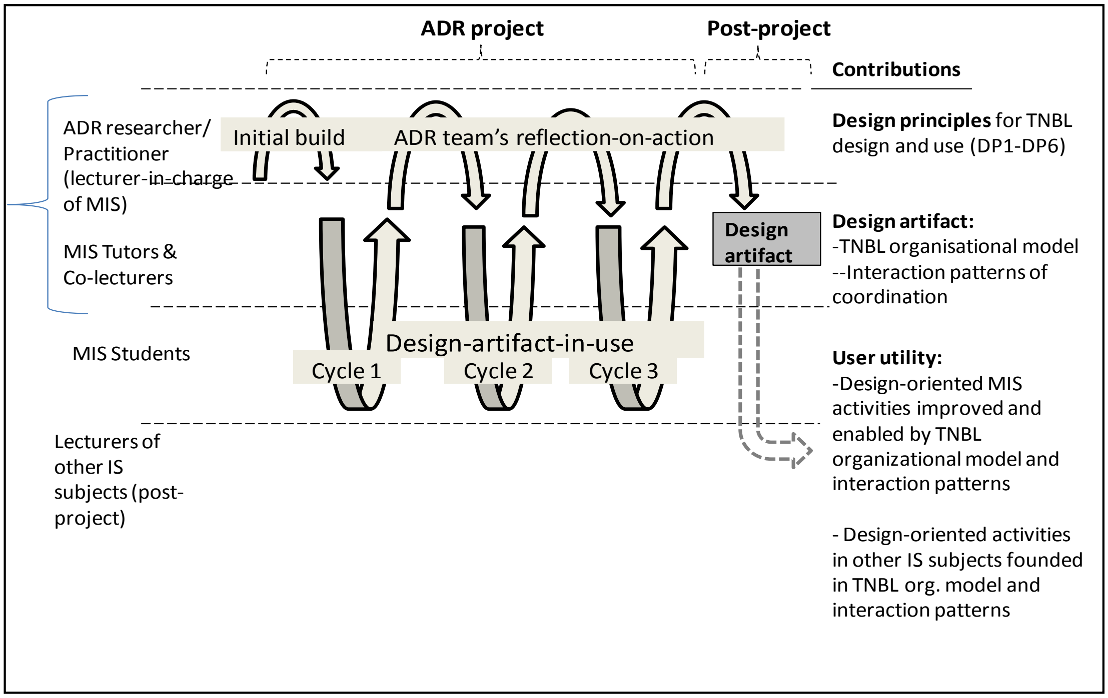

Figure 2. Organization-dominant Building, Intervention, and Evaluation in this ADR Project

5.1 Design Influences for the Main Research Artifact

In reflection, I could trace the main influences and inspiration for my initial design (build) of a new organization model to two key disciplines: education research and virtual environments. I describe these two disciplines in Sections 5.1.1 and 5.1.2.

5.1.1 Educational Research and Practice

From education research, two well-known educational models (i.e., problem-based learning (PBL) (Boud, 2003) and team-based learning (TBL) (Michaelson, Knight, & Fink, 2004)) informed my new model. While I used the PBL model to design weekly learning activities, Michaelson, et al.'s (2004) TBL model's strengths and weaknesses informed how I designed my TNBL model as I describe next.

Michaelsen et al.'s (2004) TBL model is a comprehensive group-based instructional format developed to facilitate active learning, even in large classes. Briefly, at the beginning of each class, students receive a set of multiple choice questions (MCQs) or true/false questions with deterministic answers. First, students need to answer the questions individually before joining their pre-allocated group to discuss, negotiate, and record the group's answers (one per group). This approach's main advantage is in the immediate in-class feedback achieved via "scratch-it" cards that students receive. By "scratching off" one of the four MCQ options, students can immediately determine if their selected answer is correct by an asterisk symbol's (*) presence or absence.

Note that only one instructor runs a TBL class and, therefore, works with a large number of groups. Each group engages in active discussion to negotiate and determine their group's answer. Because the scratch-it cards provide feedback/answers, the TBL instructor does not need to get around to speak with every single group and provide personalized feedback. In fact, even an administrative person in charge of distributing and collecting cards could perform the role.

Scholars from diverse disciplines have used the above-described TBL method in medicine, economics, management, and so on. Even when used at the foundation level, this method's adopters report that students positively evaluate the corresponding courses (Michaelson et al., 2004).

The TBL model's main strength (namely, small groups of students' working together in a large lecture environment) inspired my design of the TNBL model. More importantly, my design was also informed by TBL's perceived limitations when used in an applied design-oriented discipline (such as IS). These limitations include multiple-choice questions with pre-defined outcomes being not suitable for design activities, simple feedback communicated via "scratch-it" cards, the class facilitator's limited role, and the under use of the facilitator's domain expertise. I designed the TNBL model to provide a much more complex organizational structure and various patterns of interactions and knowledge sharing that, in combination, enable one to implement complex learning activities (including design activities). More importantly, the TNBL environment enables teacher to provide much more complex two-way feedback to all small groups and to every single student in lectures regardless of their size.

5.1.2 TeamNets in Virtual Environments

Scholars use TeamNets to describe networks of teams in dynamic virtual organizations including their patterns of interaction and collaboration (Ibbot, 2007). TeamNet networks work according to five principles:

1. Unifying purpose: everyone involved needs to understand a common purpose and participate in its development.
2. Independent members: individuals' activities do not depend on central authority.
3. Voluntary links: the network has many links, connections, and relationships. The links cross boundaries and are not hierarchical.
4. Multiple leaders: everyone is a leader at the time when that individual's unique experience and knowledge adds to the group's intelligence.
5. Integrated levels: networks are not just two-dimensional and homogenous. Groups naturally gather into groups of groups or divide into smaller groups.

The key to TeamNets' success involves boundary-crossing individuals and teams who help different teams to coordinate their activities by facilitating information flows (Ibbot, 2007). TeamNets bridge the boundaries inside and across organizations by fostering cooperation but retaining competitive independence. The TeamNets concept inspired the possibility that learning teams can have different patterns of interactions in and across them and that multiple leaders and boundary-crossing roles and objects can co-exist in the same class. However, compared to the virtual environments and TeamNets, my TNBL model includes co-located teams that all work in the same environment, take different roles, and engage in different forms of interactions. This line of thinking opened up an opportunity to implement a completely different classroom structure.

5.2 The Initial Build of the Main Design Artifact: TNBL

Taking a dual role of an ADR researcher/practitioner, I designed the TNBL model and implemented it in my own introductory MIS class. The main idea was to enable different patterns of knowledge sharing and co-creation in and across different teams that were all co-located in a large classroom environment. In this section, I describe the two key components of the TNBL model: its organizational structure and its patterns of interactions.

5.2.1 TNBL's Organizational Structure

Figure 3 illustrates the organizational structure of my TNBL environment. Students were organized in different small learning teams (LTs), which the figure depicts with circles. Students selected their own teams but, once formed, had to remain together until the end of the semester. Each LT had one designated tutor, and each tutor had several co-located LTs. Each LT had its own unique alphanumerical code with which we (the teaching team) tracked the learning progress of each group, and, more importantly, of each group member. In this way, I could track the progress of every single person in a large class. I also color-coded the LTs to make it visually easier to match them with their allocated tutors (e.g., the activity sheets I gave to a tutor's LTs were the same color as the tutor's name badge). Whenever possible, LTs of the same tutors were physically co-located and asked to remain seated in the same area of the room for the whole semester to facilitate easier access to and by their tutor. While tutors assumed the leadership role for their LTs, one session leader who was responsible for the overall learning experience guided each session (see Figure 3).

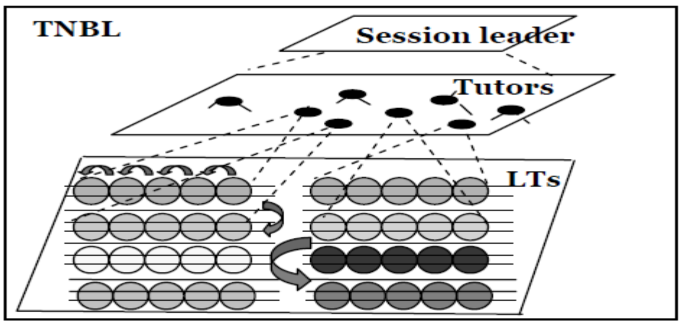

Figure 3. Organizational Structure of the TNBL Artifact

5.2.2 Patterns of Interactions

I designed an efficient system of horizontal and vertical information flows to enable various communication and collaboration patterns. In turn, they supported various patterns of knowledge sharing and co-creation: 1) between students in the same LT, 2) between LTs and their allocated tutor; 3) between tutors and the session leaders, 4) between LTs via their shared tutor, 5) between tutors, and 6) between session leaders and their whole classes or even particular students.

I then combined these horizontal and vertical information flows among the participants (individual students, their LTs, tutors, and the session leaders) into six different interaction patterns (which I explain below). These patterns were content neutral and, as such, could be combined with different content and guided by different learning objectives. I used them as the basis for interactive learning activities delivered in a large class (in my case, the largest class had 270 students in the same lecture room).

Interaction pattern 1 (IP1): this basic pattern captures a feedback loop between tutors and their allocated LTs, which enables the former to provide non-trivial feedback. Thus, regardless of the number of tutors and LTs, this pattern helps tutors provide personalized feedback to each and every student in a class of any size. For example, while working on different design activities (e.g., designing a conceptual data base model), each tutor would approach their allocated LTs, which gives all LTs' team members an opportunity to ask questions and seek clarification. By observing the work of their allocated LTs, tutors could identify and observe both the types and causes of problems in and across their allocated groups—even those that their students could not articulate. For example, rather than just focusing on a correct solution (design), tutors could observe underlying causes of incorrect solutions, such as students' inability to differentiate between basic elements of a conceptual design (e.g., in a flow diagram).

Each LT had to subsequently come up with one group answer (i.e., conceptual design) and, along the way, negotiate and reconcile any differences among group members' individual designs before recording their negotiated group solution on a given group activity sheet. Tutors could still track the performance of each individual student and offer both individual and group feedback because students had to negotiate their individual contributions and record them on the activity sheet. For example, for an equal contribution, they would record 100 percent for each group member.

Interaction pattern 2 (IP2): this pattern extends interaction pattern 1 by leveraging the information flows between tutors and session leaders (SL). Thus, I designed interaction pattern *2* to facilitate an instant and closed feedback loop that originated from all LTs and went to their designated tutors and, via them, all the way up to the SLs and then back to individual tutors, their LTs, and/or whole class. For example, a tutor may observe that several LTs are struggling to understand the same foundational concept (e.g., "an entity" in an entity-relationship model). Rather than providing the same explanation to several LTs, the tutor would communicate the issue and any other cumulative feedback to the session leader, who could then provide the explanation and additional clarification to the whole class. The session leader could provide real-time feedback to tutors who might seek some additional clarification in the case of any differences in opinions. Most importantly, the session leader could immediately adjust the subsequent activities and instruct the tutors on how to proceed.

Interaction pattern 3 (IP3): I designed this pattern to empower tutors to act as boundary spanners (Carlile, 2004) between two or more of their allocated LTs, which facilitates knowledge sharing and exchange between these teams. For example, via their shared tutor, two or more LTs could swap their group solutions and comment on another LT's work. If given a marking scheme, members of one LT could even (formatively) mark another LT's solution. The tutor's role was to help them to exchange their work, provide comments, and guide students' marking efforts. From the pedagogical perspective, this pattern is important, especially for design-oriented disciplines such as IS, because students need to observe several different solutions not only to learn from each other's mistakes but also to understand and accept that design activities often have more than one correct solution (such as different conceptual designs). I found this interaction pattern to be important for students that came from other business disciplines, such as finance and accounting, that often expect "the correct solution".

Interaction pattern 4 (IP4): I designed this pattern to enable me and the tutors to select the best solution(s) in the whole class in an efficient way. In the first step, I asked tutors to nominate one best solution across their individual allocated LTs and then together select the overall best solution(s) (e.g., by voting for the best three). Once they selected the best solution(s), tutors could immediately and easily locate the authors (i.e., the "winning" LT*)* and ask them to present their work to the whole class. I used a variation of this pattern to enable in-class and fun competitions among different tutors via their allocated teams to look for the most innovative solution, best team effort, and so on.

Interaction pattern 5 (IP5): I designed this pattern to facilitate wiki-like, paper-based co-creation among LTs allocated to the same tutor. I asked each LT to improve on the cumulative effort of the previous teams. More precisely, each team needed to come up with a solution, and then, starting from one team, their allocated tutor would pass this team's solution in a chain-like manner to the next LT, which could further improve it before passing the cumulative effort to the next LT in line. I could then easily combine interaction pattern 5 with interaction pattern 4 and turn the resulting combination into an engaging competition (e.g., between color-coded teams and their tutors), as I often did.

Interaction pattern 6 (IP6): while the previous five patterns illustrate knowledge sharing and co-creation among LTs co-located in the same room, I designed this pattern to enable knowledge sharing among different lecture streams again with tutors acting as boundary spanners. For example, the same group of tutors worked across different lecture streams. As such, they could share the accumulated feedback from their allocated LTs across different streams. This feedback was valuable not only to the LTs but also to different session leaders because they found out in advance about possible problems with various concepts being covered and the solutions provided in the previous sessions. I turned some of this cumulative feedback into learning activities in the subsequent weeks and/or posted online. For example, I designed a new database modeling activity to incorporate various problems experienced by LTs across all streams in the previous week.

Note that the initial build of TNBL model included only the first two (IP1 and IP2) out of six of interaction patterns. I identified additional interaction patterns from implementing the TNBL model in real life and evaluating it through ongoing reflection-in-action.

5.3 Evaluation of the Initial TNBL Model Design

After I designed the initial model, I performed two types of ex ante evaluations. First, I evaluated the initial TNBL design against the design requirements. Second, I evaluated the proposed design through "walk-through" scenarios with fellow IS colleagues and educational designers from the office of learning and teaching at my university. I performed these evaluations to identify any design issues with the proposed model and its planned implementation, to prevent possible problems before I used the model in real life. The evaluation criteria for this second evaluation included feasibility, understandability, clarity, and simplicity. One can classify both types of design evaluations as Eval 3 ex ante evaluation in an artificial setting (Sonnenberg & Brocke, 2012).

5.4 Instances of TNBL Artifact-in-use

I implemented (instantiated) the TNBL model in my classes over four semesters (2008 and 2009). I used the model with more than 2500 students in total. After initially building and evaluating the design model, the ADR process included three main cycles of artifact-in-use. Furthermore, I introduced different implementation challenges in each cycle, which led to my further improving (building) the initial design model. These improvements were always guided by ongoing evaluation through reflection-in-action and reflection-on-action. The artifact-in-use also shaped and changed its organizational context. For example, it changed the nature of tutors' work, which their employment contracts recognized and reflected. These changes are examples of "reciprocal shaping" with "inseparable influences mutually exerted by the two domains" (Sein et al., 2011). Furthermore, each ADR's BIE cycle also included several "mini cycles" that each corresponded to weekly sessions that also offered further opportunities to evaluate design-in-use through naturalistic/ex post evaluation (Venable, Pries-Heje, & Baskerville, 2012) or Eval 4 ex post evaluation (Sonnenberg & vom Brocke, 2012).

The ADR team also changed. Initially, I had a combined role of ADR researcher and practitioner: I designed the main ADR artifact and used it in my own MIS class. However, even during the first implementation, the ADR team of practitioners expanded to include tutors (LT leaders). Later on, it also included additional session leaders.

5.4.1 Cycle 1: Artifact-in-use

In the first three of weeks of semester 1, 2008 (the first semester of this model's implementation), the enrolment number increased by more than 200 students and, unexpectedly, reached a total of 520 students. Consequently, I had to organize the MIS class into two streams: one with 250 students and one with 270 students per room. At this time, the ADR team (i.e., teaching team) included me as the leader of both streams and my tutors who taught in both streams.

Due to the increased student numbers, I also had to move classes from the initially allocated rooms with flexible layouts that I used to plan TNBL's organization, to much larger lecture rooms. The new rooms had inflexible physical setups (e.g., fixed desks and chairs) and, as such, were better suited for traditional didactic lectures rather than TNBL classes.

In an ideal situation (as the TNBL design envisages it), all student groups would have moveable chairs and desks to enable them to reconfigure the room to best facilitate small group interactions. The inflexible room setups created the first and urgent challenge with design artifact-in-use of re-configuring the initially envisaged organizational structure around physical constraints. Hence, to enable the tutors to reach their allocated LTs and vice versa and to enable group members to work together in the most effective way, I had to invent seating arrangements that would suit any large inflexible room. Figure 4 depicts an example of a seating arrangement in a large 500-seat lecture theatre with fixed desks and chairs. It shows three seating areas allocated to three tutors, with empty rows between the areas used as "passageways" to enable them to reach their allocated LTs.

Furthermore, the two sequential lecture streams (i.e., two instances of TNBL design artifact-in-use) provided an opportunity for all ADR team members to reflect on and evaluate our shared experience. I deliberately planned and scheduled these reflective dialogues (and, thus, institutionalized them) after each session as our "collective reflection-*on*-action" (Levina, 2005) and collective sensemaking (Klein & Myers, 1999). We also engaged in "collective reflection-*in*-action" (Levina, 2005) in situ while teaching. We did this by asking each other questions such as "Is this working for everyone?" and by observing others' actions and anticipating our collective needs. Our in-class communication also included hand gestures and other non-verbal symbols we developed over time. In turn, we could adjust the learning activities in real time as they occurred to meet students' learning needs. As one of the tutors commented: "We interacted just like an NBA team, constantly observing the rest of the team and contributing to each others' activities, while helping and supporting our allocated groups.".

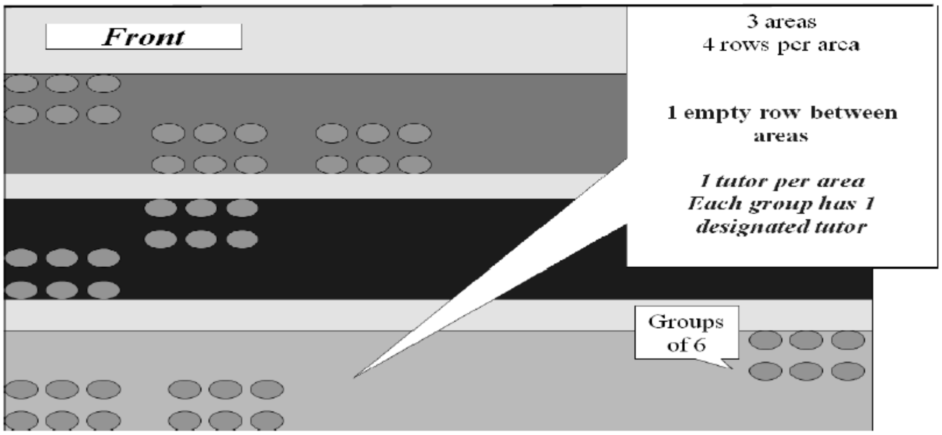

Figure 4. TNBL Seating Arrangement in Large, Traditional Lecture Rooms

Together, one can classify these two types of evaluations, both conducted through collective sensemaking, as Eval 4 ex post evaluation (Sonnenberg & vom Brocke, 2012) because we focused on a particular instance of TNBL implementation (in the current or just completed session). We also validated this instance in a naturalistic setting by focusing on its applicability and effectiveness and on our activities' impact on students.

Over thirteen weeks of semester 1, 2008, I further refined the TNBL model. For example, the team started with the first two interaction patterns, but, as our shared experience and confidence grew, I proposed one new interaction pattern (described above as interaction pattern 3). I first discussed this innovation with the team and gradually introduced it over several sessions through collective reflection-in-action (as previously described).

I soon realized that the key enabler for improving the design artifact *(*while in use) was its shared ownership (that the ADR team also gradually assumed). Based on our collective experience, we established the following two design principles (DP) based on the first action cycle of artifact-in-use:

DP1: *Ongoing reflective dialog in the ADR team*: institutionalize an ongoing collective reflection-on-action and, whenever possible, encourage collective reflection-in-action in the ADR team

DP2: *Shared ownership*: encourage and enable shared ownership of the design artifact and its instances.

At the end of the first semester, we also completed several evaluations. As per our university's policies, we surveyed students about their learning experience in the course. Furthermore, the office of learning and teaching also organized two focus group discussions: one with self-selected group of students and another with all tutors. Finally, we also conducted an additional reflection-on-action session with the whole ADR team that focused on our individual and collective experiences with different interaction patterns throughout all 13 weeks. As the evaluations all sought to confirm that the artifact was useful in practice (in terms of improving class interaction and learning) and applicable to the given context (teaching design activities in large environment), one can classify them (together) as Eval 4 ex post evaluation (Sonnenberg & vom Brocke, 2012).

5.4.2 Cycle 2: Artifact-in-use

In the second cycle of artifact-in-use (semester 2, 2008), I introduced the third teaching stream to accommodate the growing number of students. I also assumed the role of the session leader of all three streams. The ADR team grew to include new ADR practitioners (i.e., new tutors) who were not previously involved and had no exposure to the TNBL model or its instantiation. We repeated the same model of minicycles over the 13-week semester (as in cycle 1). There was an additional challenge of bringing the new ADR team members up to speed in all aspects of TNBL instantiation, including its ongoing naturalistic evaluation.

The original team of tutors was instrumental in transferring knowledge to the new team members: they observed their progress in real-time and provided help when needed without my having to ask them to do so. Furthermore, having the experience of running more interactive activities in the previous semester, the tutors started to better appreciate the interaction patterns that enabled them to engage beyond individual groups and contribute more to sharing knowledge the entire class.

Based on this feedback, I designed and proposed new interaction patterns, which expanded tutors' roles of "boundary spanners". As a result, we implemented interaction patterns 4 and 5 in the second half of the semester. This expansion further demonstrates the highly intertwined nature of design, implementation, and evaluation activities that results in refining a main design artifact. Also note that IP4 and IP5 enabled tutors to share knowledge in real time while working with their LTs, which is not possible in traditional tutorials.

Using our collective experience in the second learning cycle, we established the following two design principles:

DP3: *ADR practitioners as knowledge agents*: experienced ADR practitioners best transfer knowledge to new ADR practitioners (i.e., new tutors).

DP4: *ADR practitioners as boundary spanners*: implementing advanced interaction patterns depends on tutors' ability to act as boundary spanners.

The ADR team conducted ex post naturalistic evaluation of this particular TNBL instance, implemented during the second cycle of its use, at the end of the semester using the same evaluation activities as in cycle 1. However, in addition to these planned evaluation activities, an independent third party unexpectedly further evaluated all aspects of this learning cycle. More precisely, the university's academic board evaluated the TNBL model and students' learning experience (with this particular TNBL instance), including their learning outcomes. This evaluation was done in response to a complaint by a non-performing student who was not satisfied with the awarded in-class participation and group assignment mark.

The final outcome of this independent evaluation was encouraging, and one could take it as a DR artifact evaluation by an independent group of university (non-IS) educators. They found the model to be "educationally sound" and confirmed that it was possible to trace this student's learning progress each week (even via group activity sheets) in a large lecture environment throughout the whole semester.

5.4.3 Cycle 3: Artifact-in-use

The third cycle of artifact-in-use (semesters 1 and 2, 2009) brought yet another significant increase in student numbers. Consequently, I introduced six parallel (independent) teaching streams. Four streams were now delivered by new session leaders. Thus, the ADR team grew to include the additional session leaders and tutors—all without any prior experience with the TNBL model and its implementation.

Furthermore, additional parallel streams created a new challenge of transferring the main design artifact and the associated "know-how" to new session leaders so they could create their own independent instances of the same design artifact. This transfer turned out to be even more challenging because the new session leaders had various levels of teaching experience (some were novice teachers) and different assumptions about teaching in large lecture environments, including teacher's role (e.g., "just give me the lecture slides"). To transfer the design artifact to new session leaders, I documented the models of interaction patterns and provided detailed step-by-step descriptions of learning activities and the associated lesson plans for each session. However, these methods were not sufficient to transfer the experiential knowledge.

The ADR team found that tutors were the key facilitators of knowledge transfer among the sessions, (especially "the know-how" related to class dynamics and different aspects of interactivity). In spite of all the resources provided, trust turned out to be the key enabler of this knowledge transfer, especially among new session leaders and their team of tutors. However, the required level of trust took time to establish and did not come merely with teaching allocations.

The ADR team also observed that successfully implementing this model requires strong situational leadership skills of all session leaders. The leaders needed to "think on their feet" but remain flexible and responsive to tutors' and students' real-time feedback. Just delivering content was no longer sufficient. We also found out that situational leadership did not correlate with previous teaching experience of session leaders, especially if someone obtained this experience through lecturing (i.e., presenting content) to large classes.

Through "evaluation conversations" that continued since the first cycle of artifact-in-use but now occurred in and across all parallel streams in the third cycle, we also found different levels of classroom engagement even with the same team of tutors. We found out that teaching streams with stronger situational leaders (i.e., session leaders) and those who demonstrated trust in their tutors' abilities and encouraged tutors' engagement and leadership, had higher levels of interactivity even if they were less-experienced teachers (in the traditional sense). If the session leaders did not have these characteristics, their teams of tutors (even the most experienced ones) were simply waiting for and then following leaders' instructions without taking any initiative to create a more engaging learning experience.

We also observed "transparency" to be one of the key aspects of situational leadership. As one tutor pointed out: "this model created an environment that is just like traditional tutorials but with "invisible" and transparent walls around our own LTs". Transparency enabled the highly experienced session leader to be present in "each tutorial" to support any tutor, answer any questions, and ensure consistency across all tutors and their allocated LTs. The session leader had an immediate/real-time insight into each tutor's work and could easily "team-up" and "shadow" less experienced team members. However, this transparency went both ways because the teaching practices of session leaders also become highly visible to the team of their tutors. Unfortunately, some session leaders, especially those who favored teaching the traditional way, did not welcome this visibility.

Based on the ADR team's shared experience in the third cycle of artifact-in-use, we established the following design principles, with revised DP4 being an extension of the previous design principle DP4.

DP4 (revised): *ADR participants as boundary spanners across different instances of artifact-in-use*: experienced tutors enable session leaders to transfer a design artifact to new session leaders through boundary-spanning rather than traditional lesson plans and other teaching-related boundary objects.

DP5: *Situational leadership and transparency within ADR team*: situational leadership and transparency in the ADR team determines whether it successfully implements a design artifact instance.

DP6: *Trust in ADR team as foundation for successful experience*: a successful experience for all (ADR team and users) requires trust in the ADR team.

5.5 End-of-the-project Evaluation

As in the previous cycles, we evaluated the TNBL model via several activities at the end of the second year, which was also the final year of the ADR project. For example, as per university policies, we performed formal teaching evaluations across all parallel streams. As expected, the evaluation scores varied across different streams led by different session leaders as they would in the traditional model. Even though the overall (average) evaluation figures across different streams were much higher than in the previous years when the course occurred in the traditional mode and continued to raise after every semester, at the end of the fourth semester, they still remained lower on average than the top-performing large first-year courses that other disciplines offer.

Furthermore, one could clearly divide students' comments into two groups: those who liked or and those who did not like the experience (e.g., "too much work", "have to work in lectures", "prefer to listen", etc.). Interestingly, every semester, a vast majority of students liked the in-class face-to-face group experience in spite of many of them not liking working in groups in their own time to complete their group assignments.

Most importantly, the expert guidance from the session leaders and tutors' ongoing real-time feedback enabled students to develop the required design skills. This improvement was confirmed by students' increased ability to complete various design activities in class and in final exams compared to previous traditional deliveries of this subject. Significantly, students could design and implement design-oriented practical projects (assignments), and several projects even received industry prizes. In addition to continuously increasing student numbers and successful outcomes in terms of student learning as measured by the final exams, practical assignments, and industry awards, the ADR team used other key performance indicators to better understand our collective experience with the design artifact and its instances. Fewer than ten students per exam sought special considerations for missed exams (a number that had dropped significantly from previous years). This number was significantly lower (both in absolute and relative terms) compared to the other large first year courses at the university. One can probably attribute this situation to the ADR team's closely monitoring each student's performance and its personalized guidance. The attendance rate in all weekly sessions was well above 95 percent, even in the initial two semesters when students did not receive any marks for the in-class activities.

From a financial perspective, the TNBL model turned out to be much more cost-efficient to run in terms of its operating costs in spite of parallel streams. More precisely, two-hour TNBL workshops (one per stream with a large number of students in each) without any additional tutorials replaced traditional presentation lectures (one per stream) and numerous standalone tutorials (over 30). Therefore, the overall number of tutor hours dropped significantly compared to the traditional mode of delivery. In addition to the two-hour TNBL workshops, students also had (optional) lab workshops where they could seek help with their practical assignments.

Another form of external evaluation came from several visiting senior IS scholars and visiting fellows with long-term experience in teaching large face-to-face introductory IS classes. Some of them even participated in TNBL classes as guest tutors, while others evaluated the whole subject (including the TNBL model and all aspects of student and staff experiences) in the overall degree accreditation process.

> *I don't think any of us had imagined the type of thing you do with a large foundation IS class. From what we saw and heard, you are providing a very effective and valuable learning experience for the class.* (An external IS senior scholar and design research expert)

Table A1 (Appendix A) summarizes the main cycles of BIE, including how they correspond to Sonnenberg and vom Brocke's (2012) different types of evaluation patterns. The table also illustrates the gradual emergence of the design artifact through ongoing evaluation, reflection, and learning. Further, the table confirms the highly intertwined nature of the build, implementation, and evaluation (BIE) activities (Sein et al., 2011).

5.6 Further Implementations (Post ADR Project)

I officially completed the ADR project after two years. Colleagues teaching subsequent foundational and other more advanced IS courses in the same school independently adopted the main design artifact (i.e., the TNBL model, its organizational structure, and some, if not all, design patterns). Some of these colleagues were not even members of the initial teaching team. While the content they taught and the learning and assessment activities they used differed from those I used for my MIS course, the underlying organizational model of a session leader supported by several tutors in charge of different LTs remained the same. From the ADR perspective, this subsequent and independent adoption of the design artifact represents the strongest confirmation of the design artifact in terms of its utility and ease of use.

6 ADR Stage 3: Reflection and Learning

As Sein et al. (2011) recommend, I performed the reflection and learning stage continuously as I participated in the first two ADR stages. As I illustrate in Section 5, reflections and learning gradually emerged throughout this project, which I summarize in this section.

6.1 Addressing the Stated Design Requirements

With the TNBL model (its organizational structure and interaction patterns in particular), the ADR team addressed all design challenges that I set for this project.

6.1.1 DReq1

The previously described interaction patterns illustrate direct and meaningful closed-loop and non-trivial feedback exchange between students (even hundreds of them) and the session leader, facilitated by their designated tutors. The feedback provided *to* the session leader went well beyond a simple choice (as in MCQ) that could be easily communicated by students via "clickers" or "scratch-it" cards. Tutors could communicate cumulative feedback across their allocated *LTs* or, if needed, could single out a particular *LT* or even an individual student. This feedback often included issues that students themselves, being novice learners, were not able to detect, let alone communicate, as previously pointed out.

Tutors could even single out disruptive students *by their name* in a very large environment. This was not always welcomed by students. As one student pointed out: "We cannot hide even in a room full of people".

Furthermore, tutors could easily provide personalized feedback to their allocated *LTs* in two forms: oral and written, all within the same session. Thus, while in session, tutors would collect group activity sheets and provide a quick written (formative) assessment to each group which was returned to students within the same session. This quick marking was normally done during the presentation segments of the class delivered by the session leader, not requiring tutors' assistance.

6.1.2 DReq2

The previously described interactive patterns have enabled implementation of very engaging activities designed to promote active learning and the development of higher-level learning skills. The underlying organizational structure of TNBL environment had enabled us to reach out to each student in a very large class and scaffold their learning towards a higher level as their individual performance could be observed over time.

As students had to work within groups to negotiate and sometimes reconcile their differences in individual designs before proposing the group one, this activity also led to the development of higher-level learning skills. As they had to discuss their individual contributions to the group outcome, we helped to gradually create a habit of openness and learned to deal with any group dynamic issues on a smaller scale and within formatively assessed activities (just for an indicative mark), before doing a much larger group assignment. Furthermore, the practice of stating each group member's contribution prevented freeloading and made student absenteeism highly visible. As non-performing or absent students could be easily detected quite early in the session, their allocated tutors were better placed to help them, but also to help their fellow *LT* members in better managing group activities.

6.1.3 DReq3

A session leader (i.e., IS expert) attended each tutorial (i.e., in all LTs) and could support any tutor, answer any question, and ensure that all tutors and their allocated LTs achieved consistency. As a result, students received a single consistent message or "version of truth" that their tutors reinforced in real time. The session leader had an immediate/real-time insight into each tutor's work and could easily "team-up" and "shadow" less experienced team members.

6.2 Reflection on TNBL's Organization Structure from the Organization Studies' Perspective

As I state earlier, in organization studies, Romme (2003) proposes a set of design principles for organizing education and issued a call for future research to explore whether these or similar design principles work in other complex educational organizations. Even though I did not use Romme's design principles to guide and inform my design, in retrospect, I found supporting evidence for all of them (see Sections 6.2.1 to 6.2.4).

6.2.1 Principle 1: Designing Education as an Authentic Organization

Both of the TNBL model's components (and, in particular, its interaction patterns that illustrate dependency and coordination among tasks performed by different roles) support this principle. As Romme (2003) points out, the concept of task dependency is a key notion in the organizational design literature. The important implication here for designing education as an organization is to have substantial task interdependencies among participants. As Romme (2003, p. 698) states, "Without task interdependency, the learning process will become largely individual (as in instruction-centered education) rather than social and organizational. With task interdependency, shared responsibilities can be created that give rise to "organizational processes, behavior and learning.".

6.2.2 Principle 2: Peer Mentoring and Assessment

Different interaction patterns in TNBL facilitate different forms of peer mentoring, feedback, and assessment both in and across LTs. Thus, the TNBL environment supports Romme's (2003) second principle.

6.2.3 Principle 3: Acting and Delegating as a Manager

The TNBL's organizational structure supports the third principle. More precisely, Romme (2003) identifies two key aspects of this design principle: hierarchy and delegation. The TNBL organization model incorporates both aspects: the session leader assumes the role of the senior manager of classroom organization, and tutors assume the role of middle managers and have the responsibility and delegated authority to manage and lead their own allocated *LTs* and report back to the senior manager while coordinating their activities and sharing knowledge with other "managers".

6.2.4 Principle 4: Setting Vivid Standards

The consistency of students' learning experience somewhat supports this principle. That is, the same standards that the ADR team had to establish across different *LTs* and later lecture streams guided students' learning experience. Given the fact that new session leaders were involved in the second year of TNBL's implementation, the ADR team had to make these standards even more explicit so that individuals could share them across "different organizations" (i.e., independent session streams).

My research also confirms a previous argument by Avenier (2010) that, in "the constructivist view of organizational design science, knowledge can be generated and used in ways that are mutually enriching for academia and practice" (Avenier, 2010, p. 1229). In the case of the TNBL model and its implementation, this practice was a teacher's own practice in academia, which provides opportunities for mode 2 knowledge production (van Aken, 2005).

6.3 Other Lessons Learned

This research created some fundamental (self-reflective) questions we ought to ask ourselves in our multifaceted role as teacher, designer, action researcher, and reflective practitioner: are we prepared to lead by example? We do expect our business and IS students to become business and community leaders and, in this capacity, deal with various change management-, knowledge management-, and/or process-related issues in their future environments. Are we prepared to do the same in our own environment and practice leadership by example—especially during an initial "thankless phase" when expectations are high and workloads are even higher and mostly invisible or even when (or in spite of) knowing that prior educational research shows that students prefer passive to active learning experiences and don't value active engagement (Haidet, Morgan, O'Malley, Morgan, & Richards, 2004). Active-learning courses in large environments do have much lower teaching evaluations than more traditional courses (McGann, Frost, Matta, & Huang, 2007; Haidet et al., 2004), at least initially until students "accept" this new mode of working. As such, are we even prepared to actively seek, influence, and contribute to the new teaching evaluation instruments, to replace those developed for the transmission model of teaching?

Leadership concerns initiating and doing the unknown. To make a positive impact on our academic community and the wider business community seeking to employ our students, we need academic leaders not only in research but also in teaching. Furthermore, "the most important way in which our research findings are appropriated in practice –is through our teaching" (Lyythinen, 1999, p. 26). In the case of the TNBL model and many other organization design projects in education, our own teaching becomes our research practice, with research findings appropriated in our own environment.

My final reflection concerns the role of students (i.e., users of the design TNBL artifact) and their expectations as to what education in general and more specifically IS education is all about—either the passive "transmission" of knowledge or active co-creation of knowledge through shared responsibility and ownership not only of the outcome but also of the learning process. This particular observation led the ADR team to revise the previously stated DPs (e.g., DP4) related to the leadership and ownership of the design artifact and to expand it from the ADR team to include ADR users (i.e., students), which I discuss in Section 7.

7 ADR Stage 4: Formalization of Learning

In this ADR stage, one formalizes acquired learning by moving from the specific and unique to the generic and abstract. Sein et al. (2012) suggest the following three levels for this conceptual move: 1) generalize the problem instance, 2) generalize the solution instance, and 3) derive design principles from the design research outcomes.

Following the ADR principle of generalized outcomes, I articulate the challenge of teaching design activities in a large face-to-face environment as a class of problems (generalization of problem instance) relevant for any design-focused IS unit or even any teaching discipline involving design activities. I then propose the main design artifact to be representative of a class of solutions (generalize the solution instance).

My implementation of BIE of the main design artifact (TNBL) over several cycles resulted in a set of design principles (see Section 5). However, the ADR team further revised some of these principles (e.g., DP4) through our shared experience of using design artifact instances in practice and through ongoing reflection-in-action and reflection-on-action (both collective and individual). The resulting DPs constitute this paper's main contribution to this class of problems.

Table 1 summarizes the revised set of design principles resulting from this ADR project and their consequences for both the ADR team and users of the design artifacts.

Table 1. Revised Design Principles and their Consequences

<table>
<tr><th>Revised design principles</th><th>Description</th><th>Consequences</th></tr>
<tr><td>DP1: Ongoing reflective dialog within ADR team and with users of design artifacts.</td><td>Ongoing reflective dialog includes institutionalized (planned) opportunities for collective reflection-on-actions and situational (ad-hoc) collective reflection-in-action while design artifact is in use.</td><td>- One needs to use different types of teaching and learning evaluations to provide opportunities for reflection on the learning process enabled by the new design artifact and its implementation.
- One needs to foster a culture of open dialog founded in trust.
- One needs to encourage collective reflection-in-action (while design artifact is in use) but carefully implemented in a subtle way ("just like NBA players") so it does not disrupt learning activities in progress.</td></tr>
<tr><td>DP2: Shared ownership with ADR team and users.</td><td>Shared ownership of design artifact enables the process of its continuous shaping through use (both individual and collective).</td><td>- Shared ownership assumes shared responsibility. Yet, to be effective, one needs to gradually develop this responsibility (e.g., through encouragement and support rather than delegation, such as through teaching allocations).</td></tr>
<tr><td>DP3: ADR practitioners as knowledge agents.</td><td>As knowledge agents, ADR practitioners enable transfer of knowledge to new ADR participants in the same instance of an artifact-in-use.</td><td rowspan="2">- Together, these two principles create a call for different type of training for ADR practitioners (in our case, tutors) founded in related work from the knowledge management discipline. For example, I found shadowing and mentoring to be more effective for transferring experiential knowledge than classroom-based professional development courses offered to tutors.
- One needs to acknowledge (through changed job descriptions) and appropriately award the changing nature of ADR participants' work.</td></tr>
<tr><td>DP4: ADR practitioners as boundary spanners across different instances of artifact-in-use.</td><td>As boundary spanners, ADR practitioners enable transfer of knowledge (especially knowledge-in-action) across different instances of an artifact-in-use to ensure the experience's consistency.</td></tr>
<tr><td>DP5: Situational leadership and transparency at all levels.</td><td>Situational leadership and transparency, if practiced at all levels (by session leaders, tutors, and students), enable a more agile and participatory learning experience.</td><td>- Situational leadership should be included in professional development courses offered to teaching staff at any level and made more explicit for students (e.g., when communicating class expectations).
- Two-way transparency fundamentally changes teaching practice from being somewhat "private" to open and transparent "for everyone to see". Not everyone (even more experienced teachers/lecturers) welcome this transparency.</td></tr>
<tr><td>DP6: Trust among all participants (ADR team and users) as foundation for successful experience.</td><td>Successfully implementing a continuously evolving artifact-in-use is founded in trust, especially when new models of working and interacting are experienced for the first time with (at that time) unpredictable consequences.</td><td>- Trust takes time to develop and does not come with teaching allocations. The ADR team found that articulating the explicit values and using them to guide the ADR team's shared experience "through unknown" to be useful in developing trust-based relationships among all participants, especially when faced with new challenges.</td></tr>
</table>

8 Summary of the ADR Process

Table 2 summarizes the ADR process I undertook in this project. The columns map the main stages of this project against the ADR principles (Sein et al., 2011).

Table 1. Summary of the ADR Process in This Project

Stages and principles	
Stage 1: problem formulation	
Principle 1: practice-inspired research	I conducted this research due to the practical need to conduct effective design-type learning activities in a large lecture environment with two-way feedback between experts (experienced teacher) and each student in the class regardless of size.
Principle 2: theory-ingrained artifact	I initially used the relevant literature from education research, IS, and IS education to evaluate and inform design requirements for a new organization model.
Stage 2: organization-dominant BIE	
Principle 3: reciprocal shaping	This project also demonstrates “the inseparable influences mutually exerted by the two domains” (Sein et al., 2011)—in this case, the main design artifact and its organizational context where the artifact was used. For example, a large lecture environment shaped the TBNL organization. Also design artifact-in-use reshaped jobs of individual tutors (even in terms of their duty statements). Through their work, tutors also re-shaped TNBL’s interaction patterns.
Principle 4: mutually influential roles	I initiated the project by taking the dual role of researcher/practitioner. However, even during the first cycle of artifact-in-use, all ADR practitioners were fully involved and our collective learning gradually shaped our roles, which the ownership of the main design artifacts’ gradually changing from individual (i.e., the main researcher/practitioner’s) into shared (i.e., with the ADR practitioners and, later, with end-users) evidences.
Principle 5: authentic and concurrent evaluation	I did not evaluate the design artifacts at a separate stage after building. Instead, I fully embedded evaluation into each cycle of BIE (see Table 1).
Stage 3: reflection and learning	
Principle 6: guided emergence	The main design artifact reflected not only the initial (preliminary) design but emerged and was shaped by its real-life use in its natural organizational context and by its ongoing evaluation and the ADR team’s shared learning, which the new interaction patterns that the team created in response to our shared learning and observations and implemented in sub-sequent cycles of design-in-use evidence.
Stage 4: formalization of learning	
Principle 7: generalized outcomes	I articulated the organization design challenge of teaching design activities in large face-to-face environment as a class of problems (generalize problem instance) relevant for any IS subject or teaching discipline involving design activities. I then proposed the main design artifact (TNBL) as representing a class of solutions (generalize the solution instance). I then articulated the outcomes as design principles that I disseminated to other practitioners (IS and other design educations) together with the main design artifacts.

9 Conclusions and Future Work

This paper contributes to the stated design challenge of teaching design-type activities in large lecture environments by making three research contributions. First, it contributes to *action design research* (ADR) by 1) presenting ADR as a method for designing and implementing innovative education and 2) showcasing the method using the example of teaching design activities in a large lecture environment. Second, it contributes to innovative education in information systems by providing an innovative model of large class instruction (i.e., the team net-based learning (TNBL) model) and by describing its main components. Third, it contributes to emerging organization design research by considering education from the perspective of organizational design rather than pedagogy or instructional design.

The paper describes all phases of the action design research project resulting in an innovative model of team net-based learning (TNBL). As I designed and implemented the model in my own practice, I had a combined role of the main ADR designer and reflective practitioner. The model was also extensively evaluated following the guidelines and principles of ADR. Later, other IS educators also independently adopted different elements of the TNBL model in their own teaching contexts.

Even though there were significant and steady increases in student enrolments across four semesters and students achieved successful learning outcomes, the action design research reported in this paper has some important limitations. For example, to scientifically confirm that the main factor for the increased student enrolment and improved learning outcomes was the new model, one would need to have a control group and run two models (traditional and TNBL) in parallel provided that the two student cohorts were comparable and taught by the same or comparable teachers. Doing so would be resource intensive and hard to implement in practice. The subsequent IS subjects (units), which students took after this MIS subject, also experienced increased enrolments. However, one cannot claim that the increased student engagement enabled by TNBL led to more students taking the subsequent IS units due to many other complex factors involved.

The ongoing refinement of the TNBL model created many interesting opportunities for future research beyond education. For example, a large-scale innovation of this nature opened up new research questions in the disciplines of: process management (co-design of knowledge-intensive processes through boundary spanning), knowledge management (especially design and sharing of good practices across different streams and even different courses), management of educational innovations, change management, transformational leadership, organizational learning, and performance management in educational environments.

As Senge et al. (2000, p. 102) observe:

> *If what happens in the classroom is primarily a product of the ways people think and interact, the methods that improve the quality of thinking and interacting can make everything else that goes on in the classroom more powerful.*

Senge et al. (2000) also point out that this kind of "sophistication" in classroom interaction does not happen naturally; rather, it results from intensive design and implementation. The TNBL model, which I designed, implemented, and evaluated through intensive action design research demonstrates this same point.

Finally, based on the experience gained in this project, I argue that own teaching practices offer new opportunities for design-oriented mode 2 research in our own workplaces. These environments that are often more challenging and complex to research than to any external organizations "out there" because the researcher/practitioner/educator is ultimately responsible for the outcome of their own innovation. Educational design projects, such as the one described in this paper, illustrate new opportunities for reinventing the future by adding design science to organization studies (van Aker & Romme, 2009). At the same time, these projects also contribute to reinventing the future of higher education through action design research and research-guided practice.

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Appendix A: Summary of Build, Implement, and Evaluate Cycles

Table A1. Summary of BIE Cycles in this Project

Phases (in BIE)	Emergence of design artifact	Evaluation		
		Evaluation patterns (Sonnenberg & vom Brocke, 2012)	Method	Objectives (criteria)
Initial build	Justified problem statement Justified research gap Justified design objective	Eval 1 (ex ante) of problem statement and research need	- Review of related literature from IS, IS education, organization science, and educational research - Review of practitioner initiatives - Reflection-on-previous actions (i.e., practice) - Development of walk-through scenarios	- Relevance - Importance - Novelty - Validity of initial observations
	Justified design requirements	Eval 2 (ex ante) of design requirements		
	Validated design specification Justified and validated TNBL artifact instance: - Organization model - Interaction patterns 1 and 2	Eval 3 (ex ante) of initial design in an artificial setting	- Evaluation against design requirements - Walkthrough scenarios with fellow IS educators and educational specialists	- Feasibility - Understandability - Clarity - Simplicity
Cycle 1	- Refinement of TNBL's organization model to better fit its org. context (i.e., physical environment) - Design and introduction of an additional instructional pattern (IP3) - Emergence of two design principles (DP1 and DP2)	Eval 4 ex post (both during and after completion) of two sequential instances of TNBL artifact-in-use (two MIS streams) in their naturalistic settings	- During each instance: in-class situational (ad-hoc) individual and collective reflection-in action of ADR team - After each instance: 13 minicycles of evaluation through collective reflection-on-action of the whole ADR team, after each session over 13 weeks	- Applicability - Effectiveness - Impact on student learning - Impact on ADR team and students
		Eval 4 ex post of a design artifact instance at the end of cycle 1	- End-of-the-semester teaching and course evaluations - Focus groups with students - Focus group with tutors - Reflection on overall experience with TNBL design artifact and its use	- Applicability/usefulness to ADR team and users - Effectiveness in practice in terms of improved class interaction and improved learning - Impact on ADR team and students
Cycle 2	Refinement of TNBL's organization model to enable knowledge transfer to new ADR participants (e.g., through shadowing and situational support) - Design and introduction of two additional instructional patterns (IP4	Eval 4 ex post (during and after completion) of three sequential instances of artifact-in-use (three MIS streams)	Same as in cycle 1 (ADR team expanded by new tutors)	- Same as in cycle 1 - Effectiveness of different boundary spanning techniques for knowledge sharing and transfer to new ADR participants)
		Eval 4 ex post of three design artifact instances at the end of cycle 2		

Table A1. Summary of BIE Cycles in this Project

	and IP5) - Emergence of two design principles (DP3 and DP4)	Eval 4 ex post at the end of cycle 2 (additional independent review of the design artifact instance and performance and experience of a particular student)	Review by the university academic board	-“Educational soundness” of the design artifact and its implementation - Learning progress of a particular student throughout the semester - Each student’s educational experience in the context of the overall student experience
Cycle 3	Refinement of TNBL’s organization model to enable knowledge transfer to new ADR participants (i.e. session leaders and tutors) - Design and introduction of an additional instructional pattern (IP6) - Emergence of two design principles (DP5, DP6) and further refinements of previous one (DP4)	Eval 4 ex post (during and after completion) of six parallel instances of artifact-in-use (six MIS streams)	Same as in cycle 1 (ADR team expanded by session leaders and new tutors)	- Same as in cycle 1 - Effectiveness of different boundary spanning techniques for knowledge transfer across different instances of design-artifact-in-use with (now) independent teams of participants led by new session leaders.
		Eval 4 ex post of different aspects of TNBL model by visiting IS and educational scholars (in naturalistic settings)	- In-class participation as ADR participants - Class observation (in situ) and peer-review of teaching - Observation and feedback on ADR process	- Effectiveness of teaching and learning in IS design activities - Effectiveness of two-way feedback loops - Applicability, clarity, and effectiveness of ADR research method and its process
Post cycle 3 (end of BIE)		Eval 4 ex post of overall experience across all three cycles of artifact-in-use	- Reflective journals, notes, and story telling - Collective reflection-on-action of the core ADR participants (those with prior experience with artifact-in-use over at least two cycles - Case study	- Fidelity with real-world phenomenon - Generality - Effectiveness of educational outcomes - Appropriateness of design requirements - Organizational performance (operation costs, impact on support services, teaching and administrative staff) - Impact on organizational environment of design artifact, ADR team, and users

About the Author

Olivera Marjanovic is an Associate Professor at The University of Sydney Business School, Australia. Her research seeks to assist business, government, non-profit, and since recently cooperative organizations, to effectively manage, improve and innovate their knowledge-intensive business processes and services. Her research and professional interests and capabilities include Business Intelligence/Business Analytics, Business Process Management and human-centered Knowledge Management. She has received numerous research grants and teaching awards for her innovative teaching practices, including a highly prestigious Bronze Award (Category: MBA and Social Sciences) for the 3rd place at the 2015 International Competition on Innovation in Higher Education: Wharton–QS Stars Re-imagine Education Awards—the Oscars of higher education innovation (with over 500 entries) in Philadelphia, USA, in December 2015. Olivera has held visiting professor positions at the Loria/Inria Institute in France (three times), University of Duisburg in Germany, and Arizona State University in USA.

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