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Teaching Design Science Research

Professional Development Workshop

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Abstract

Design science research (DSR) aims to generate knowledge about innovative solutions to real-world problems. A comparably new stream of research, DSR has matured methodically, and is increasingly catching the interest of researchers, specifically for its potential to contribute to problem solving in society and the economy. Since research methodology curricula develop slowly, however, DSR is still underrepresented in most curricula and courses on research design and methods, and we lack guidance on what and how to teach in a DSR course in a way that enables junior academics to conduct DSR according to high standards. We report on teaching DSR methodology both on PhD and Master levels and for both managerially and technically oriented student populations. Our interactive on-site and distance formats have been refined over 14 years. The PDW presents an effective syllabus, teaching material and experience from conducting over 25 courses with students from over 20 countries across all three geographic AIS regions.

Keywords: Course design, design science research, research methods

Introduction

Design Science Research (DSR) is an important research paradigm that aims to generate design knowledge on the solution of real-world problems. Today, DSR is applied in many disciplines and has developed considerably over the last decades, especially driven by a rich discourse in the Information Systems (IS) community (Baskerville et al. 2018; Gregor and Hevner 2013; Gregor and Jones 2007; Hevner et al. 2004; Peffers et al. 2007; Sein et al. 2011). With the focus on solutions to real-world problems, DSR enables researchers to make contributions of significant societal value (Watson et al. 2010) and DSR therefore also brings the potential to demonstrate relevance as a field (Rai 2017; vom Brocke et al. 2013), e.g. by contributing to the solution of grand societal challenges (Becker et al. 2015).

As methodology teaching curricula develop slowly and design science research (DSR) is a comparably new—and rapidly developing—research approach, DSR is often insufficiently represented in scholarly education. This is problematic, given the high relevance of DSR for the IS discipline. At the same time, DSR is a complex and rapidly developing field, which makes it essential to provide a systematic and up-to-date education on DSR to assure high quality contributions.

We encounter a wide variety of DSR perceptions:

- DSR is sometimes seen as ‘consulting’, i.e. an application of descriptive insights—As an IS research approach, however, DSR aims at creating design knowledge (DK) contributions, either in the form of design theory or in the form of projectable solutions to classes of relevant problems (vom Brocke et al. 2020b).

- DSR is sometimes reduced to conceptual (enterprise) modeling—While models and modeling are often components of DSR and design knowledge, modeling is only a sub-aspect of problem solving.
- DSR is sometimes reduced to solution design (e.g., software solutions)—In IS, however, design knowledge and projectable designs integrate technology, people and task/business perspectives.
- DSR is often associated with specific types of artefacts (processes, knowledge bases, data)—IS DSR as a discipline should be artefact agnostic, as projectable solutions can have very different manifestations, even beyond the classical artefact types (constructs, models, methods and actual IS solutions).

An Information Systems DSR course needs to provide a consistent conceptual frame with regard to what constitutes DSR and the forms it can take. Recent contributions, for instance, put the creation of design knowledge (DK) in the focus of DSR (Gregor and Hevner 2013), with DK constituting means-end-relations in problem and solution space (Venable 2006). DK can relate to different levels of projectability be represented in different levels of fitness and be evaluated to different levels of confidence (vom Brocke et al. 2020b).

Against the background of a consistent understanding, key elements and streams of DSR can be derived. In DSR, for instance, the design processes play a major role, and different perspectives a researcher takes on the design process can be distinguished. For instance, design processing (“design research”) and design theorizing (“design science”) have been distinguished as DSR streams (vom Brocke and Maedche 2019; Winter 2008): in the form of design processing, DSR engages in design and evaluation activities to produce design entities to solve a class of problems. Such design entities mark DK in the form of models, methods, concepts or instantiations (Hevner et al. 2004). DSR in the form of design theorizing, engages in the analysis of design processes, with the aim of generating design knowledge in form of design theory (Gregor and Jones 2007).

Given the complex nature of DSR, planning and scoping the DSR process plays a key role in high quality DSR (vom Brocke and Maedche 2019). DSR happens in context, and, thus, it does not follow a straightforward process. Researchers have to learn how to explore and navigate the problem and solution space, to carve out potential clusters in the problem and solution space to position an intended DK contribution, to challenge their understanding, reformulate it and engage with many stakeholders to continuously seek and incorporate feedback (Abraham et al. 2014; Sonnenberg and vom Brocke 2012). Researchers need to command a repertoire of methods and tools, while the research process arriving at DK is highly individual and contextual considering both constraints and opportunities as they arise in course of the research (vom Brocke et al. 2021). In teaching DSR, it is therefore important to cover this element of experience in context.

This paper summarizes the background, challenges and process of developing a successful portfolio of IS-DSR educational formats, presents key course components and outlines a possible avenue for a community-based development of effective DSR methodology formats.

Background

The organizers use their current courses to demonstrate how they successfully developed educational formats for DSR. At the University of St.Gallen, DSR has been established since as early as 2007 as a compulsory course in the Business Innovation concentration of the PhD program in Management (ca. 30 students p.a.), taught by the two authors of this paper. Starting in 2018, in St.Gallen a DSR component has also been incorporated also into the compulsory research method course for Master students in Business Innovation (ca. 250 students p.a.). At the University of Liechtenstein, DSR has been a component of research method courses on bachelor, master and PhD level since 2010 involving students from both the Business Faculty and the Faculty for Architecture and Design (ca. 50 students p.a.). From 2017 onward, the German Academic Association for Business Research included a DSR course in its cross-university, cross-concentration PhD course program in Business/Management for Germany, Austria, Switzerland and Liechtenstein. Introduced initially in German as regular onsite courses, the courses were successively offered in English and in an online course format. In 2021, the authors were invited to offer the course also as a component of PhD programs in Finland and Germany. Overall, the courses developed and delivered by the co-authors have attracted more than 2,000 participants from 20

countries in all three geographic AIS regions. It is noteworthy that, while many participants had their background of their study focus in IS, nearly all courses explicitly were positioned outside a specific IS concentration.

Challenges and Course Design Requirements

We identify the following key challenges to guide the course design:

1. **Progress of the Field:** DSR progresses comparably fast as a field, so the body of knowledge is represented in a portfolio of disperse contributions. Contributions need to be contextualized in terms of how they relate and how topical they are.
2. **Diversity of the Field:** An expression of the dynamic development of DSR, many contributions also appear to be contradictory, follow different assumptions and, thus, need to be well selected and discussed for the students to provide appropriate guidance.
3. **Critical Thinking:** Students need to be empowered in critical thinking. They need to be able to understand, yet challenge, contributions in the literature. They need to learn how to follow methodological guidance, but also to interpret and adapt methods in context.
4. **Action Competence:** Given the complex and temporal nature of DSR, the competences to apply DSR in projects need specific consideration. Students need to learn from experience in order to be prepared to actually plan and scope their DSR projects.

Process of the Course Design

To develop DSR methodology courses, we have applied DSR ourselves. Over the past 15 years, continuous self- and student evaluations as well as changing context conditions (internationalization, collaboration tools, pandemic) have led to a large number of changes. In addition to the formal evaluations, we have collected qualitative feedback by inquiring about the experience and evaluation of the students in the closing discussion of each course. Given the institutional setup of our courses, the students were used to an open feedback culture and reported openly both on positive and negative experiences. In turn, we have also very openly invited students to provide ideas for improvement. All participants have been invited to join a discussion group on LinkedIn where new methodology papers, surveys, job offers, etc. are frequently discussed and announcements are distributed (<https://www.linkedin.com/groups/8943562/>).

In course of the iterations in various contexts, we have also developed variations of the course design. For instance, we have developed specific variations of the course on master level as opposed to on PhD level, and have developed variations for a 4 ECTS course as opposed to a 6 ECTS course. Due to the changing course delivery requirements in the Pandemic, we have developed completely online/offline distance formats in addition to the traditional onsite formats.

Principles of the Course Design

Our course design is communicated best by stating the following principles, which represent the essential design knowledge we were able to gain so far:

- **Spark a fascination for real-world contributions:** Despite the diversity in methods and approaches, a clear and major constant in DSR is the intent to contribute to real-world problem solutions. Awakening this vision in students is important, and in some ways even more important than teaching individual methodological details, which students can also largely acquire independently.
- **Create an encouraging learning environment:** Since it is key to experience DSR and to discuss individual ideas with fellow students and lecturers, it is important to create an atmosphere of togetherness, shared identity, mutual respect, and trust. In our courses, for instance, we facilitate the creation of this sort of environment by a very casual introduction round, getting to know each other as equals, establishing links to joint backgrounds and interests, as well as a good dose of humor and fun.
- **Get students up to speed quickly:** Over the many iterations of our courses, we have learned that it is beneficial to offer a rich learning portfolio to the students upfront, which allows them to get familiarized with the state of the art in DSR before the course starts. This gives room to engage

in the course and to jointly discuss aspects of conducting DSR in context. Specifically, we provide a carefully curated reading list and take time to discuss reading assignments on selected topics that have to be prepared by students.

- **Involve students in their own DSR projects:** To ensure action competences, it is crucial to not only “teach” DSR, but to let students “experience” DSR. In our courses, we therefore organize a DSR project marketplace, at the end of the first day, where students can pitch and select projects which they work on in groups. These projects serve as “objects of study” throughout the course. We found it particularly helpful for the students to suggest such projects from their individual backgrounds, since this increases their identification with the methodology and ability to apply it.
- **Provide continuous mentoring:** With the individual DSR projects serving as objects of study thought the course—in the vein of DSR—these cases are continuously discussed, challenged, and further developed as the course proceeds. Specifically, we make use of multiple rounds of “walk throughs”, in which the students present the progress of their case to a different set of audiences (e.g. one of the lecturers, both lecturers, or the entire class). Currently, we are evaluating options on how to include peer feedback more systematically and to further train students in giving and receiving structured, constructive feedback.
- **Iterate and progress in richness:** Given DSR is a complex matter, we have come to apply an iterative way of introducing DSR: First we convey its very essence, e.g. in an opening key note, and then we revisit it from various angles, including many different modes of engagement, such as presenting and discussing a paper, working in groups “offline”, pitching one’s own ideas, presenting and discussing one’s research proposal and providing feedback to others, in turn. It is an important task for the lecturers to moderate and link the various activities and to consolidate insights both during the course as well as in a dedicated closing session of the course.
- **Ensure a professional course management:** The course design results in a comparably high level of complexity: pre-course assignments each with a different character and timeline, multiple forms of engagements, or groups with different background and intentions. Particularly important is time management, content management and communication management, and we have had a good experience in establishing standards regarding these aspects. We apply time boxing and have introduced small units of 60 min max, particularly to support the online setting. Regarding content management, we have established a common shared folder structure to distribute teaching material as well as to allow student to upload their work. Regarding communication we use templates to efficiently communicate tasks.
- **Provide supporting material:** The high level of complexity in DSR sometimes makes it hard for the students to understand what they are expected to do. To some extent, this vagueness is “by design”, to enable students to learn by experience in navigating complex DSR processes. That said, we found it important to develop material to additionally support students in this endeavor. For instance, we provide a template to plan and scope DSR projects (vom Brocke and Maedche 2019) as well as a set of cases demonstrating high quality DSR (vom Brocke et al. 2020a). Further a checklist outlining what to consider in defining and presenting the DSR project is provided, and guidance on how to communicate and present DSR (Cahenzli et al. 2021). We also provide access to tools students can use to plan and document their design process (vom Brocke et al. 2017) and keep a journal of their DSR experience (vom Brocke et al. 2021). We continuously grow this toolbox of useful artifacts to support students in learning how to plan and conduct DSR to high standards.

Artefacts

In this section, we give an overview of artifacts developed as part of our DSR course design. We provide a brief illustration and a reference to sources, if available. Since the artifacts are subject to continuous development, we advise getting in touch with the authors to access the most up to date version, in case readers would like to access some of the resources for their own work.

- **Syllabus:** Clear outline of the course, serving as a single point of truth for all course-related matter. The syllabus gives a brief introduction to the topic and outlines the mode of work, specifically how to combine both online sessions together with all students and the faculty as well

as the so-called “off-line” tasks in which students come prepared with (for example) pre-readings and assignments, and in which they jointly work on their design projects in groups. A sample syllabus can be accessed at https://vhbonline.org/fileadmin/user_upload/VHB-ProDok_2109MSO4_Syllabus.pdf

- **Presentations:** We provide two slide decks, one giving an introduction to DSR and the other containing all relevant information on the course organization. The introductory slides serve the purpose to spark some fascination on DSR, and start with examples. Then, we provide some essential models and frameworks, as very concisely presented in (vom Brocke et al. 2020a). We then walk the student through exemplary projects we have conducted ourselves and we add reflections on our practical and personal experience.
- **Reading list:** The reading list contains a well curated list of seminal articles on DSR, which is regularly adapted. First, it contains three to five mandatory articles intended to provide a common basic understanding and vocabulary. Second, the reading list contains elective articles for specific topics, and we group such articles in reading packages, e.g. on DSR paradigm, DSR artifacts, DSR process, DSR evaluation and DSR theorizing, each of which containing three to four articles, depending on the group size. Each student would prepare at least one of those elective papers. In class we organize panels for each of the packages, including a joint discussion across all articles in the package. Sample reading lists can also be found in the syllabus (see link above).
- **Check Lists:** For the students to prepare their own DSR projects, we provide a check list, which raises essential questions to be answered in order to define and efficiently communicate their project. For instance, the lists start with the question “What are we doing?”, detailed by a sample gap text along the lines of “We are designing a (specify artifact). In terms of DSR, it is a (specify artifact type). It is intended to be used by (specify stakeholder/s) to help them to (specify purpose/s).” Further covered positioning aspects include: “Why are we doing it?”, “How are we doing it?” and “What do we expect to learn?”.
- **DSR Grid:** For the first walk through, we recommend using the DSR grid (vom Brocke and Maedche 2019) to position the student’s design project. Developing a communication structure and balancing process/result and problem/solution aspects right from the start has proven to support the early stages of developing student projects.
- **Process Support / Project Log:** We recommend using the tool MyDesignProcess.com to support students in planning and documenting their research activities and to reflect on the progress they make in their own DSR projects. The tool is free to use for educational purposes and it supports working in teams as well as archiving and publishing results (<https://www.mydesignprocess.com>).

Outlook

In this practice development workshop (PDW) on teaching design science research (DSR), we report on the experience of nearly fifteen years’ teaching DSR at a number of universities involving over 2,000 students from over 20 countries. First, we report on specific challenges in teaching DSR, which are very specific for DSR as compared to other research approaches. Second, we formulate principles on how to teach DSR, as they consolidate our experience over the past years. Third, as part of our course design, we have developed artifacts we use in teaching, and present a selection of these artifacts, which we are also happy to share.

We hope to initiate greater discourse on DSR methodology teaching as well as to establish a community of colleagues who would like to engage in the exchange of experience, resources and ideas on how to further develop our capacities to teach DSR. For instance, we would like to encourage major conferences, such as the International Conference on Design Research in Information Systems and Technology (DESIST), to establish related tracks on DSR education.

Our understanding is that is particularly through teaching that the academic community can develop impact. The more graduates and junior academics we qualify in conducting top quality research of relevance to society, the greater the value both for society and the academic community. Since DSR, through the focus on innovative solutions to real-world problems, has the particular opportunity (and the

fascination) to make such contributions, we feel particularly passionate about teaching design science research.

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