An Information Systems Design Theory for Adaptable E-Learning

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Abstract

An Information Systems Design Theory is a prescriptive theory that offers theory-based principles, which can guide practitioners and scholars in the design of effective information systems and set an agenda for on-going research. This paper introduces and describes an ISDT for adaptable E-Learning. We formulate our ISDT based on two cycles of Action Design Research. The cycles were conducted in an authentic organizational setting with end-users, responsible for organizing, producing and distributing civic orientation. Based on our findings, we propose that our ISDT, together with its components, can be used to design, implement and support an information system that incorporates E-Learning, which is not explicitly constrained to the formal context of higher education.

1. Introduction

E-Learning is a well-established idea of promoting Information Systems and Technology for open, distance and flexible forms of learning and teaching. Universities have adopted this idea to support and enhance learning and teaching in higher education institutes [1]. For example, E-Learning systems such as Learning Management Systems (LMS) have been designed and marketed to educational institutions to support teaching and learning [2], scholars have built academic communities for diffusing relevant body of knowledge about E-Learning [3] [4], and last but not least, professional IS-designers and developers have created innovative Information Systems and Technology for supporting the success of critical factors of E-Learning [5]. It has been the convergence of the technological and pedagogical developments that has driven E-Learning innovation and its collaborative potential to create and sustain a community of learners [6]. But is the adoption of E-Learning only relevant for higher educational settings?

Recent studies [7] [8] [9] shows how the need of adopting E-Learning has reached levels that are not explicitly situated on higher levels of education. Such levels are situated in the private sector and emphasize E-Learning for societal issues, which override the traditional setting of universities. Instead, the issues assert the process of informing and teaching about how the very foundation of a society is constituted in terms of a society’s’ culture, norms, values, laws and traditions. Examples on E-Learning and societal issues comprise online civic engagement supporting youths [8], civic identities and online technologies to support civic experiences [9], and online-distributed civic orientation for immigrants entering a new country (newcomers) [7]. This creates a problem that challenges the technological and pedagogical prerequisites of which E-Learning is traditionally organized and distributed. It also challenges how practitioners perceive and use guidelines for implementing E-Learning that is for a non-traditional E-Learning context. In an attempt to address this problem, this paper develops and presents theory-based design principles in the form of an Information Systems Design Theory (ISDT).

1. 1. Problem

Information Systems Design Theories (ISDTs) were originally described by Walls et al [10] as prescriptive theories developed to provide solutions to specialized classes of IS design problems [11]. ISDTs serve both practitioners and scholars beneficial means for knowledge production and use. For practitioners, ISDTs are beneficial because they provide development reliability and plausibility of success by providing principles derived from kernel theories, which demarcate the range of system features and development activities to a more manageable set [10]. For scholars, ISDTs provide principles that are open to empirical testing and thus can form a basis for further research [12] [13].

The development of ISDTs for E-Learning in general has been expliciated into formulations and fully developed theories, providing practitioners guidelines in how to design and develop E-Learning systems [14] [15] [16]. Alternatives to E-Learning systems have
been suggested to offer a better fit for the requirements of tertiary E-Learning and the broader context within which it operates [17]. But those approaches have explicitly emphasized the context of higher education and not other levels of education. Therefore, prior E-Learning literature [6] [14] [15] [16] [17] shows that there has been limited theory-based guidance for the design and support of underlying information systems for E-Learning, which overrides the traditional discourse of E-Learning.

The contribution of this paper is to offer an ISDT that identifies and proposes a set of design principles. The purpose with the design principles is to offer theory-based guidance for the design and support of underlying information systems for E-Learning that overrides the traditional discourse of E-Learning. An initial set of design principles have already been validated through a recent project for the design and support of an information system for E-Learning and civic orientation. The information system offers flexibility in terms of feature use and integration within the organization in which it operates. Therefore, developing an ISDT is an important theoretical contribution, because it provides practitioners and scholars necessary knowledge in how to design and develop underlying information systems that support E-Learning at levels of teaching and learning, which is not explicitly constrained to the formal context of higher education. Hence, we address the following research question:

- How to design, implement and support an information system that incorporates E-Learning, which is not explicitly constrained to the formal context of higher education?

2. Information Systems Design Theory

Theories in general are identified into five interrelated categories of theory based on the principle question at the groundwork of a research project [17]. These five categories are summarized in Table 1.

<table>
<thead>
<tr>
<th>Type</th>
<th>Question</th>
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<tbody>
<tr>
<td>Analyzing &amp; Describing</td>
<td>What is?</td>
</tr>
<tr>
<td>Understanding</td>
<td>How &amp; Why?</td>
</tr>
<tr>
<td>Predicting</td>
<td>What will be?</td>
</tr>
<tr>
<td>Explaining &amp; Predicting</td>
<td>What is, how, why and what will be?</td>
</tr>
<tr>
<td>Design &amp; Action</td>
<td>How to do something</td>
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</table>

An ISDT belongs to the fifth and last category of theories, focusing on generating principles that inform practice and are open for empirical evaluation [17] [12]. An ISDT provides design principles for guidance about how to achieve specific goals in reality without explicitly constraining hypothetical tests to closed experimental environments [10]. It also provides theory-based guidelines about how to design and support a particular type of information system [10], but also assist with more cumulative knowledge building [12].

ISDTs are integrated with components of prescription (see Figure 1) consisting of a particular class of requirements, a type of system solutions with particular features, and a set of efficient development practices [10]. Walls et al’s [10] anatomy for an ISDT defines both design as a noun (product) and a verb (process). However, both the aspect of nouns and verbs are generally informed through kernel theories [10], or as Gregor & Jones [12] address it ‘Justificatory Knowledge’, which enables the formulation of empirically testable predictions relating the design theory to actual outcomes.

3. Research Approach

Our research approach for constructing an ISDT follows the advice of Walls et al [10]. Walls et al’s [10] advice provides appropriate and efficient components for formulating an ISDT with incorporated design principles, which informs crucial design knowledge for practitioners and researchers within the field of IS.

Our research approach for constructing our ISDT follows the advice of Sein et al [18] through Action Design Research (ADR). Sein et al’s [18] ADR-approach provides a sufficient method for conducting research that emphasizes processes for building, intervening and evaluating IT-artifacts in organizational settings, which researchers can adopt to generate design knowledge that can be formalized and formulated into design principles and theories.

Our distinction between formulating and constructing an ISDT lies in the work of activities, where formulating an ISDT emphasize the explicit...
approach for presenting our use of the different components of the ISDT, and where constructing the ISDT emphasize design activities that generate design knowledge for the formalization-process. We will combine empirical findings with kernel theories to motivate and formulate our ISDT.

3.1. Past Research Activities

The ISDT that we will describe for this paper, have been constructed by using the ADR-method (see Figure 2). The ADR-method enables iterative development of testable hypotheses and design principles within a real organizational setting. Our ADR-activities have been iterated through past activities for identifying requirements, design challenges, design implications and refinements of system features. Similar, but not equivalent, action-oriented approaches have been used by Markus et al [11], Lindgren et al [19], and Jones [12] where the iterative process inaugurates with a set of requirements to hypothesize a collection of design and development principles. The principles are then used to generate a set of system features that are implemented and used for further evaluation [10]. But in order to improve the ISDT, observation of feature use is combined with changing requirements, development of a new theory, or better understanding of existing theory.

3.2. Research as an On-Going Process

For this work the on-going research process has been present since late 2013 with activities comprising formulation of initial requirements, design implications and initial design and development of an underlying information system for E-Learning and civic orientation. Past activities have been reported through research papers presenting early findings in terms of design challenges and implications [7] [20], tentative design principles for guiding design activities [21], and a formal schema and architecture of the supporting information system [22]. Thus, we will not repeat detailed descriptions and explanations about our project and the nature of civic orientation, because they have already been reported in previous papers. However, our conducted design activities are necessary to report, because they have generated design knowledge, which we now want to formalize and communicate to other scholars. Therefore, we will in the following section frame past identified activities and describe them through two different ADR-cycles.

4. ADR-Cycles

Our research has been conducted through two ADR-cycles. The cycles were implemented together with organizational representatives such as clerks and tutors at a municipality in Sweden. The representatives were, due to our ADR-approach, identified as end-users. One common thing for both cycles was that, we in the process of building, intervention and evaluation (BIE), did use The Generic Schema for Organization-Dominant BIE. Sein et al [18] suggest the schema as suited for efforts to generate early design knowledge where the primary source of innovation is organizational intervention, such as the set of tools created by Pries-Heje and Baskerville [23] for structuring decision-making situations in organizations. In our case, we have throughout the BIE-cycles, created an information system with a wide range of flexible system features for organizing and distributing E-Learning for civic orientation. The actual features and the underlying technology have already been reported in a recent paper [22]; the features comprise a wide range of supporting functionality for clerks and tutors in their tasks for conducting civic orientation. Furthermore, the technology used is an aggregate of different cloud services (e.g. Google Drive), content management systems (e.g. WordPress), social media (e.g. Youtube), and video conferencing tools (e.g. Adobe Connect).

Figure 3 depicts the two ADR-cycles with the respective activities in each cycle. The ADR-cycles were conducted between late 2013 and early 2015. The ADR-team consisted of researchers and practitioners (system developers) working together with clerks and tutors (end-users) from the municipality. Clerks and tutors have the role to organize and distribute civic orientation for newcomers through different use of content (video, text, images, interactive online-modules etc.) The end-users were actively involved throughout both ADR-cycles. Both cycles are already completed, with the exception of the last stage within the second cycle. The last stage within the second
cycle is highlighted as the current stage reported in this paper.

In the first cycle, we conducted interviews and workshops with the end-users at the municipality’s facilities. The conducted interviews and workshops revealed that the end-users had a heterogeneous pre-understanding towards system needs and requirements in terms of features for organizing and distributing civic orientation. Building on a literature review, we proposed and grounded a synthesis of design implications as an early instantiation of our alpha prototype [20]. The purpose with our alpha-prototype was to address the early needs and requirements for further BIE-activities. In the BIE-activities, we involved the end-users for instant feedback and evaluation of design solutions. Thus, they were constantly involved throughout the whole BIE-cycle, providing the ADR-team with crucial input for design and development decisions.

Throughout the stage of reflection and learning, we identified challenges for design and development of system features for collaboration, production and maintenance of learning material for civic orientation. We also identified challenges for development of pedagogical learning strategies, which govern tutor’s teaching approaches and clerk’s production of learning content. From these learning outcomes, we formalized our reflections by formulating a set of tentative design principles for an early formulation of an E-Learning system for civic orientation [21]. The design principles have been qualitatively evaluated in a series of iterations together with the end-users (for an explicit description about the tentative design principles, please see reference 21).

The second cycle mainly aimed at the adaption of the first cycle’s results in order to refine the first set of tentative design principles. We conducted supplementary courses for the end-users, so that they could learn how to use the prototype’s features. The courses were divided into eleven different phases and conducted on the municipality’s facilities. For the evaluation of the design principles, we analyzed outcomes from the supplementary courses and instantiated and realized a beta version of our prototype by identifying design decisions being appropriate to fulfill the design principles (for details on our fully implemented prototype, see reference 22).

Essential learning outcomes for the second cycle resulted into four design paradoxes (see Table 2). The design paradoxes derived from the BIE-stage in the second cycle. They were discovered through an evaluation together with the end-users and our beta-prototype. The evaluation was first conducted at the municipality’s facilities together with the end-users, providing them the opportunity to interact with the prototype and its features. Second, we followed up by conducting a survey evaluation, providing the end-users questions about their experience with the prototype. The survey evaluation resulted into a further revelation about end-user’s needs and requirements. Hence, the design paradoxes emerged as challenging findings during the reflection and learning stage.

### Table 2. Design Paradoxes

<table>
<thead>
<tr>
<th>Paradox</th>
<th>Description</th>
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<tbody>
<tr>
<td>Paradox 1 – Open VS Closed</td>
<td>The design of the supporting Information System shall both be developed as an open system with learning content available open online, but also, material that is restricted and closed to a handful of users online.</td>
</tr>
<tr>
<td>Paradox 2 – Standardization VS Flexibility</td>
<td>The design of the supporting Information System shall both incorporate standardized language and content for the learning material, but also provide flexible features for tutors, so that they can embed online learning material that overrides the standardized material.</td>
</tr>
<tr>
<td>Paradox 3 – Control VS Involvement</td>
<td>The design of the supporting Information System shall provide system features for both facilitated control such as controlling the presence of attendees at the lectures (online and classroom held), and the content of learning material, but also features that allow a wider involvement of attendees through E-Learning.</td>
</tr>
<tr>
<td>Paradox 4 – Homogeneous VS Heterogeneous</td>
<td>The design of the supporting Information System shall provide both homogeneous and heterogeneous content because...</td>
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</table>
The newcomers are a heterogeneous group of learners, which may vary from academic to analphabets.

The design paradoxes shown in Table 2 are our latest findings in terms of learning outcomes from the second cycle. They are addressed as paradoxes because of their contradictory nature. Robey & Boudreau [24] argued that a paradox is one of the most common types of contradictions in the management of information systems and organizations. Paradoxes require problem solving and creative thinking about how contradictory elements can logically or meaningfully coexist [24] [25]. Smith & Lewis [26] highlight paradoxes as “elements that seem logical individually but inconsistent and even absurd when juxtaposed” [26]. In our case, the paradoxes derive from the second stage of BIE, and they have emerged as a challenging theme throughout the second stage of reflection and learning. They coexist with each other because they identify contradictions between the design and development of system features. They seem logical individually, but inconsistent when juxtaposed (e.g. control VS involvement). Finally, they suggest dual intentions that affect the nature of their design. Hence, we define them as design paradoxes.

Since the main goal of this paper is to address how to design, implement and support an information system that incorporates adaptable E-Learning, which is not explicitly constrained to the formal context of higher education, we propose, as the last stage in cycle two, an ISDT for adaptable E-Learning. With adaptable E-Learning, we mean E-Learning that is supported by underlying features that are adaptable for the actual learning context. The context can for example be a non-traditional context for E-Learning, emphasizing teaching and learning for societal issues (e.g. civic orientation) but it could also be a context, which emphasizes teaching and learning at levels in society that is not constrained to higher education (e.g. university). Therefore, we propose that the underlying technology for E-Learning, can together with its system features be adapted to support different kinds of learning that is not only constrained to the traditional scope of E-Learning.

5. An ISDT for Adaptable E-Learning

This section introduces our ISDT for adaptable E-Learning by describing each of the components (see Figure 1) as explicated by Walls et al [10] including: kernel theories, requirements, features, development practices and design principles together with their testable hypotheses.

5.1. Kernel Theories

Inspired by similar works such as ours [14] [16], our kernel theories consist of a combination of informing literature for constituting the anatomy of our ISDT. The kernel theories of the ISDT for this paper include: Communities of Practice [27] [28], literature on E-Learning research [6] [14] [29] [30] [31], and Agile Software Development [32] [33] [34] [35].

We have chosen these kernel theories, because of our empirical findings. Our empirical findings derive from a context, which comprises issues regarding information systems design and development, societal learning, E-Learning and a community with employee’s working with civic orientation. We will in the next upcoming subsections; (1) present our chosen kernel theories, (2) frame how we have used them according to Walls et al’s [10] anatomy, and finally (3) explain the purpose and development of our design principles and their testable hypotheses.

5.1.1. Community of Practice

Community of practice (CoP) refers to groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly [27] [28]. Wenger extended the work of CoP to organizational and educational learning. His “Social Theory of Learning” model integrates the following components necessary to characterize social participation as a process of learning and knowing:

- **Meaning**: learning gets established through experience
- **Practice**: learning gets established through doing
- **Community**: learning gets established through belonging
- **Identity**: learning gets established through becoming

Wenger suggests that learning should be primarily a practice of identity formation and modes of belonging, and not just only accumulating skills and information.

5.1.2. Literature on E-Learning Research

Literature within distance education and learning [6] [14] [29] [30] [31] provide a wide range of incorporating principles for conducting E-Learning. Such forms are established through the interaction...
between technological prerequisites such as Information Communication Technologies (ICT) in education, learning technologies, multimedia learning, and technology-enhanced learning [6] [29]. But at the same time, technology alone cannot establish learning. Therefore, pedagogical prerequisites are an integral part of E-Learning, providing various strategies, techniques and procedures to increase the amount of interaction between learners and teachers (e.g. newcomers and tutors) [30].

E-Learning’s transformative power and capacity to add value is not based upon information access. What is required, and what E-Learning offers, are better ways to process, make sense of, and recreate relevant information for learning. At the core of the E-Learning context is a collaborative constructive transaction [6]. E-Learning is exciting from this perspective in that it enhances and enriches both content and context.

5.1.3. Agile Software Development

The Agile Software Development methodology provides a group of software development methods in which the process of identifying needs, requirements and solutions evolve through collaboration between self-organizing, cross-functional teams [32]. Most agile methods break the tasks into small increments with minimal planning and do not directly involve long-term planning. Instead, most agile development involves short iteration time frames, which typically last from one to four weeks [33] [34]. But at the core of Agile Software Development, lies the promotion of adaptive planning, evolutionary development, early delivery, continuous improvement, encourages rapid and flexible response to change, and a close involvement with the stakeholders and/or end-users of the product [35].

5.2. Requirements

Based on experience with distance education and learning, and literature on E-Learning research [6] [14] [29] [30] [31], we motivate a set of functional and non-functional requirements. For the non-functional requirements, we include governing factors such as: flexibility and the ability to adapt to change, platform independence, use of Internet, and other widely accepted standards, maximizing the choice and flexibility provided to newcomers, clerks and tutors, providing them with tools and not the rules. Doing so, we minimize online time, minimizing the new skills required to use the system, not reinventing the wheel, but instead being freely available in a non-traditional E-Learning context. Excerpts from interviews with clerks and tutors, illustrates the mapping between our formulated requirements and needs:

- “System-features must provide easy features because we are not IT-experts."
- “We want the ability to update by ourselves.”
- “Our participants are newcomers with a heterogeneous background… some of them are scholars, and some of them or alphabets… we need system-features that provide simplicity and support for everyone.”

The focus on flexibility and diversity implied that a single set of functional requirements would not be appropriate; instead, the functional requirements were identified and tested throughout the process of our ADR-cycles, and based on the recognition that learning and teaching includes tasks associated with information distribution, communication, assessment, administration and design [15] [35].

5.3. Features

In keeping with the kernel theory of Community of Practice [27] [28], this ISDT intends to implement a framework of features appropriate for the context of application. Such features shall be adaptable for the actual use and learning context [27] [28]. The features shall provide and structure the underlying IS based upon a notion of E-Learning activities through doing, belonging, becoming and experiencing [27]. Furthermore, the features shall incorporate a notion of adaptability for different individuals and different type of individuals (such as the heterogeneous group of newcomers) [27]. Our features shall, in accordance with identified needs and requirements, incorporate functionality for individual online-learning through direct and indirect interaction with teacher-mediated content, active including and involvement of online-participants, and intermediate communication and collaboration between wide ranges of students (such as the newcomers).

5.4. Development Practices

Through the initial stages within the first cycle, it became obvious that the traditional Systems Development Life Cycle-based development methodologies were not a good fit for our development team. Around that time, literature introducing agile development [32] [33] [34] [35] became more used to involve clerks and tutors throughout the BIE-iterations in our ADR-cycles. The agile software development approach were attractive because it is based on the assumption that there are a group of developers
working with users, who continually strive to achieve alignment between the organization and its information systems. This assumption matched the view of the entire ADR-team.

5.5. Testable Hypotheses

Drawing on principles from our empirical findings and our presented kernel theories, it is possible to pose a range of hypotheses that are open for further empirical testing. We propose and formulate a set of design principles, which shall govern the activities for the design, implementation and support of an information system that incorporates adaptable E-Learning. Furthermore, we list our design principles, together with their testable hypotheses and design paradoxes in Table 3. The idea is to map our design principles and testable hypotheses with the design paradoxes. Doing so, we want propose possible hypotheses for empirical testing and potential resolving of the declared paradoxes.

Table 3. Design Principles, Paradoxes and Testable Hypotheses for an ISDT for Adaptable E-Learning

<table>
<thead>
<tr>
<th>Design Principle</th>
<th>Paradox</th>
<th>Testable Hypotheses</th>
</tr>
</thead>
<tbody>
<tr>
<td>DP1 Bridging</td>
<td>P1</td>
<td>TH1 Distribute and produce content on various levels</td>
</tr>
<tr>
<td></td>
<td>Levels of</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Distribution</td>
<td></td>
</tr>
<tr>
<td>DP2 Differentia</td>
<td>P2</td>
<td>TH4 Establish features standardized/non-</td>
</tr>
<tr>
<td></td>
<td>ted Use of</td>
<td>standardized content</td>
</tr>
<tr>
<td></td>
<td>Content</td>
<td></td>
</tr>
<tr>
<td>DP3 Space for</td>
<td>P3</td>
<td>TH6 Operationalize afford features for</td>
</tr>
<tr>
<td></td>
<td>Reciprocal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Interaction</td>
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</tbody>
</table>

The first design principle encapsulates and proposes three testable hypotheses to resolve the first paradox through bridging levels of distribution. Literature on E-Learning research [6] [14] informs the development of system features for producing and distributing content on various levels of availability [6]. The content shall be distributed independent of platform (e.g. browser compatibility), and managed by different users with different roles (e.g. clerks and tutors) [30]. Central repositories (e.g. cloud services) for learning content needs to be established in order to collectively collaborate and update common information (e.g. books, slides, video-material, pictures). Users with administrative roles, such as clerks and tutors, shall have possibilities for asynchronous/synchronous interaction and collaboration. They shall also have the possibility to regulate the level of content-availability (e.g. available for everyone, available for a certain group of students) [29] [30], which addresses the contradiction between an open and closed system.

The second design principle proposes development of technological prerequisites, which utilizes learning through differentiated use of content [6] [14]. Literature on E-Learning research [6] [30] informs that an underlying IS shall provide efficient features for organizing and implementing learning content, which can offer a standardized structure for both administrators of a course site, but also end-users such as the students. But at the same time, the IS must have the adaptability to simply be complemented with non-standardized content, such as embedded videos, pictures and applications, which teachers themselves can choose to incorporate [29]. Adaptable system features shall provide functionality for supporting decisions about the nature of learning content in terms of its appropriateness and flexibility for change. For example, users with administrative tasks (e.g. clerks) shall provide standardized learning content, which users such as tutors/teachers can use. But teachers alone shall also have the ability and rights to incorporate non-standardized content in different format (e.g. video, picture, text), which is appropriate for their actual teaching/learning situation [6] [30].
Such content may be pre-arranged through standardization, but it can also be non-standardized content (e.g. embedded videos, images) provided by a second party source.

The third design principle addresses the paradox of control versus involvement. The design principle was informed through literature on E-Learning research [6] [14] and the concept of Community of Practice (CoP) [27] [28]. We used the literature to understand the importance of social participation as a process of learning and knowing [27] [28]. Constructs of CoP (meaning, practice, community and identity) inform and elucidate the purpose of learning civic orientation and becoming a learned member of the society through a space for reciprocal interaction between teachers and students (e.g. dialogues instead of only instructions) [27] [28]. Literature [6] [27] informed that an underlying IS shall provide a set of affording features for involving participants through activities that opens up for reciprocal dialogues between the students and teachers. The students shall have the ability to learn through activities, which emphasize practical activities (both collectively and individually), and activities where societal issues are highlighted as important for their understanding of being a member of a wider community such as a society [27] [28]. The teachers shall have the ability to, through the incorporation of system features, moderate the lectures without loosing control over the actual activities [6] [14]. A space for reciprocal interaction comprises the engagement of both teachers and students. Students need to feel included into that space, and teachers need to establish an atmosphere where students feel included [27]. Such atmosphere is incorporated through adaptability (both human and technological) but also mutual understanding towards goals and means for learning [28].

The fourth, and final design principle, advocate providing sufficient features that support multimodal and large variation of IT-literacy. The aspect of heterogeneity among teacher’s and student’s IT-skills, govern a need for system adaptability. Students such as newcomers in civic orientation, have a large heterogeneity in terms of previous and current IT-skills. Their background as human beings, previous and current understanding towards societal foundations and technology vary strongly (e.g. alphabets versus scholars) [7]. It is therefore crucial that learning is provided through doing and experiencing [27] as central for learning societal concepts (e.g. democracy, laws). But in order to do so, proper prerequisites for learning must be established [28]. Such prerequisites shall be incorporated through use of system features, which operationalize and offers functionality at various levels of engagement (e.g. advanced students, early students, scholars, alphabets) [6] [30]. Various richness among system features and functionality, address the need for both heterogeneous and homogeneous learning requirements. An underlying IS shall offer system features, which users such as teachers and administrators can use to balance the content as suitable for different individuals and different types of individuals. System features shall be provided for administrators, so that they can easily organize and distribute both advanced and basic forms of content. Teachers shall be provided with the ability to promote content in different languages and different modes of setting (e.g. levels of advancement). Students shall therefore be provided with equal formal prerequisites, which addresses the nature of their learning [28]. Their learning may vary depending on the topic (e.g. civic orientation versus mathematics), and will therefore govern the matching of learning strategies and system features.

6. Concluding Discussion

In this paper, we have illustrated how we have followed both Sein et al’s [18], and Walls et al’s [10] advice for constructing, formulating and presenting an ISDT. Drawing on a recent ADR-project for design, development and implementation of an information system for civic orientation and E-Learning, we have presented an ISDT for adaptable E-Learning. Such a theory can help both practitioners and researchers; for practitioners, it offers theory-based guidance in form of design principles, about how to design and implement efficient and sufficient information systems for adaptable E-Learning. For researchers, it identifies a number of theory-based principles that are subject to empirical validation. Our experience has shown that use of our ISDT can be used to design and support successful E-Learning in non-traditional E-Learning contexts (e.g. private sector instead of universities). Use of our ISDT provides an IS underlying E-Learning that is flexible, customizable and close to the needs of its specific context of learning. Our argument for this notion is based on the premises of our incorporating design principles; they are formulated based on both empirical findings and motivated through kernel theories; the empirical findings strengthen the reliability and validity of our proposed ISDT, while the kernel theories create an added value, which derive from relevant literature. The design principles do not only encapsulate relevant design knowledge deriving from our conducted ADR-cycles, but they also provide testable hypotheses which addresses means for potentially resolving our declared paradoxes.
Our presented design paradoxes provide an understanding about how design suggestions can be identified as paradoxes, which can be situated in similar and relevant intervening settings such as ours. Indeed, there are examples on how Design Researchers such as Markus et al [11], Lindgren et al [19] and Pries-Heje & Baskerville [23] have suggested governing design principles, which are formulated to resolve a set of problems that belong the same class of problems. In our case, the results of our ADR-cycles include both the implementation of an innovative information system intended to support adaptable E-Learning, but we also propose an ISDT that may guide other practitioners in how to create instances of artifacts such as ours. Such artifacts may be instantiated to solve problems, which are characterized by juxtaposing issues such as our identified paradoxes. Hence, we propose and define our paradoxes as a class of problems that may be identified by our design principles, and resolved through an artifact instantiation that is based on the testable hypotheses provided by our ISDT. In order to illustrate the relation between our class of problems and our ISDT, we present a concept map that conceptualizes a logical relation between our essential components and findings for this paper.

Figure 4. A Concept Map for the Relation between an ISDT and Class of Problems for Adaptable E-Learning

Figure 4 illustrates how our proposed class of problems for adaptable E-Learning relates to our ISDT for this paper. The class of problems consists of design paradoxes, which are identified by design principles that are based on empirical findings deriving from conducted research. Furthermore, the design principles are motivated through kernel theories, which provide essential knowledge based on prior relevant research [6] [14] [27] [28].

The design paradoxes emerge through stages of reflection and learning, which emphasize outcomes from BIE-activities. But they are also justified through previous IS research and logical contradictions such as paradoxes [24] [25] [26]. The design paradoxes can also be situated through stages of BIE, and/or in settings for promoting learning about societal issues such as in the context of distributing civic orientation. However, such settings are suggested because of our research background. Therefore, we cannot fully formalize our statement as a general rule for what and which settings a set of design paradoxes may emerge through. Our setting is only an example that adds to the validity of our conducted research, and may therefore be appropriate for use by other scholars and practitioners. In other words, other scholars and practitioners have the opportunity to use our concept map as a guide for validating our proposed design principles, to identify and address problems in the same class of problems as ours.

References


