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Towards a Holistic Understanding of Technology-mediated Learning Appropriation

Research-in-Progress

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Abstract

Information technology in the learning process is one major success factor for innovative learning scenarios. A necessary pre-condition is the faithful appropriation of technology-mediated learning (TML) to ensure learning outcomes. However, research still lacks insights concerning determinants and consequences of a faithful TML appropriation. Therefore, this research-in-progress paper presents a mixed-methods research approach to gain a holistic understanding of TML appropriation. First, based on the insights of adaptive structuration theory, a theoretical model is developed considering objective and subjective measures for TML appropriation as well as antecedents and consequences of TML appropriation. Second, the mixed-methods approach is presented in order to evaluate the theoretical model. Our expected contribution to theory includes an extension of both TML and adaptive structuration theory with an in-depth view of TML appropriation. Expected practical contributions include the derivation of design implications for TML services that are faithfully appropriated to ensure learning success of TML participants.

Keywords: Technology Appropriation, Faithfulness of Appropriation, E-Learning, Technology-mediated Learning

Introduction

Training is one of the most prevalent and pervasive methods to engage the productivity of individuals (Gupta and Bostrom 2013; Arthur et al. 2003). In this context, technology influences the majority of current learning scenarios, especially in universities. Usually, this concept is referred to as technology-mediated learning (TML), or synonymously e-learning (Gupta and Bostrom 2009). TML is considered important because it improves learning outcomes, facilitates cost advantages, and fosters the sharing of expertise in a global setting to provide learning opportunities at disadvantaged locations (Webster and Hackley 1997; López-Pérez et al. 2011). In addition, IT support in the learning process allows for a new quality of self-directed and individual learning (Delen et al. 2014; Rubin et al. 2010; Janson and Thiel de Gafenco 2015) as well as collaborative learning opportunities (Alavi et al. 1995).

However, practice shows some serious pitfalls connected to TML, for instance regarding the effective support during self-directed learning phases (Morrison 2013). New TML providers such as the Massive Open Online Course (MOOC) provider Coursera are facing issues of low retention and activity rates of learners that may hinder the success of a promising TML approach (Adamopoulos 2013; Clow 2013). For example, the partnership between San Jose State University and Udacity was put on hold in reaction to disappointing student outcomes in math and statistics introduction MOOCs (Ebben and Murphy 2013). Connected to these issues stands the black box learning process, which is a significant predictor of learning outcomes such as learning satisfaction and learning success, but still under investigation in research (Gupta and Bostrom 2009, 2013). This research gap is disconcerting since support in the learning process is a key success factor for all learning scenarios, as highlighted in a recent meta-analysis (Hattie and Yates 2014). The importance of support in the learning process holds especially true for TML strongly dependent on self-directed learning (Santhanam et al. 2008).

Therefore, research suggests the effects of a faithful appropriation of learning methods and structures in TML to ensure the success of innovative learning scenarios (Gupta and Bostrom 2009, 2013; Gupta et al. 2010). The concept of appropriation helps us to gain a better understanding of how learners in TML scenarios act and use IT to produce learning outcomes. The specifics of the appropriation process as a prerequisite for learning outcomes contribute to obtain a more detailed understanding of how the learning process affects learning outcomes. Still, little is known regarding the antecedents and consequences of the appropriation process (Gupta and Bostrom 2013). In consequence, the goal of this research-in-progress paper is to shed light on the appropriation process of TML by presenting a mixed-methods approach in order to capture comprehensive insights on the determinants and effects of the appropriation process in TML. The guiding research questions (RQ) are as follows:

RQ1: Which antecedents determine the faithful TML appropriation?

RQ2: What is the impact of the identified determinants on the faithful appropriation of TML and which consequences does the faithful appropriation of TML have?

With our completed research, we expect to provide answers to the stated research questions as well as a more detailed understanding of TML. These insights can serve as a basis for deriving design guidelines for TML provision that will help practitioners to design TML in their context of interest more effectively. This research-in-progress piece is structured as follows. We start with the theoretical background and the hypotheses development of our research model. In particular, we introduce TML in the context of the adaptive structuration theory, which is well suited as a guiding theory for TML (Gupta and Bostrom 2009). The third section is dedicated to the details on the upcoming study and the proposed research methodology. We highlight limitations of this research in progress and show future research directions in section four. The paper closes with the expected contributions of the completed research and an outlook on the next steps.

Theoretical Background and Hypotheses Development

Technology-mediated Learning

In a comprehensive sense, TML describes “*environments in which the learner’s interactions with learning materials (readings, assignments, exercises, etc.), peers, and/or instructors are mediated*

through advanced information technologies” (Alavi and Leidner 2001, p. 2). In consequence, research often uses the term e-learning as a synonym (Gupta and Bostrom 2013). However, it should be noted that TML has many variations in practice and is often a combination of different learning modes and methods and can therefore be considered a blended learning approach. Such a blended approach could be designed with the following elements according to Gupta and Bostrom (2009):

- Web- or computer-based approaches
- Asynchronous or synchronous
- Led by an instructor or self-paced
- Individual- or team-based learning modes

This variety of possible combinations poses many challenges to TML research. In consequence, empirical TML research has found mixed results concerning the impact of TML that are related to the individual as well as the team level (Gupta and Bostrom 2009). One possible explanation is the focus of TML studies on input and output research designs that consider the above listed elements of TML but often neglect the critical learning process (Alavi and Leidner 2001; Hannafin et al. 2004). Considering previous studies, seminal TML research has focused on the effects of collaborative learning, especially with the deployment of group support systems for the purpose of learning (Alavi 1994; Alavi et al. 1995; Alavi et al. 1997). In the early 2000s, TML research has shifted to a more learning process-centered view (Alavi et al. 2002; Alavi and Leidner 2001) that is supported by recent empirical research regarding the influence of the learning process on learning outcomes (e.g., Gupta and Bostrom 2013; Janson et al. 2015). However, an integrative assessment of the learning process is still missing and needed for a better understanding and design of TML scenarios.

Adaptive Structuration Theory

To solve these learning process-related challenges, Gupta and Bostrom (2009) proposed a research framework for TML based on adaptive structuration theory (AST) that allows to investigate the relationship between technology and social structures, for example how group decision support systems are used in organizations (DeSanctis and Poole 1994). AST, developed by DeSanctis and Poole (1994), is a meta-theory describing the social existence of a group beyond their information processing activities (Chin et al. 1997). According to them, the social aspect of group work determines the adoption of technology supporting their own working processes, and therefore influences the information process and interaction features within the internal group work, and finally their output. By this means, the appropriation of technology gives the group process a structuration and is thus produced and reproduced in social action (Comi et al. 2013).

These thoughts are based on two premises (Gupta and Bostrom 2009). The first one relates to the influence of structures embedded in a specific context and is defined as rules, resources, and capabilities in a given context (DeSanctis and Poole 1994). Applying this in a TML context, we consider the learning methods and structures that are for example reflected by the deployment of information technology (IT) such as a learning management system (LMS). The second premise focuses on the learning process. Within this process view, we acknowledge that the learners interact with the above described structures, where participants of a TML learn and adapt the learning methods and structures (Gupta and Bostrom 2009). The learning process is in itself a complex phenomenon and includes cognitive processes and interactions relating to the already introduced learning methods, individual differences of the learner, support in the learning process (i.e., scaffolding), and other elements of the learning scenario influencing the learning success. The latter represents “*the goal assessment or measures for determining the accomplishment of learning goals*” (Gupta and Bostrom 2009, p. 713) and is the key outcome measure of TML. In line with previous studies (Hattie and Yates 2014; Bitzer and Janson 2014; Janson et al. 2015; Gupta and Bostrom 2013), we therefore hypothesize:

H1: A satisfactory learning process has a positive influence on learning success.

The Appropriation Process of Technology-mediated Learning

To further adapt this shift to a more in-depth view of the learning process, the AST-based framework of Gupta and Bostrom (2009) recognizes the appropriation process of TML methods and structures. During this process, faithfulness as a social aspect (DeSanctis and Poole 1994) regarding the use of technology

can be observed as certain perceptions about the role and utility of the technology are created. Faithfulness with regards to the appropriation process is defined as the extent to which the provided structural potentials are used consistently to the underlying spirit of the TML (Chin et al. 1997; DeSanctis and Poole 1994; Gopal et al. 1992). Referring to TML, a faithful appropriation occurs when the learning methods and structures are appropriated in consistence with the overall learning goals and epistemological perspective, which represent the underlying spirit of the TML, and in turn positively influence learning outcomes (Gupta and Bostrom 2009). An according example would be the use of a forum in an LMS to discuss learning materials. In contrast, an unfaithful or ironic appropriation occurs for example if learners do not fully comprehend a sophisticated LMS and need to shift their focus on understanding the technology itself, which in consequence detracts from the overall learning process (Gupta and Bostrom 2009; Janson et al. 2014a). Besides faithfulness, the agreement among group members on how technology should be used, namely the consensus and the attitude towards using technology, can be characterized (Chin et al. 1997). In our context, we refer to the members of the learning groups. These three aspects can vary among groups due to different assumptions and appropriation of technology. However, we focus in this paper on the faithful appropriation of TML and therefore neglect consensus and the attitude towards using technology as these aspects are excluded from our theoretical scope.

Recent research has also highlighted the role of subjective and objective assessment for a faithful appropriation (Comi et al. 2013). The latter is assessed based on the concept of the underlying spirit the TML aims to promote and is “*an explicit or implicit construction in the mind of the individual*” (Chin et al. 1997, p. 354). On the one hand, the explicit spirit is externally imposed by the designer of the TML (e.g., a teacher) and includes appropriation moves that the learner interprets as correct or faithful appropriation (Comi et al. 2013). However, in the appropriation process, the externally imposed conception of the TML spirit is interpreted by the learner and is hence the basis for a subjective conception of the spirit that may differ from the objective spirit (Comi et al. 2013). When drawing on such a distinction between subjective and objective spirit, one implication is the necessity of different measures for the faithfulness of appropriation. For this purpose, Chin et al. (1997) suggest to use self-reported scales to assess the faithfulness against the implicit spirit (subjective faithfulness) and observed measures that provide insights on the evaluation of objective faithfulness. Considering the described relationship between a faithful appropriation and its effects on learning process and learning outcomes, previous TML research has not provided any insights on the distinct effects of an objective or subjective faithful appropriation. We theorize that both are distinct constructs (Chin et al. 1997; Comi et al. 2013) that have a positive effect on the learning process and learning outcomes, i.e., learning success. Subjective faithfulness as the belief of an individual to use TML in a correct manner according to the subjective spirit should increase learner self-efficacy and, hence, guide the learning process and engage learning outcomes. An objectively correct use of the structural features provided by the TML (i.e., objective faithfulness) should leverage the satisfaction with the learning process and learning success by enabling the learner to fully exploit the TML potential.

Therefore, we derive the following set of hypotheses regarding the consequences of faithful TML appropriation:

H2a: Subjective faithful appropriation positively influences the satisfaction with the learning process.

H2b: Subjective faithful appropriation positively influences learning success.

H3a: Objective faithful appropriation positively influences the satisfaction with the learning process.

H3b: Objective faithful appropriation positively influences learning success.

Antecedents of the Appropriation Process

To gain specific insights on the appropriation process, we seek for antecedents of the appropriation process that may affect this process and therefore indirectly affect the learning process and learning success as well. Recent research has recognized this need for a user-centric view of TML and therefore examined process-related antecedents of TML that emphasize the interaction between learners and the structural potentials of TML (Gupta and Bostrom 2013; Bitzer et al. 2013; Bitzer and Janson 2014). For this purpose, we introduce two constructs which we hypothesize to act as individual antecedents of the

faithful appropriation process: IT support and interactivity. The first one relates to the individual reflection in the learning process (Gupta and Bostrom 2009; Hui et al. 2008), thus providing control in the learning process (Sorgenfrei et al. 2013). For instance, wizards may support the faithful appropriation of learning methods and structures by giving advice on how to use the methods and structures coherent to their purpose. Connected to IT support stands interactivity, defined as “learning activities including interactions between students (student–student interaction), interactions with the teacher (teacher–student interaction), and interactions with the learning methods and structures (student–content interaction)” (Schrum and Berge 1997; Moore 1989). Interactivity has proven to be an important learning process variable (Arbaugh 2000; Bitzer et al. 2013), directly influencing learning outcomes (Evans and Gibbons 2007; Sims 2003; Smith and Woody 2000). However, in line with recent research, we propose that such antecedents are mediated by the faithful appropriation, both subjective and objective (Gupta and Bostrom 2009). Thus, we hypothesize:

H4a: IT support positively influences the subjective faithful appropriation.

H4b: IT support positively influences the objective faithful appropriation.

H5a: Interactivity positively influences the subjective faithful appropriation.

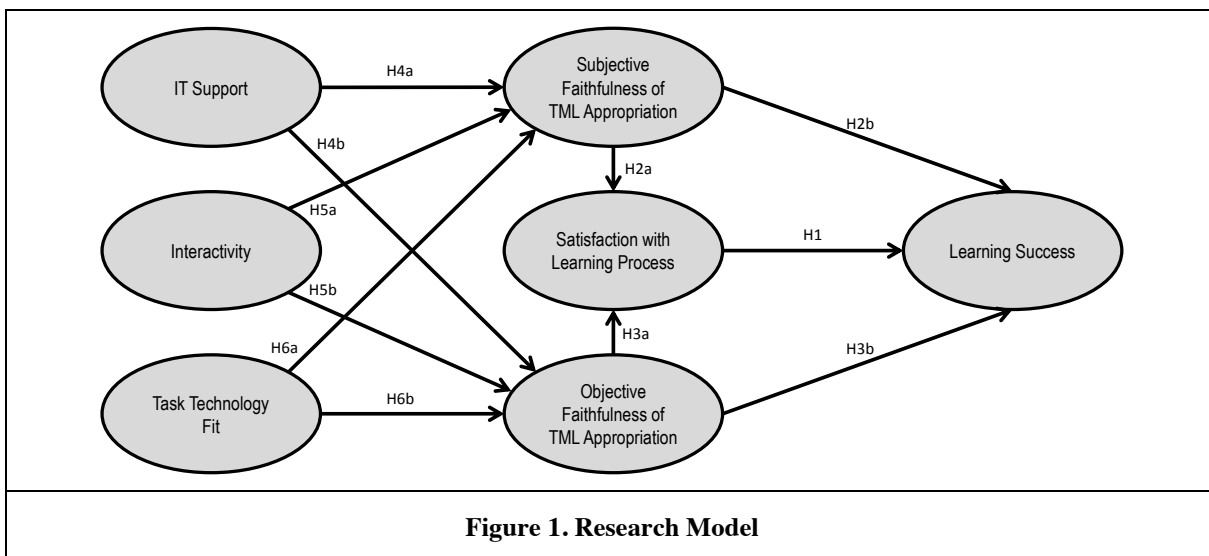
H5b: Interactivity positively influences the objective faithful appropriation.

Besides IT support and interactivity in the learning process, we intend to investigate how the fit of an IT artifact such as an LMS in TML corresponds to the appropriation process as an antecedent. In this context, research highlights the role of the task technology fit (TTF), which has also shown to be a significant predictor of IS success in general (McGill and Klobas 2009). Considering TML, TTF relates to the requirements of the learner, their individual abilities, and the functionalities of the IT artifact (McGill and Klobas 2009; Goodhue and Thompson 1995). In distinction to the already introduced construct IT support, TTF relates to the functionalities of an IT artifact in TML and how this artifact is appropriate to support the learner (McGill and Klobas 2009). In contrast, IT support corresponds explicitly to the learning process and how it is structured with IT support (Bitzer et al. 2013; McGill and Klobas 2009). Referring to an LMS such as Moodle, an example for the TTF would be the workshop module, which supports the peer assessment learning method. If the TTF is high and the learner is accordingly supported, we assume that the learner faithfully appropriates (objective and subjective) the provided IT artifact. Therefore, we hypothesize:

H6a: Task technology fit positively influences the subjective faithful appropriation.

H6b: Task technology fit positively influences the objective faithful appropriation.

In conclusion, Figure 1 depicts our research model with the corresponding hypotheses.



Research Design and Method

This section outlines our proposed research methodology. We specifically investigate the appropriation process of an LMS that is used within our TML provision. Therefore, we propose a mixed-methods approach. The outline of our study can be found in Table 1.

Data	Collection	Analysis Method	Purpose	Expected Outcome
Quantitative survey	Online survey with several measurement points.	Structural equation modeling with a partial least squares approach.	Identify antecedents and consequences of the (subjective) faithful appropriation of TML.	Confirmation of the proposed structural relationships within the theoretical model.
User data from learning management system	User data such as user behavior and online discussions are exported from the LMS.	Text analysis and coding (objective appropriation) of user behavior, as well as text analysis of online discussions with grounded theory approach.	Complement quantitative survey data with respect to the objective LMS appropriation and profound insights on group interaction.	Complimentary insights on how learners exploit the features provided by the TML artifact (objective appropriation) and insights on a group level.
Interviews	Structured interviews with participants of the TML service.	Text analysis with a grounded theory approach.	Complement quantitative data with rich qualitative data.	Profound insights on the TML behavior of learners.

The quantitative part of our research focuses on the empirical testing of our proposed research model. For the operationalization of our research model, we will on the one hand use well-established scales and adapt them to the context of TML in line with Gupta and Bostrom (2013), in our case an LMS. We measure learning success as the major dependent variable with exam results and do thus not operationalize learning success with self-reported scales (see further details on the data collection on the next page). Table 2 shows the latent construct measures and, if applicable, corresponding literature sources of the indicators.

Latent Construct	Latent Construct Type	Literature Source
Interactivity	Reflective	Siau et al. (2006)
IT Support	Reflective	Bitzer et al. (2013)
Task Technology Fit	Reflective	McGill and Klobas (2009)
Satisfaction with Learning Process	Reflective	Gupta and Bostrom (2013)
Faithfulness of Appropriation (subjective)	Reflective	Chin et al. (1997)
Learning Success	-	Exam Results

We measure all latent variables with reflective indicators. For this purpose, we evaluated the measurement instrument with regards to its suitability to measure the constructs in a reflective manner. This was done by checking the reflective constructs according to the guidelines of Jarvis et al. (2003). We use a 7-point Likert response format that ranges from 1 (“strongly disagree”) on the left to 7 (“strongly agree”) on the right, with 4 as a neutral point to assess the indicators. To increase statistical power and reliability of our results, we additionally use instruction manipulation checks to detect participants that do not read and follow our instructions (Oppenheimer et al. 2009).

In addition to the subjective appropriation measures, we want to analyze objective measures of the appropriation process. For this purpose, we use a coding scheme for appropriation moves corresponding to the objective definition of the TML spirit. This is in line with recent technology appropriation research (Comi et al. 2013). Hence, we developed on the basis of Comi et al. (2013) a coding scheme that reflects the objective appropriation of our LMS under investigation. The underlying dimensions – understand, discover, relate (Griffith 1999) – reflect the appropriation process and we assume that users in TML first of all try to understand basic features of a system before discovering advanced features to finally appropriate the relations between LMS features. The latter refers to the full exploitation of the TML potential when learners realize how features can be combined to achieve higher learning outcomes. Table 3 provides an overview of the parameters for measuring each dimension and the respective codification scheme.

Dimension	Parameter	Description	Score
Understand	Using basic learning materials	Using both videos and quizzes.	3
		Using only the videos.	2
		Using only the quizzes.	1
		Not using any learning material.	0
Discover	Using additional learning materials	Using both group discussion forums and reading materials.	3
		Using only the group discussion forums.	2
		Using only the reading material.	1
		Not using any additional learning material.	0
Relate	Logical use of learning materials	Learning material is used in a logical way and related to learning goals.	1
		Learning material is used without relation to learning goals.	0

For example, the use of basic learning materials is the basic purpose of the LMS under investigation. By using both basic learning materials, a higher score is assigned in contrast to users who only use quizzes without watching the lecture videos. The discover-dimension reflects whether the learner discovers additional learning material provided in the LMS. Additional materials include in our case reading material and group discussion forums. The relate-dimension refers to the interconnection between learning materials. An objective faithful appropriation includes the use of learning materials in accordance with the underlying learning goals, e.g., acquire factual knowledge, take a quiz, and in a last step intensify learning by using additional learning material as well as the discussion forum.

The evaluation of our research model is embedded in an undergraduate business MIS course that is, as a flipped classroom, heavily IT-supported and therefore a suitable scenario for investigating TML (Oeste et al. 2014). This enables us to measure learning success as the major dependent variable in the research model with objective data, i.e., exam results in order to avoid common method biases (Janson et al. 2014c). This also applies to the research design with three measurement points and a temporal separation of measurements (Podsakoff et al. 2003; Sharma et al. 2009). Also, the participants are from a wide range of majors, including business administration, business law, and business pedagogy. In addition, we

control for self-regulated learning ability (Pintrich and De Groot 1990), technology readiness (Parasuraman 2000), and personality (Rammstedt and John 2007). To evaluate the proposed research model in this study, we use structural equation modeling with the variance-based partial least squares (PLS) approach (Chin 1998; Wold 1982). We chose this approach because it is more suitable to identify key constructs than covariance-based approaches (Hair et al. 2011), since we want to derive design implications that drive learning success as a dependent variable. We use SmartPLS 2.0 M3 (Ringle et al. 2005) as our tool of analysis.

The qualitative data collection focuses on the learners' perspectives regarding our learning community under study. For this purpose, we primarily collect qualitative data in our LMS in order to capture the authentic online interaction of the participants to gain additional insights on the appropriation of our provided LMS with this complementary study. By analyzing data that include group interaction with the LMS, we are able to obtain additional insights on a group level. Finally, we conduct structured interviews with randomly chosen participants of the MIS course to capture profound insights on their specific appropriation moves. To collect our qualitative data, all data are either transcribed or online data of group discussions imported into our tool of analysis, ATLAS.ti. To analyze the qualitative data, we use a macro-level coding approach to analyze the appropriation moves of the learners (Chudoba 1999). By this means, we are able to derive appropriation patterns that deliver rich insights of TML appropriation in a highly IT-supported learning scenario.

Limitations and Future Research

This research-in-progress paper is not without limitations. We aim to gain a holistic understanding of the appropriation process of TML. However, we draw on a self-reported approach to understand the objective appropriation. Results from user observations in experiments might be a more valid and reliable measure and could be applied in future research. The sample might also limit the generalizability of the findings. Although we control for individual differences like technology readiness, the sample is embedded in an MIS course, which is conducted as a flipped classroom. Hence, future research should evaluate our model in replication studies in other learning scenarios and with other samples. Also, we investigate a use process of TML. Therefore, longitudinal measures could help to obtain a more exhaustive understanding of TML beyond the amount of use and single measures of TML appropriation. Still, we hope to shed some light on the use process by investigating the qualitative data. Last, we identified three antecedents of the TML appropriation process on the basis of TML and AST literature. Future research should account for further user-centric antecedents, e.g., cultural differences (Janson et al. 2014b) that might also influence the individual TML appropriation process.

Expected Contribution and Outlook

Our expected contribution is twofold. The theoretical contribution of our research-in-progress paper is the holistic consideration of antecedents and consequences of the TML appropriation by applying a mixed-methods research approach. By answering the proposed RQs, we therefore aim to provide a theory of explanation and prediction (Gregor 2006) that enables us to derive insights on how certain antecedents influence TML appropriation and ultimately gain an understanding of how TML can be adapted to individual needs. By applying a mixed-methods research design, we account for the holistic assessment of both subjective and objective appropriation and thus shed light into the black box of the learning process (Gupta and Bostrom 2009). Hence, the complementary qualitative analysis also enables us to capture more profound insights on the appropriation moves of learners. By analyzing the authentic interaction with the deployed IT artifact, in our case an LMS, we are also able to develop an understanding of TML use on a group level. By investigating TML use on an individual as well as group level, we thus recognize the call for multi-level theories in IS research (Bélanger et al. 2014). Connected to this stands the practical contribution of our research enabling practitioners to design more effective TML scenarios and services (Leimeister 2012). With our completed research, we aim to provide theory-driven guidelines for TML that is faithfully appropriated. This enables practitioners to ensure that learning outcomes in TML are improved, even if the learning scenario is heavily supported by IT, thus ensuring the success of innovative TML approaches such as MOOCs or flipped classrooms (Chen et al. 2014).

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