# ThesesDB – Single-Source of Information and Workflow Support for Students' Work

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**Abstract.** e-Learning can be seen as service creation process including core, enabling and enhancing services. We focus on enhancing services for managing thesis and seminar processes at our university in order to support transparency, track-ability, communication, and success for our students and lecturers. We analyze the processes for bachelor, master, and PhD theses and bachelor and master seminars. Consequently, we suggest process templates to cover these processes. The process templates are implemented as an enhanced IT web application, named ThesesDB, utilizing modern web technologies and used in our lectures. We evaluate our approach by the Computer System Usability and USE Questionnaire.

**Keywords:** e-Learning · Service enhancement · Process · Workflow · Tutoring · Supervised student publication

## 1 Introduction

e-Learning is not a new trend, but a trend seemingly accelerating. Just recently the LearnTec 2016 fare was hold in Karlsruhe, Germany. We observed three major trends at this important fare: (1) workplace and blended learning, offering low-cost solutions especially for technical and facts-based training contents, e.g. new product information for all sales employees, (2) gamification, thus melding gaming and learning,(3) the fusion of e-Learning ideas and "Industry 4.0".

As a university having a focus on both, top research and high-quality teaching for our students (and teachers), our department follows closely the development on the e-Learning field trying to apply new ideas in our environment. We see teaching as a special kind of service being provided for our students coming along with some specialties. The attribute "special" arises from the setting that our "client" in universities' teaching services are mainly students who are assessed by the service provider, e.g. by examinations. In more typical services, e.g. a hair-stylist or a restaurant, the client assesses the service provider and not

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vice versa[1]. Seeing teaching and e-Learning as services it seems reasonable to apply (research) principles of service management to this kind of service, too. C. Grönroos is a very influencing researcher teaching the so-called “Nordic School” with focus on high-quality service creation and delivery and considering external consequences of decisions made by the service provider (cf. [2,6]). Grönroos (e.g. in [5]) distinguishes three basic service types for every service a service provider can offer to its clients:

- Core services: these are services that are basically the reason for a service provider to be in the market. E.g. for a hair-stylist this is styling hairs, for universities this is giving lectures.
- Enabling services: these are services which must be offered in order to enable the core services to be able to function, e.g. the paying services or offering examination for lectures.
- Enhancing services: these are services enhancing the service experiencing of the clients providing advantages in competition for the service provider, e.g. offering a cup of coffee to the client at the coiffure.

Looking at university lectures with this kind of mindset, we realized, that a lot of e-Learning activities are tailored towards the core services. Identifying this gap, we decided to improve the enabling and enhancing services in e-Learning.

In this paper we describe an innovative approach how to improve the interaction between students and lecturers. We focus on the creation, support and supervision process for student theses, e.g. bachelor thesis, master thesis, PhD thesis and student seminars. Lecturers at our department are supervising quite a number of these types of works simultaneously and, despite their best efforts, sometimes lose track, what in detail has been going on in every specific thesis/seminar. Consequently, our research targets for this work are

- analyze and formalize the process for creating and supervising seminars, bachelor/master/PhD theses (on a general level).
- design, implement, and introduce an IT tool to support these processes. We named the IT tool *ThesesDB* (theses database).
- evaluate (or at least start the evaluation) of the ThesesDB.

To our knowledge, no such effort has been undertaken so far.

## 2 Related Work

A study of Mc Farland and Hamilton in 2005 [11] compares the performance of offline and online students. They conclude that no major difference can be found on a general level, but that (structured) online material can have positive effects on the success of students.

[1] We are aware that lecture assessments are a increasingly used instrument to establish the client (student) assessment of the service provider (lecturer), however, at least in Germany, the consequences of bad or even good assessments for a lecturer are very limited.

Johnson, Killion and Oomen [8] put forward success factors for online courses. These factors are design (target group), flexibility, contact (make contact to lecturers easy), student-student interaction, monetary support (for the online systems), and orientation (which we interpret as process-focus).

Alanazi and Abbod [1] did a general research on the needs for e-Learning repository systems at Saudi Universities. They analyze different type of media (e.g. source materials, videos, audio) and how these materials can be connected/linked. However, apart from the collection and sharing process they avoid to elaborate on processes that are necessary for such a repository system, e.g. versioning, diffs, notification of further materials for students and teachers (e.g. during a course when material is added), lifetime analysis, archiving and so on.

Eybers and Giannakopoulos [4] do research on the engagement of students in an online environment and compare this to the face-to-face perspective. They conclude that "the teachers' roles, the students' needs, the administration must satisfy e-Learning criteria providing a student centered collaborative approach which could lead to student satisfaction and thus get a more engaged student" [4, p. 74]. We see this as a strong argument towards IT systems supporting collaborative and structured processes in e-Learning environments; like our ThesesDB.

Caione et al. [3] analyze the effectiveness of e-Learning environments related to their respective goal. They do this by an example in the agri-food sector of unstructured information being analyzed with the help of an ontology. The feedback analysis is being planned to be implemented in our work.

A virtual assistant to provide aid in e-Learning in environments for students is tested by Harvey et al. [7]. They use rule-based systems for an avatar-based FAQ system for university services at a London university.

Radhamani et al. [12] suggest a virtual lab for biotechnology students at the Amrita School in India. Following a standardized process (selecting an experiment, protocol standardization, virtualization, sketching of story board, and value platform), the authors analyze the effectiveness in supporting the students to increase their active learning process. The result was, that "virtual labs [...] ensured a better performance during evaluations" [12, p. 145].

However, supervision, advising, and writing a thesis may be a special case, different from a typical subject-based e-learning situation. We focus on the structured and process-oriented way, on how this approach was conducted.

## 3 Key Features

We propose the platform ThesesDB that supports the creation process of students' work from the different views of authors, supervisors or administrators. Based on customizable processes (e.g. for bachelor, master, PhD theses or seminar papers), the platform stores all related information from announcements of open theses through official dates for presentations to the final archiving step.

Due to the integrated rights management and personalized views, each involved party can track the overall progress of the work and its own responsibilities and tasks. New processes can be created from scratch or extended by additional steps. Every step can point to additional material or it can require actions and activities from the users. When a process reaches a stage that requires attention of a specific role, notifications can be sent via e-mail and reminders appear in the users' overview sites.

In addition to explicitly modeled actions and activities in every process step, it is possible to upload attachments and notes. This allows to track meetings, add supplementary materials or keep track of relevant information for future reference.

External systems and services can be connected through custom code. For example, this can be used to file the final work with sources and references to a separate archive system.

## 4 Processes and Examples

Analyzing the typical papers created by students of our faculty (processes and their related participants), showed us high grades of similarities: The sequence of actions and participants are almost the same, although minor differences being present with PhD thesis being a kind of special case compared to the other processes. As we want to support those processes by our IT tool, we chose to opt for customizable process templates supporting each of the above processes. We found three different process roles (responsibilities) re-occurring in all process templates: author, supervisor, and administration. It is possible to add new processes or roles for special cases, for example when a thesis is supervised jointly with a third party. Utilizing these templates, the whole process of allocation, editing, submitting feedback, archiving, and accounting will become more transparent to all process partners and enable each party to see the current process state at one glance.

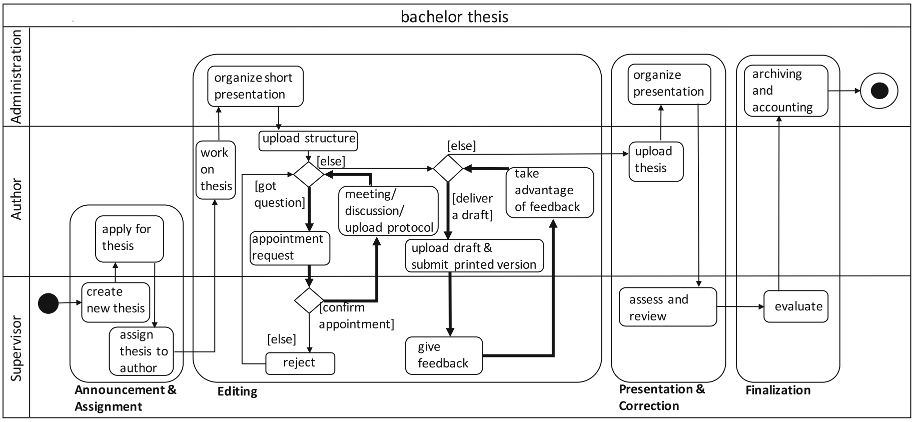


**Fig. 1.** UML activity diagram for a bachelor thesis. The four major activities are described in the text. Feedback loops in bold.

As an example, we depict our current process template for the bachelor thesis (Fig. 1) with the four activities *Announcement & Assignment*, *Editing*, *Presentation & Correction*, and *Finalization*. Each activity possibly consists of several (sub-)activities and/or atomic actions. These activities encapsulate atomic actions, e.g. the necessity to organize a presentation date. As process organization may differ between organizational units or universities, the described process could be modeled in another way. ThesesDB is capable of dealing with such requirements.

Here, the wording differs between UML and the concrete implementation. In ThesesDB, UML (sub-)activities are called *(sub-)process steps* and UML actions are split up into *activities* and *actions*. Details on that are provided in Sect. 5.

The process of a bachelor thesis can be summarized as follows:

1. Announcement & Assignment: As a first step, the supervisor publishes the topic of the bachelor thesis. Interested students can apply.
2. Editing: The student (author) works on the thesis, during that time a short presentation will take place, organized by the administration. Irregular meetings between author and supervisor are not modeled explicitly.
3. Presentation & Correction: In this process step, the author uploads the final submission. The submission includes the thesis as PDF and LaTeX, presentation slides and used literature. After the supervisor corrected the work, he gives a feedback to the author.
4. Finalization: Evaluation, archiving of materials and recording of results.

## 5 Implementation

This section describes the translation of the key features (see Sect. 3) into software, from the abstract concept down to some implementation details. In order to stay flexible in designing our processes (see Sect. 4), we divide the different specialized components into more general elements. These are outlined in the following as well.

Furthermore, we distinguish between design time and runtime of a process, well comparable with classes and objects in object-oriented programming. Each time the start of a process is triggered (e.g. a new bachelor thesis is made available), an instance of a previously designed process is generated.

Instances are linked to the "template" process. However, changes (e.g. due to process redesign) do not affect the instances. This is an important feature as thesis finished in the past or currently running must not be altered.

### 5.1 Design Time

We reduced our process model to the three building blocks *process steps*, *activities* and *actions*. As an overall structure we chose to model business processes in a tree-like manner:

– A unique *root process step* defines the process. Different business processes have different root processes.

- Each process step that is not a root process has a parent process step and an ordinal number which defines the ordering of process steps having the same parent. Such process steps are called *sub process steps*.
- *Activities* and *actions* also have process steps as parent. *Activities* are also ordered. These two elements represent the "dynamic" part of our process model whereas the process steps can be seen as "static" part.

By "dynamic" we mean the point of user interaction with the system. *Activity* and *action* are distinguished as follows:

- An activity is a predefined and reusable building block that requires a user to perform some simple task. These tasks can be e.g. entering a date/text/url, uploading a file or simply ticking a checkbox to signal that the manual task related to the activity is done. The semantic of an activity is given by its descriptive text which is assessed by the process designer.
- An action is much more complex than an activity and covers a special task that cannot be accomplished by an activity or a combination of several activities. Other than an activity, an action must be explicitly implemented by a programmer to perform this special task. An example is given in Sect. 5.3.

To complete the design time business process definition, we introduce special (user-)roles that are attached to process steps: On the one hand, there is a visibility relation that permits restricting visibility to only those users which have an appropriate role (not limited to one role). On the other hand, there is a responsibility relation that assigns exactly one role to be responsible for this process step.

## 5.2 Runtime

When a process is initiated, copies of the above defined elements are made and encapsulated within a "thesis" instance. This data model holds all meta-information (name, start/end dates, ...) that are needed at runtime and have nothing to do with the abstract business process definition. The instance elements' names are then prefixed with *thesis* (e.g. *thesis process step*). To assign to a user in a thesis, the user gets a role for the thesis. The user then can see all process steps visible for this role and can interact via activities and actions.

Furthermore, it is possible for every involved user to add *attachments* to a *thesis process step*. This allows the interchange of documents (e.g. meeting notes) that are not directly part of the business process itself. To prevent later changes (e.g. after some deadline due), *thesis process steps* can be locked manually or automatically if some point in time is reached. Locked process steps are read-only. To keep track of changes, users can subscribe to several events which allows them to be notified via email.

### 5.3 Implementation Details

We implemented our process model with the *Django web framework*[2] which has a powerful object-relational mapper (ORM) that allows quick modeling of structural data and rapid development overall. The design and runtime components are decoupled by using separate modules (called *apps* in the Django domain). The user interface is mainly written in plain *HTML* which fits best with Django's template engine and makes debugging easy.

As an example for an action, we implemented the submission procedure of a student's thesis: The student uploads the thesis' PDF file and the LaTeX source files. The related bibtex file is parsed and the student can upload the cited literature. The supervisor reviews the uploads and afterwards triggers the archiving process. The archiving process is done in a completely separate system and therefore includes invoking multiple web service calls which makes up the increased complexity that disallows the use of "simple" activities.

## 6 Example

In Fig. 2 we provide an example of the user interface depicting the sub-process "Delivery" and its assigned activities (we use the wording of Sect. 5). We now explain the functionality of ThesesDB by the example of a bachelor thesis.

The supervisor ("Supervisor Demo") chose the template "bachelor thesis", set the name "Single-Source of Information and Workflow Support for Students' Work" and added a small description. With this, the thesis is instantiated. The supervisor assigns himself the role "supervisor" for this specific thesis.

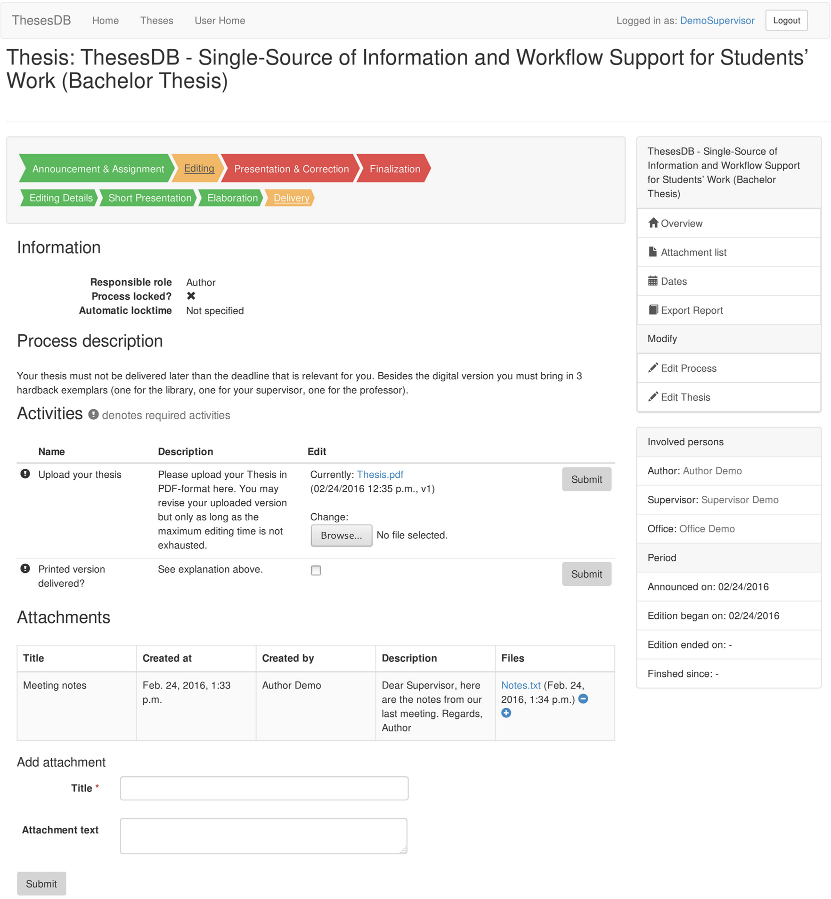
Next, interested students can find the newly available thesis, read the topic and description and apply for it.[3] The supervisor assigns the author-role for this process instance to the particular student. Additionally, the supervisor assigns "Office Demo" as contact person/responsible role for administrative purposes. As a result, only supervisor, author and assigned administrative contact person are able to interact with the process instance.

The student works on the topic. The short presentation event will be organized by the administration, the author uploads the structure of the thesis. As the author has some questions, she decides to ask for an appointment with her supervisor. The supervisor confirms the request (within ThesesDB); the meeting takes place. The student uploads the meeting notes to the ThesesDB making them accessible for all participants.

The author uploads the first version of the thesis as a PDF file. The reminder (check box) to hand in a printed version remains unchecked as a to-do for the author. After the correction by the supervisor, feedback is given to the student. The student takes advantage of the feedback and finalizes her work.

[2] https://www.djangoproject.com/ (last accessed 02/2016).

[3] The application process is currently not implemented in the ThesesDB. However, there are no technical limitations to extend ThesesDB with this functionality.



Thesis: ThesesDB - Single-Source of Information and Workflow Support for Students' Work (Bachelor Thesis)

Information

| | |
|---|---|
| **Responsible role** | Author |
| **Process locked?** | ✖ |
| **Automatic locktime** | Not specified |

Process description

Your thesis must not be delivered later than the deadline that is relevant for you. Besides the digital version you must bring in 3 hardback exemplars (one for the library, one for your supervisor, one for the professor).

Activities ❶ denotes required activities

| | Name | Description | Edit | |
|---|---|---|---|---|
| ❶ | Upload your thesis | Please upload your Thesis in PDF-format here. You may revise your uploaded version but only as long as the maximum editing time is not exhausted. | Currently: Thesis.pdf (02/24/2016 12:35 p.m., v1)<br>Change:<br>Browse... No file selected. | Submit |
| ❶ | Printed version delivered? | See explanation above. | □ | Submit |

Attachments

| Title | Created at | Created by | Description | Files |
|---|---|---|---|---|
| Meeting notes | Feb. 24, 2016, 1:33 p.m. | Author Demo | Dear Supervisor, here are the notes from our last meeting. Regards, Author | Notes.txt (Feb. 24, 2016, 1:34 p.m.) ⊖ ⊕ |

Add attachment

**Title** *

**Attachment text**

Submit

ThesesDB - Single-Source of Information and Workflow Support for Students' Work (Bachelor Thesis)

Involved persons

Author: Author Demo

Supervisor: Supervisor Demo

Office: Office Demo

Period

Announced on: 02/24/2016

Edition began on: 02/24/2016

Edition ended on: -

Finshed since: -

**Fig. 2.** The subprocess "Delivery" from the supervisor's point of view.

The author uploads the final version and all attachments (e.g. presentation slides, literature). The thesis will be archived and the student gets a result (mark). The supervisor checks the documents and uses an interface to the archive system to archive the documents.

## 7 Evaluation

In order to evaluate the usability of the proposed system, we conducted a study with 5 participants of our bachelor seminar in the winter term 2015/2016. The seminar takes place in the field of economics and computer science. We used self-reported metrics, as explained by Tullis and Albert [13, pp. 121–162] and selected the Computer System Usability Questionnaire (CSUQ) [9] as well as the USE Questionnaire [10].

**Table 1.** Scores of the CSUQ (top) and USE (bottom) scales

| CSUQ | System usefulness | Information quality | Interface quality | Overall satisfaction |
|---|---|---|---|---|
| | 0.85 | 0.69 | 0.78 | 0.86 |
| USE | Usefulness | Ease of use | Ease of learning | Satisfaction |
| | 0.65 | 0.69 | 0.68 | 0.72 |

The users rated their agreement on both scales on a seven-point Likert scale from *strongly agree* to *strongly disagree*. The score for the particular dimensions is calculated by the mean over the respective items and ranges from 0 to 1, where 1 represents full agreement.

As shown in Table 1, the reactions are mainly positive, since dimensions range between 0.65 and 0.86. In the free text answers students mainly criticize technical difficulties at the beginning but they emphasize the good structure and helpful guidelines provided by the system.

A time saver for supervisors is that students upload their (digital) bibliography in a structured way. Students request less organizational help than before, because they are pointed to relevant information in the system.

## 8 Conclusion and Future Work

In this work we treat the university as a service provider for its students. In particular, we look at the business process that represents the creation and supervision of students' theses or term papers.

Therefore, we propose a system that supports the creation of processes templates during design time and the management of a concrete work in runtime. It provides information for supervisors, authors, and administrators and can be extended to work with additional tools or services.

Future extensions could include better integration with existing systems, e.g. the application process. Meeting dates could be exported to personal calendars or presentation dates could be published on a website, for example. Application handling and the selection of candidates could be integrated as well. Finally, the use of a full-featured workflow management system with graphical process design would enhance the functionality and the ease-of-use even more.

## References

1. Alanazi, A., Abbod, M.: E-Learning repository system for sharing learning resources among Saudi universities. In: Vincenti, G., Bucciero, A., Vaz de Carvalho, C. (eds.) eLEOT 2014. LNICSSITE, vol. 138, pp. 10–18. Springer, Heidelberg (2014). doi:10.1007/978-3-319-13293-8_2
2. Berry, L.L., Parasuraman, A.: Building a new academic field - the case of services marketing. J. Retail. **69**(1), 13–60 (1993)

3. Caione, A., Guido, A.L., Paiano, R., Pandurino, A., Pasanisi, S.: E-learning project assessment using learners' topic in social media. In: Vincenti, G., Bucciero, A., Vaz de Carvalho, C. (eds.) eLEOT 2015. LNICSSITE, vol. 160, pp. 92–100. Springer, Heidelberg (2016). doi:10.1007/978-3-319-28883-3_12
4. Eybers, S., Giannakopoulos, A.P.: Student engagement in an online environment: are we trying to mimic contact education? a South African perspective. In: Vincenti, G., Bucciero, A., Vaz de Carvalho, C. (eds.) eLEOT 2015. LNICSSITE, vol. 160, pp. 68–75. Springer, Heidelberg (2016). doi:10.1007/978-3-319-28883-3_9
5. Grönroos, C.: Service Management and Marketing: Customer Management in Service Competition, 3rd edn. John Wiley & Sons, Chichester (2007)
6. Gummesson, E., Lehtinen, U., Grönroos, C.: Comment on nordic perspectives on relationship marketing. Eur. J. Mark. **31**(1–2), 10–17 (1997)
7. Harvey, P.H., Currie, E., Daryanani, P., Augusto, J.C.: Enhancing student support with a virtual assistant. In: Vincenti, G., Bucciero, A., Vaz de Carvalho, C. (eds.) eLEOT 2015. LNICSSITE, vol. 160, pp. 101–109. Springer, Heidelberg (2016). doi:10.1007/978-3-319-28883-3_13
8. Johnston, J., Killion, J., Oomen, J.: Student satisfaction in the virtual classroom. Internet J. Allied Health Sci. Pract. **3**(2), 1–7 (2005). Article ID 6. http://nsuworks.nova.edu/ijahsp/vol3/iss2/6/
9. Lewis, J.R.: IBM computer usability satisfaction questionnaires: psychometric evaluation and instructions for use. Int. J. Hum.-Comput. Interact. **7**(1), 57–78 (1995)
10. Lund, A.M.: Measuring usability with the USE questionnaire. Usability Interface **8**(2), 3–6 (2001)
11. McFarland, D., Hamilton, D.: Factors affecting student performance and satisfaction: online versus traditional course delivery. J. Comput. Inf. Syst. **46**(2), 25–32 (2005)
12. Radhamani, R., Sasidharakurup, H., Sujatha, G., Nair, B., Achuthan, K., Diwakar, S.: Virtual labs improve student's performance in a classroom. In: Vincenti, G., Bucciero, A., Vaz de Carvalho, C. (eds.) eLEOT 2014. LNICSSITE, vol. 138, pp. 138–146. Springer, Heidelberg (2014). doi:10.1007/978-3-319-13293-8_17
13. Tullis, T., Albert, B.: Measuring the User Experience: Collecting, Analyzing, and Presenting Usability Metrics, 2nd edn. Elsevier/Morgan Kaufmann, Amsterdam (2013)