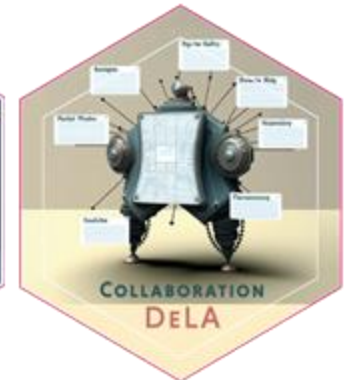
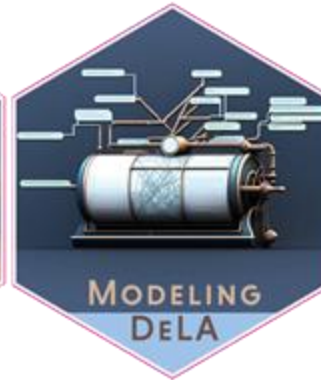

Bachelor's and Master's Thesis Topics in Education Technologies

Provided by



Category 1: Highly-Informative Learning Analytics



[1.1] [DEV] Learning Analytics Dashboard



Suitable for:

Bachelors & Masters

First examiner (Betreuer):

Prof. Dr. Hendrik Drachsler

Mentor:

Atezaz Ahmad

ahmad@studiumdigitale.uni-frankfurt.de

Background. Learning Analytics Dashboards (LADs) provide users with insights about their study progress and an overview of the system through visualizations. LADs consist of metrics and indicators. Metrics are the unit of measurement (e.g., number of views/courses, total keywords/resources, keywords frequency, etc.). We refer to this unit of measurement as metrics. Metrics are used to create indicators; an indicator results from analyzing one or multiple metrics and gives a more comprehensive picture of a particular abstract, e.g., course analytics, self-reflection, engagement, etc.

Task. The task is to develop a learning analytics indicators dashboard (e.g., [link](#)) that provides an overview of the platform. An extensive JSON dataset containing over a million courses will be provided. The dashboard should be able to give a complete overview of the system. The visualization should include course analytics (numbers), world cloud (keywords and course description), and course distribution by location (country and cities), for example [link](#).

Skills. JavaScript, HTML, and visualization libraries like Highcharts, Echarts, D3, or C3.js can be used. The mentioned libraries and languages are not mandatory to be used. You can use any other programming language or technology.



Background. The integration of Learning Analytics into Learning Management Systems, especially Moodle, offers significant potential for improving learning success through formative feedback. Despite the increasing use of MindMap tools as didactic resources in Moodle, efficient strategies for analyzing the generated process data are lacking. This gap hinders the provision of precise, implementation- and content-oriented feedback, which is essential for individual learner support.

Task. The aim is to address this challenge by developing specific data identification strategies and thus contribute to optimizing the use of Learning Analytics in educational technology.

Suitable for:

Masters

First examiner (Betreuer):

Prof. Dr. Hendrik Drachsler

Mentor:

Tornike Giorgashvili

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Skills. Basic knowledge in the field of e-learning and a fundamental familiarity with Learning Management Systems, especially Moodle, are required. Also necessary are basic skills in data analysis and processing, preferably with experience in using database management systems such as MongoDB. Knowledge in the development and application of Learning Analytics or similar data-driven analytical methods in the education sector is advantageous but not mandatory.

[1.3] [DEV] Ask the paper: AI-based Extraction System for Understanding Research

Background: In many research scenarios, users want to ask a specific questions about scientific papers, e.g., “Which methods are used for task X?” or “What materials are related to this method?” A QA system can automatically answer these questions by extracting entities and relations from papers and presenting structured, understandable answers.

Tasks: 1. **Entity & Relation Extraction**, identify key entities and their relationships from scientific papers. 2. **Information Retrieval**, fetch relevant entities and relations based on user questions. 3. **Answer Generation**, use LLMs to convert structured data into clear, natural language answers, optionally visualizing relationships.

Skills: Familiarity with models like BERT, GPT, zero-shot, few-shot or fine-tuning approaches for scientific text. Software Development, such as Backend (Python, databases, APIs), frontend (web frameworks, visualization), and system integration.

Suitable for: Bachelors & Masters

First examiner (Betreuer):

Prof. Dr. Hendrik Drachslar

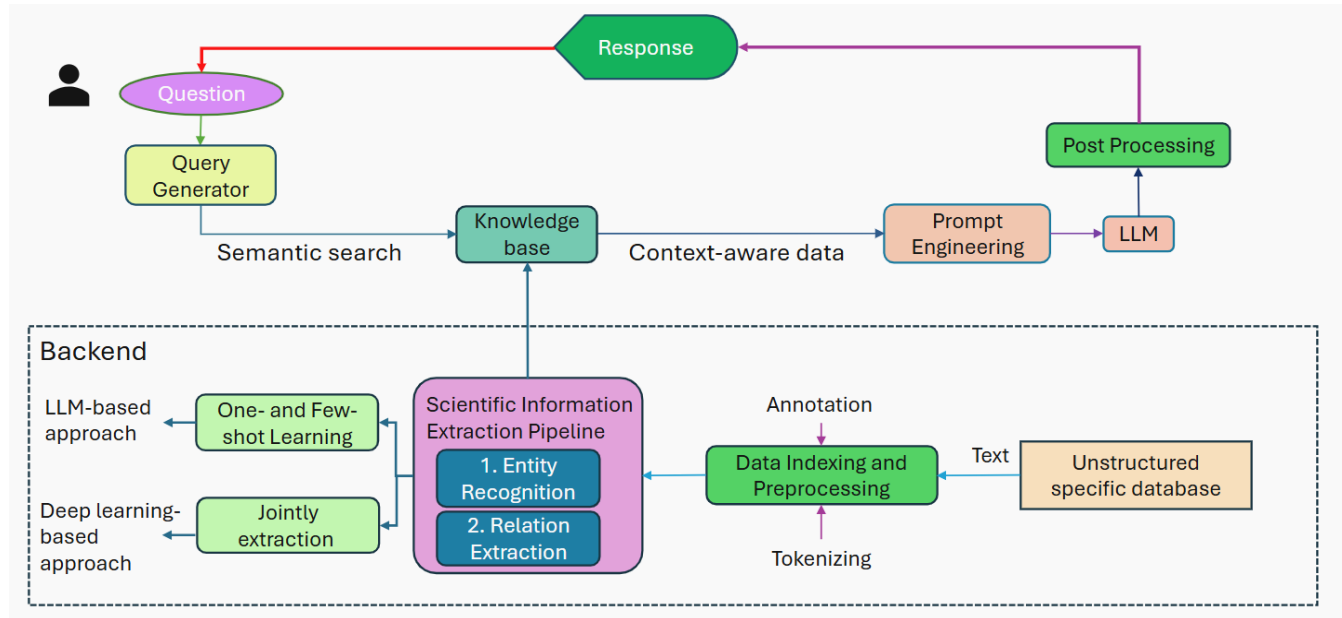
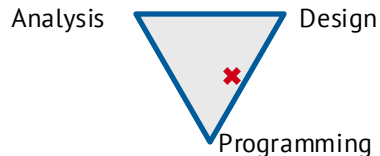
Supervisor:

Atezaz Ahmad / Amir Rajabi

ahmad@sd.uni-frankfurt.de

a.rajabi@dipf.de

Evaluation: Design-driven evaluation



Category 2: Multimodal AI for automated feedback



[2.1] Training oral presentation skills with motion capture



Background. There are different techniques that help people to read, understand, and remember the content of a text. One of these techniques consists of writing down the summary of a text's first paragraph in one sentence. Write in one sentence the summary of the second paragraph. For the next paragraphs, one needs to write two sentences, 1 summarising what happened previously, and one summarising the current paragraph. Current text readers are not designed for this practice.

Research Task. Develop a text reader designed for this practice. Explore to what extent LLMs can be used to assess if the user provided good summaries or not and help users to correct their summaries.

Expected result. An application that users can use to conduct an active reading approach that helps them to understand and remember the content of texts.

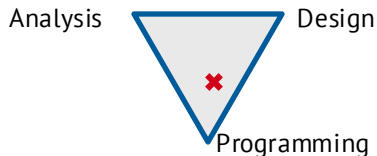
Suitable for: Bachelors & Masters

First examiner (Betreuer):
Prof. Dr. Hendrik Drachsler

Mentor: Jan Schneider

j.schneider@dipf.de

Evaluation: Design-driven evaluation



[2.2] Presentable: AI feedback Presentation training software

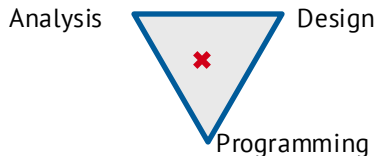


Suitable for: Bachelors & Masters

First examiner (Betreuer):
Prof. Dr. Hendrik Drachsler

Mentor: Prof Dr Daniele Di Mitri
daniele.dimitri@german-uds.de

Evaluation: Design-driven + small
Evaluation (MSc)



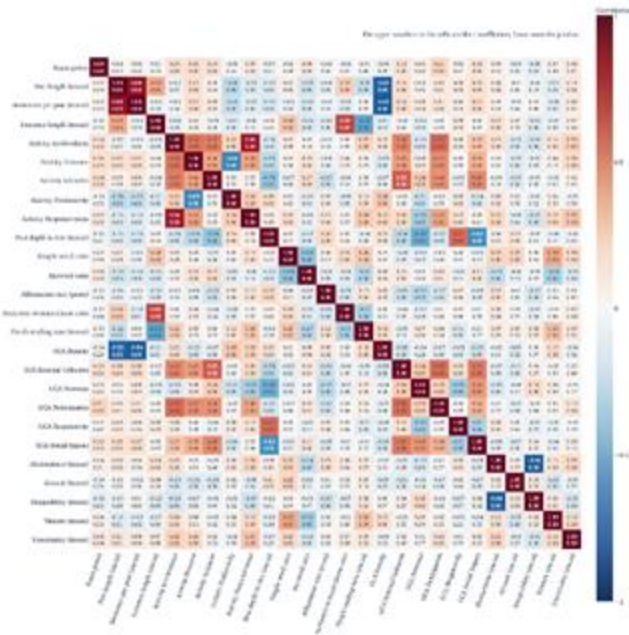
Background. Presentable (www.presentable.info) is a presentation training software developed at the DIPF in the context of the HyTea project. Is an advanced research software (collects data) designed to enhance users presentation skills through personalised AI-driven feedback on voice and body language and guidance on message composition. It provides educators with dashboards to monitor and support student progress, making it essential for improving presentation skills.

Research Task. Currently there several Master thesis ongoing in the context of Presentable which cover topics such as multimodal data analysis, voice analysis, game-based learning, speech transcription, MLOps, computer vision, mobile technologies etc.

Expected result. Dependent on your background/coding strength, we could find a relevant topic of research for you. You are expected to formulate a research question and develop a component which can be fully integrated in Presentable - should be compatible with the tech stack Next.js, django, MySQL, mediapipe. The thesis must be written in English.



Category 3: Natural Language Processing



[3.1] Rewriting Grading Rubrics for Better Clarity Using LLMs



Background. Rubrics are structured documents which define clear criteria used to assess all kinds of learner-produced content such as test answers, essays, or student-drawn diagrams. Recently, we started to experiment with AI and how well it can apply unseen rubrics to unseen tasks. In the ALICE project, we collected a dataset of student answers and corresponding rubrics. However, unfortunately, these rubrics are not always formulated in a clear way which we suspect hinders models to successfully apply them in all cases.

Research Task. The task at hand is to develop a method that can be used to identify and rephrase unclear or uncertain parts within grading rubrics so that they are more clear to follow. We suspect that this can be solved best with a pipeline implemented with the help of multiple LLM prompts and existing metrics for measuring text clarity, but are open to other approaches if discussed with us. We provide you with a German-language dataset that contains rubrics and student answers. Ideally, it must be shown that rewriting the prompts for more clarity improves downstream results when these are used to train short answer scoring models. This needs to be tested.

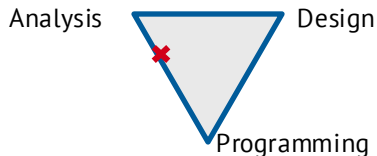
Expected Result. An answer to the question whether rewriting grading rubrics for better clarity using LLMs benefits downstream performance of scoring models when used with these rubrics.

Suitable for: Bachelors & Masters

First examiner (Betreuer):
Prof. Dr. Hendrik Drachsler

Mentor: Sebastian Gombert,
s.gombert@dipf.de

Evaluation: Data Science-driven
evaluation



[3.2] Implementing an LLM-based Annotation Recommender



Background. In our working group, we use the tool INCEption to annotate all kinds of textual data sets. This tool offers the option to interface annotation recommender systems which learn from users' input and then provide annotation recommendations to users. We want to explore to which degree prompting LLMs with few-shot prompts can provide us with useful annotation recommendations.

Research Task. For this purpose, we need a system which provides both a simple, but comprehensive user interface that can be used to design prompts which can be used for recommendations. This system should interface with INCEption over the corresponding REST API and with an LLM, e.g., gpt-4o, and use the latter to provide recommendations within the prior. In this context, it is important that there is a UI which helps users to flexibly design prompts, and that there are placeholders for few-shot examples that are filled by the system with already annotated passages retrieved from INCEption when issued to an LLM. While the exact tech stack is up to the candidate, the system should use MariaDB or PostgreSQL as database and run in a Docker container.

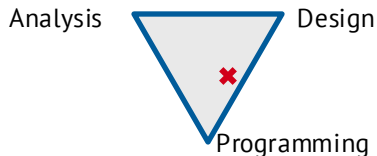
Expected Result. A tool which can be used to design flexible annotation recommenders using LLM prompts and interfaces with INCEption. For an MA thesis, this tool should also be evaluated in a small-scale user study with our HiWis who will then use the tool on an almost daily basis, if successful.

Suitable for: Bachelors & Masters

First examiner (Betreuer):
Prof. Dr. Hendrik Drachsler

Mentor: Sebastian Gombert,
s.gombert@dipf.de

Evaluation: Design-driven evaluation (BA), Design-driven + small Evaluation (MA)





Background. GovData.de serves as Germany's central portal for open government data, providing access to datasets from a wide range of public authorities. The primary method for users to discover and access these valuable datasets is through the portal's search function. While functional, the current search system on GovData.de offers significant potential for improvement. For instance, there is currently no system in place to recommend similar or related datasets to users, limiting discoverability.

Research Task. The primary objective of this thesis is to investigate, conceptualize, and potentially prototype improved methods for data discovery on GovData.de.

Suitable for: Bachelors & Masters

First examiner (Betreuer):

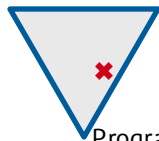
Prof. Dr. Hendrik Drachler

Mentor: Dr. Daniel Biedermann,

daniel.biedermann@fitko.de*

Evaluation: Design-driven evaluation (BA), Design-driven + small Evaluation (MA)

Analysis



Programming

- Researching state-of-the-art recommendation techniques applicable to dataset portals.
- Identifying relevant criteria for generating meaningful dataset recommendations
- Designing and evaluating different recommendation approaches.

Expected Result.

1. **State-of-the-Art Review:** A comprehensive analysis of current research and best practices in Recommender systems for data portals.
2. **Feasibility Analysis:** An investigation into potential recommendation criteria and an assessment of the technical possibilities and constraints
3. **Conceptual Design:** Development of a clear concept for the proposed improvements.
4. **Proof of Concept (PoC):** Implementation and demonstration of a working prototype showcasing the core ideas and functionalities of the proposed solution.

This thesis project will be conducted in close collaboration with the **GovData Product Management team and the technical service provider **SEITENBAU GmbH**, offering valuable insights into real-world operations and development*

[3.4] Span-based Classifier for short answer scoring and beyond.

Prerequisites

1. Interests and experience in NLP
2. Familiarity with transformer and the attention architectures
3. Experience with NLP libraries such as transformers and pytorch.

Suitable for: Masters.

First examiner (Betreuer):

Prof. Dr. Hendrik Drachsler

Mentor: Zhifan Sun,

z.sun@dipf.de

Evaluation: Data Science-Driven evaluation

Background: The standard approach to sequence classification in modern DL-based NLP is to either 1): stack a static classification head on top of the encoder and outputting a probability of a list of predefined labels; 2): Prompt an LLM directly to generate the label. Both approach are limited. The former lacks flexibility: this approach assumes a static set of labels, which hinders the model from scaling to tasks with varying labels numbers. Short answer scoring is one such example: Each question might have varying amount of levels. The LLM Prompting on the other hand, can adapt flexibly to new tasks and labels but is expensive to train and inference. It is sensitive to prompt engineering and needs extra preprocessing steps to extract the label. To alleviate this, one could encode the text and all the labels, extracting the hidden representation of the labels.

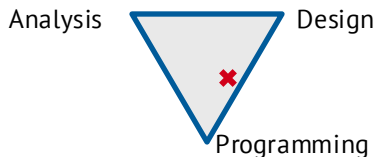
Research Task:

- Apply the proposed methods to several Short Answer Scoring datasets.
- Explore various configurations of label-sequence-(text) alignment.
- Adapt decoder-only LLMs to a span-based classifier.
- Apply the proposed methods to another sequence classification task. (bonus)

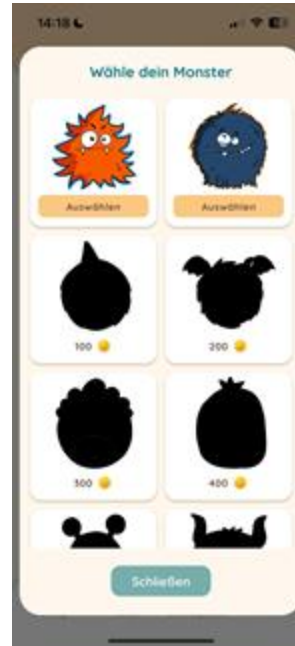
Expected results:

Finish the above tasks and answer the research question:

- Does span-based classifier outperforms te baselines?
- Can decoder-only LLMs be adapted to the proposed span-based classifier?
- Does the proposed method generalise to other tasks? (bonus)



Category 4: Mobile Learning App for Children



[4.1] Mini-Games to Promote App Engagement



Suitable for: Masters

First examiner (Betreuer):
Prof. Dr. Hendrik Drachster

Mentors:
Dr. Daniel Biedermann
Dr. Jasmin Breitwieser,
d.g.biedermann@gmail.com
j.breitwieser@dipf.de

Evaluation: Design-driven + small
Evaluation

Background. In this interdisciplinary research project, we develop the mobile app “PROMPT – Die Lernplan-App” to promote self-regulated learning (SRL) in young students (5th-6th grade). The app supports children in setting learning goals, strategically planning learning times and monitoring and evaluating their progress in the context of vocabulary learning. The app includes a structured training, a learning diary, and targeted prompting. To be effective, the app must not only be pedagogically sound but also engaging for its young users. To this end, we draw on gamification principles to enhance motivation and sustain interest over time. The current version of the app includes basic gamification mechanics, such as collecting coins and unlocking avatars.

Task. The goal of this thesis is to develop an interactive mini-game that can be integrated into the app as a gamification element. The challenge is to develop a game that is child-friendly, motivating and functionally linked to the learning process of the app. Ideally, the game also provides us with data on children’s cognitive abilities (e.g., working memory).

Expected Result. A mini-game programmed in Flutter and a concept of how this game should ideally be integrated into the app. This game should also be evaluated in a small-scale user study (e.g., focus groups) with children.

Skills. Programming skills are a must, as well as experience and interest in game development and gamification concepts, as well as an interest in application-oriented, education-related software development.