Pedagogical Principles in the Online Teaching of NLP: A Retrospection

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Abstract

The ongoing COVID-19 pandemic has brought online education to the forefront of pedagogical discussions. To make this increased interest sustainable in a post-pandemic era, online courses must be built on strong pedagogical foundations. With a long history of pedagogic research, there are many principles, frameworks, and models available to help teachers in doing so. These models cover different teaching perspectives, such as constructive alignment, feedback, and the learning environment. In this paper, we discuss how we designed and implemented our online Natural Language Processing (NLP) course following constructive alignment and adhering to the pedagogical principles of LTU. By examining our course and analyzing student evaluation forms, we show that we have met our goal and successfully delivered the course. Furthermore, we discuss the additional benefits resulting from the current mode of delivery, including the increased reusability of course content and increased potential for collaboration between universities. Lastly, we also discuss where we can and will further improve the current course design.

Keywords- *NLP, Constructive Alignment, LTU's Pedagogical Principles, Student Activation, Online Pedagogy, COVID19, Canvas, Blackboard, Zoom*

1 Introduction

With the COVID-19 pandemic, academic institutions were pushed to moving their education online (Gallagher and Palmer, 2020; Dick et al., 2020). Furthermore, even institutes that still allowed students on campus were more open to online alternatives. However, in order to solidify the results attained in online education (Ossiannilsson, 2021) in these extraordinary circumstances, it is crucial to demonstrate that this mode of education can be a viable alternative to presential education in terms of the underlying pedagogical fundamentals and the success of practical implementation. For this, in setting up our Natural Language Processing course, our goal was to do so based on constructive alignment and LTU's pedagogical principles. We hypothesized that adherence to both set of principles would be possible in an online version too. In this paper, by examining the design and implementation of the course and analyzing the student feedback, we will demonstrate the viability of our hypothesis.

The rest of the paper is organized as follows. First, we discuss the related literature in Section 1.1, followed by LTU's pedagogical principles in Section 1.2. Then in Section 2, we present the course design. That is followed by the Teaching and learning activities being discussed in Section 3. Next, we present the course evaluation result and the perspective of a volunteering student of the course in Section 4. Lastly, we conclude the paper and outline planned improvements in Section 5.

1.1 Related work

The teaching paradigm has been moving from a teacher-centered view to a more student-centered perspective (Kaymakamoglu, 2018). Meaning that instead of focusing on the role of the teacher, the focus is more and more on what the student should do, that is, process the material through deliberate practice, collaboration, and active reflection. To effectively support this process, teaching is planned and conducted with the student's disposition in mind, considering their prior knowledge, expectations, study skills, and other conditions. With the proper planning, design, and implementation of the course, active learning can then be achieved.

This active learning or student activation (Cook and Babon, 2017) is achieved when students are going into lectures and tutorials prepared to engage in the learning process, and they are not just passively trying to absorb information. Active learning encourages active cognitive processing of informa-

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tion, and the concept is not a new one. Confucius is often quoted as saying: "Tell me and I will forget, show me and I may remember, involve me and I will learn". The use of student activation or active learning is well suited for presential learning. In an online setting, this type of learning has to be adapted to acquire the same knowledge from online activities. The main goal for students is to learn as well from online as in presential lectures.

Following levels from (Center for Teaching and Learning, 1990) might help to trigger student activation.

- To test the students' memory by asking questions related to specific facts, terms, principles, or theories.
- To utilize the students' knowledge to solve problems or analyze a situation.
- To exercise the informed judgment of the students.

Many pedagogical theories and frameworks have been developed to facilitate effective teaching covering different aspects of teaching (Kandlbinder, 2014; Chi and Wylie, 2014; Cook and Babon, 2017; Rust, 2002). However, with the advancement of technology and globalization, the traditional pedagogical models were evolved to make distance learning possible. Students can sit anywhere and learn online through the internet and connect with other students in the physical classroom or online.

Our designed course follows pedagogical principles to enhance learning outcomes. The course is segmented into 83 videos, given by eight lecturers of different expertise, coherent and harmonized. This well-balanced theory-practical course covers a broad range of applications and approaches.

1.2 LTU's Pedagogical Principles

To support the development of teaching practices and students developing the necessary skills required for them to become independent actors in their respective fields, LTU developed its pedagogical idea centering around nine important principles (Luleå University of Technology, University Pedagogy Center). These principles support Örebro University pedagogical principles (Örebro University), and we believe other courses, in other universities, should follow the same principles. Here, we briefly introduce these principles (along with feedback regarding the course) as a barometer for our course design.

1. **Emphasize relevant knowledge and skill,** is an important goal at university education to emphasize relevant skills and knowledge; that is to say, students should acquire the relevant theoretical knowledge, as well as the skills necessary to apply that knowledge.

2. **Encourage active cognitive processing,** so as students engage with the subject matter deliberately, contributing to long-term learning (Chi and Wylie, 2014).

3. **Choose forms of assessment that enhance learning.** The design of assessment has a great impact on student learning (Snyder, 1971; Wiiand, 1998; Ramsden, 2003), and thus it is important to choose the methods ("If you want to change student learning then change the methods of assessment" (Brown G., 1999)), frequency, and content of assessment in a way that would contribute to student learning. Naturally, active learning, and student activation discussed in more detail in Section refssec:related are crucial components of adherence to this principle.

4. **Ensure clarity in the course and task design,** an important principle to make sure students have a clear picture of the course and its requirements. One approach to achieve this is that of constructive alignment (Kandlbinder, 2014), making clear connections between the goals of the program, the intended learning outcomes of the course, the assessment methods, and the activities carried out through the course.

5. **Promote knowledge-enhancing feedback.** It is important that students receive feedback on their work beside the final assessment, which could guide their progress and inform them how close they are to learning outcomes (Elmgren and Henriksson, 2018). The impact of feedback is highest when it is in-time, personalized, and specific.

6. **Foster independence and self-awareness** is an important principle when we consider the current need for life-long learning and the goal of university education as enabling students to become independent actors in their respective fields.

7. **Be aware of your students' starting points,** as learning is more effective when the new information is either integrated into existing mental frameworks or said frameworks are reshaped by the new information. For this, however, it is crucial that we are aware of the current mental framework of students. Furthermore, being aware of the starting point of learners is also crucial to identify skill or knowledge gaps that should be filled.

8. **Communicate high, positive expectations,** so as to stimulate students for higher performance; a phenomenon widely known as the Pygmalion effect (Goddard, 1995).

9. **Create a supportive learning environment,** is a principle supporting all preceding principles. Since the proper environment is key to communicate not only high but positive expectations in a manner that encourages and not discourages students. Similarly, in a supportive environment, students are more open to discussing their experiences and receiving feedback.

As we consider adherence to them especially difficult in an online setting, we will give particular consideration to principles 2, 5, and 9. For example, in the absence of in-presence teaching, when in-person interaction between students and teacher and among students is not possible, it is especially challenging to create a supportive learning environment, and the opportunities to give feedback also diminish. Online learning management systems like Canvas and Blackboard provide the infrastructures to conduct courses online. However, similar to classrooms, it is up to teachers and course developers to fill them with content and utilize them effectively. We would discuss the learning management systems and how we used them to support the pedagogical principles in Section 3.3.

2 Course Design

In this section, we examine the course design based on LTU's pedagogical principles (see Section 1.2), the principle of constructive alignment, and other pedagogical considerations. We should note here that one may arrive at similar design patterns based solely on practical considerations as well. However, we consider it an integral part of our contribution that the design of the NLP course discussed here is rooted not only in pedagogical practices but also in pedagogical theories and research.

2.1 Objectives/Intended Learning Outcomes

In accordance with constructive alignment (Kandlbinder, 2014), course level objectives and Intended Learning Outcomes (ILOs) were set at the beginning of process of course design. For this, we were following the pedagogical principles, as well as ABCD and SMART techniques (Tullu et al., 2015; Smaldino et al., 2005; Doran et al., 1981). Based on these factors, the ILOs for the NLP course were as follows: *After passing the course, the student should be able to...*

- *... explain and use text preprocessing techniques*
- *... describe a text analytics system together with its components, optional and mandatory ones*
- *... explain how text could be analyzed*
- *... evaluate results of text analytics*
- *... analyze and reflect on the various techniques used in text analytics and the parameters needed as well as the problem solved*
- *... plan and execute a text analytics experiment*

2.2 Course description

The course contents were designed according to the ILOs discussed in Section 2.1. The syllabus and content of the course were designed after examining NLP courses, and other similar courses offered by different universities, as well as reviewing relevant literature (Agarwal, 2013; Hearst, 2005; Liddy and McCracken, 2005). Our NLP course consists of seven modules that provide motivation, tools, and techniques for solving NLP problems. This section explains the contents of the modules briefly to give the reader a better understanding of how the ILOs are reflected in the proposed contents.

The course starts at the first module with NLP applications, providing links to online API, chatbots, and dialog systems to motivate students. Then we discuss basic definitions and concepts in NLP, such as what a language is. The second module of this course is devoted to structure analysis of texts. Morphological analysis like n-grams and filtering (such as identifying missing values, tokenization,

stemming & lemmatization, handling URLs, accents, contractions, typos, digits, etc.) is covered in the second module. Moreover, Part Of Speech (POS) is described, including its application and a more in-depth view into it. This module also describes the syntax and syntactic analysis of a text, followed by feature extraction and text representation; it starts with commonly used features in NLP and describes different encodings that can represent text to machines.

The third module of this course delivers the theory and practice of neural networks. It starts with the basics of neurons and network architectures, then training using backpropagation followed by vanishing gradients and over/under fitting problems. RNN, LSTM, GRU, and CNN layers are covered in depth. This module finishes by debugging neural networks, discussing regularizers, and covering common problems of neural networks.

Having the essential tools of NLP, the fourth module is more towards application, text classification, and how NLP problems can be solved using neural networks. This module starts in learning taxonomies, with a step-by-step design of an end-to-end neural network. It also discusses common choices for simple network architectures, learning taxonomies, multi-class, multi-label, and multi-task problems. After that, text classification is grounded to the problem of tagging in NLP, followed by transfer learning methods. At the end of this module, standard metrics in NLP are discussed.

The fifth module is dedicated to semantics, introducing semantics and symbols in NLP and possible ways to represent them. The theory of frames and synsets are discussed as the formal representation of semantics. Then, vector representations of semantics are discussed alongside different approaches to obtain them. Approaches like distributional hypothesis, statistical methods, and neural methods such as Word2vec are covered. At the end of this module, some of the state-of-the-art word embeddings are reviewed.

Sequence to sequence architectures, encoder-decoder architecture, attention, transformers, and Bert model are discussed in the next module. At the end, some different topics such as structured prediction, arc-standard transition parsing, and insights into dialog and chatbots, image captioning, and gender bias in NLP were discussed.

2.3 Video Clips

Our main challenge here is to deliver the material in a manner that still adheres to Principle 2 and encourages active cognitive processing. To achieve this goal, the design of the lecture format is one of the first consequences. For that, we split our material into short videos with a length of at most ten minutes. (McKeachie et al., 2006; Benjamin, 2002; Ozan and Ozarslan, 2016; Bordes et al., 2021). Delivering the course in short videos has the benefit of encouraging active cognitive processing of students among videos, as discussed in Section 1.

Another benefit of presenting our course content in short videos is the potential for the reusability of videos (Crame, 2016). Lastly, splitting all subjects into smaller topics facilitates sharing the workload among many presenters. It allowed us to organize the course in a joint setting, as discussed in more detail in Section 2.4.

2.4 Joint Course

Designing and developing a course for multiple initiatives requires a deep knowledge of the field, a broad range of knowledge in the field, and a deeper understanding of each topic. This requirement is not easy to be fulfilled by one lecturer. Thus, we make it a joint course between Örebro University (ORU) and LTU. This allows benefiting from multiple lecturers that let each deliver a specialized lecture. Load sharing is the other benefit of a joint course. However, designing and developing a joint course with multiple lecturers brought some difficulties, such as:

- Keeping harmony between lectures.
- Segmenting sub-topics to keep the lengths short.
- Distributing each subtopic between lecturers.
- Avoiding repetition in lectures.

To overcome these difficulties, lecturers from the two universities hold weekly meetings to design the course and distribute sub-topics among themselves. Lecturers created material by themselves, and then the material and the narratives are reviewed weekly. Moreover, after the course's first run, all materials are reviewed again to keep the outcome coherent and harmonic. This revision and harmonization of material should contribute to the clarity of course content (Principle 4).

2.5 Assessment and Assignments

To achieve desired students' activation, we designed the initial assignments and project tasks involving ready-to-use web API for various applications like hate speech, profanity filtering, image captioning. Later, the focus is on how these applications are developed using NLP. Therefore, we cover theoretical, numerical, and programming tasks in assignments and projects.

The course's assessment design is based on a quote by David Boud "students can escape bad teaching, but they cannot escape bad assessment". The forms of assessment in the joint NLP course were based on guiding the students towards achieving their learning outcomes. We avoid designing the assessment as a written exam at the end of the course as we are looking to engage the students with the course contents all the way till the end of the course (Principle 2, 3) (Luleå University of Technology, University Pedagogy Center). The assessment had been done in two stages which are practical project and oral discussion. The practical project is designed to follow the principle of the constructive alignment (Kandlbinder, 2014). The project's main objective is to lead the student to develop an actual NLP application (Principle 8) (Luleå University of Technology, University Pedagogy Center) but in the form of accumulative five tasks. The task will guide the students through the different levels of Bloom's cognitive domain (Bloom et al., 1956), namely *Remembering, Understanding, Applying, Analyzing, Evaluating and Creating*.

Each task is designed to match with the weekly delivered contents, so it will give real feedback on how the students understand and implement the concepts in practice (Principle 5) (Luleå University of Technology, University Pedagogy Center), and whether they can transfer the knowledge (theory) from one context to another context (Practical Implementation). Students have the flexibility to choose the programming language (however, Python is preferred), framework, or tool that they would like to use to reach the target. The provided flexibility will give a chance to find multiple approaches proposed by different students to sort out the problem (Principle 6, (Luleå University of Technology, University Pedagogy Center)). The sharing of different ideas among the class will add significant value to the course outcome. The final exam is an oral exam for each student. It is more like a discussion, and we assess each student based on that. An open discussion trying to mimic the understanding of a real problem related to NLP is conducted. The discussion starts with an asking about the general understanding of one of the known NLP applications, such as machine translation. All the consecutive questions are asked to evaluate the practical understanding of the problem and test the need in each stage to implement the solution. The examiner and examinee use the zoom's whiteboard to convey the questions and answers for better clarity.

3 Teaching and Learning Activities

The course is designed to maximize the intended learning outcomes. We refer to students some python programming tutorials available online to get familiarized with Python. This section describes this course's teaching and learning activities, which includes delivering lectures in short videos, live sessions, lab sessions, and our learning management system.

3.1 Live Sessions

The lectures are delivered through recorded videos on each module of the course. However, it is essential to take the students' questions, reflections and address their potential confusion after they have watched the video lectures. For this, we conducted weekly live sessions for each module. Students learned from the video lectures and discussed with the instructors in the live sessions, thus, aligned with flipped classroom learning. These live sessions where students had the opportunity to directly ask the instructors contributed toa supportive learning environment (Principle 9), and gave us the opportunity to provide the students with feedback (Principle 5).

The live sessions were delivered to address the queries regarding the theoretical concepts, practicals, contents, specific assignments, and other organizational queries. We addressed the immediate queries, and the queries asked in discussion threads in Canvas for the modules covered until a specific live session. However, there was a scope of queries related to the upcoming part of the course.

Live sessions are conducted online through zoom every week during the course. There are at least two instructors and one teaching assistant present during online live sessions. First, we took the queries asked in the learning management sys-

tem. We have a follow-up discussion regarding those queries. Next, we have other questions related to the theory and practicals.

We encourage students to ask more and more questions/confusions to enhance their learning (Gibbs, 2005). In the end, we ask for regular feedback (Principle 5) (Luleå University of Technology, University Pedagogy Center) for each module, either in the live sessions or in learning management system.

3.2 Lab Sessions

Practical (lab) sessions make up student-centered teaching strategies for experiential courses (Moate and Cox, 2015). The lab sessions provide practical programming experience to the students, following Kolb's cycle and ICAP framework (Kolb, 2014; Chi and Wylie, 2014). Students watch or read a given experience (as concrete experience) and reflect on it (as reflective observation) before conceptualizing how to go about implementation through flowchart or pseudocode and finally active experimentation by writing and running the codes. Furthermore, in a lab session, students get to ask questions and get possible answers from their colleagues or the instructor. They also get formative feedback after the lab session (Principle 5) through online channels identified in this work, making it possible for them to improve their practical skills. They can work together in groups (using online collaborative tools), which is sometimes preferred. This makes it an interactive session, thereby achieving the interacting stage of the ICAP framework (Chi and Wylie, 2014). Assessment at the end of each lab session provides a good context and affects learning (Rust, 2002).

The technique is a vital element of pedagogy, which is the science of teaching (Lea, 2004). This approach fulfills the emerging trend of flipped classroom (Europass Teacher Academy, 2020), where students are responsible for their own learning before attending classes (Ng, 2018). The sessions help to bridge the gap in knowledge between students and the instructors. It was essential to be aware that not all the students had the same level of programming experience. Hence, it was essential to provide the practical sessions in stages that could address the beginner, intermediate and experienced developers. Students were given tasks that progressed from introductory programming with Python for text preprocessing to introduction to the Pytorch framework and, finally, an advanced machine translation (MT) task.

3.3 Learning Management Systems

The lack of in-person interaction between students and teachers did emphasize the framework through which the students were interacting with the course material and the teachers. The two universities offering the NLP course used different frameworks or Learning Management Systems (LMSs) for this task; however, the principles to bear in mind were the same. Most importantly, the course material had to be presented in the LMS in a way to make it clear for the student what their task is and how to proceed with their learning (Principle 4: ensure clarity in the course and task design). Another critical aspect of the LMS was to facilitate interaction between teachers and students, providing an open channel of communication (Principle 9: Create a supportive learning environment). Additionally, it was required that the LMS facilitates feedback (Principle 5: Promote knowledge-enhancing feedback) and supports the assessment methods to be used for the course (Principle 3: Choose forms of assessment that enhance learning). In the following sections, we will discuss how each LMS was used to achieve these goals.

3.3.1 Canvas and Blackboard

Both Canvas and Blackboard are cloud-based LMS used for courses at many educational institutes. Here, we will discuss (in numerical order) how we set up the course in them to support the above-listed pedagogical principles.

- Principle 3: Both Canvas and Blackboard enables the posting and evaluation of the assignment types we used (for more details, see Section 2.5). Moreover, they also enable students to assign peer feedback tasks for students automatically. This feature contributes to the adherence to Principle 6 (Foster independence and self-awareness) by encouraging students to reflect on others' learning and the requirements of each assignment.

- Principle 4: On the starting page (the entry point for students to the course room), the course syllabus is linked, and students can also find the course plan here, along with a weekly, thematical breakdown of the course. In this breakdown, we also provide links that allow students to access all materials allotted for the

given weeks. Moreover, to further enhance the clarity in course design, the material was added weekly to direct students' attention to the current tasks. Another tool provided by Canvas and Blackboard that serves clarity is assignments page, where students can access all assignments in one place, enabling them to overview what assignments they have already fulfilled, what assignments are still due, and when due dates are coming up.

- Principle 5: The opportunity to provide knowledge-enhancing feedback was two-fold. For one, teachers could rate and comment on student assignments. Moreover, teachers could provide feedback through the various forums on the course's discussion page, also hosted on Canvas and Blackboard.

- Principle 9: The discussion page of the LMS used also served as an open communication channel among students and between students and teachers. This contributes to a high degree of interaction that is important for a supportive learning environment.

4 Results

The NLP course (7.5 credits) was a part of the one-year Data Science Masters program at LTU. There were 24 students enrolled in the NLP course. The students were from academia and industry both. Most students had a background in computer science or engineering and thus had at least an introductory course in programming. Some students, however, had no programming background.

4.1 A student's perspective of the course

This section is the work of a student who took the course and gave his comments, as discussed below.

Keeping in mind that students need to be prepared for both the industry and research front. Students need to focus on using tools and methods that are most widely used. When there are so many tools to deal with, students get overburdened. Here, the instructor needs to follow a suitable pathway to let students understand the concept and implement an executable project for demonstration. The class contains students with both programming and non-programming backgrounds. Python was used in the project assignments. The students without a programming background may not feel confident using Python. Therefore, there should be an alternative to that.

Text Preprocessing is an essential step in NLP that various libraries exist for that. The main attention of lecturers was on applying preprocessing (such as identifying missing values, tokenization, lemmatization, etc.) on a text file. It did not seem easy to apply those on Pandas dataframes. Specially applying regular expressions on Pandas dataframe for a beginner seemed to be daunting. Though the instructors have done their job of both concepts and practicalities, students felt less confident to carry the instructor's work and stuck using libraries. So, one needs to develop a clear strategy or steps for being selective in using libraries that are more helpful for carrying real project development. It helps to form the proper foundations for the student. Therefore students would feel more confident to carry forward the concepts taught by the lecturers in a class. Similarly, when using libraries such as Tensorflow and Pytorch.

Some students had high expectations towards the instructors that instructors should have supported them in building a web-based or desktop NLP application, i.e., taking the NLP course project to technology readiness level 7. However, this was beyond this course.

Another difficulty students were facing was understanding the speech patterns in the videos recorded by lecturers coming from different backgrounds, and having different accents. Moreover, there were many technical terms and idioms in the course that are hard to capture at the first sight. A neat solution to this can be subtitles. Adding subtitles to recorded lectures improve speech understanding, and helps students to capture new technical terms.

This course came with various interesting points from students' perspectives. Such as:

- Efficient knowledge transfer.

- To make the student feel confident at the end of the course by applying theoretical and practical aspects learned in the course.

- Removing the barrier for students coming from different cultures, different backgrounds.

- In initial stages, sticking to most widely used programming language and libraries and ecosystem in NLP. At the same time, being

selective in libraries, which are more useful in day-to-day project/coding implementations.

- Motivating students to build their own models, and its customization.

4.2 Course evaluation by students

The department surveys each course. Students are asked to give a rating on a scale of 1-6 (1: strongly disagree, 6: strongly agree). Students are encouraged to provide feedback; however, it is up to them if they want to give the feedback or not. Here, we discuss the students' reflections we received after the course. In total, eight students gave their responses in the course evaluation report out of the twenty-four students taking the course. The survey consists of six sections: self-assessment, course aims and content, quality of teaching, course materials, examination, and overall assessment.

Table 1 shows the stats of students′ self-assessment. It can be noticed that many students did not spend sufficient effort. In a way, we failed in motivating students to put their efforts into the course. It may be due to students' other commitments. However, the fact remains that we could not manage students to put enough effort into the course. Thus, we need to think about how we can improve more in this regard.

The following questions (Table 2) were asked regarding ILOs of the course, to ensure that the course design and implementation adhere to one aspect of the principle of constructive alignment (i.e. the teaching and learning activities support the ILOs), as well as that Principles 1 (Emphasize relevant knowledge and skill) and 4 (Ensure clarity in course design) were at least partially fulfilled. While the last question partially reflected in Principle 9 as well (Create a supportive learning environment). The average scores for these statements are between 4.25 and 4.9, suggesting that students on average agree with the given statements, thus we have managed to achieve these goals in the design and delivery of the course. The lowest agreement was given for the third statement, thus our main objective for the upcoming installment of the course will be to ensure that the study guide provides better guidance for the students.

Another set of questions were asked for the evaluation of course delivery, and the exam conducted (see Table 3). For one, these questions measure another aspect of the constructive alignment (i.e. the alignment of assessment with ILOs - Question 3.5). Moreover, it is also measured here, how well adherence to some of LTUs principles was implemented. It can once again be noted here that all average values are above 3.5, thus students are more inclined to agree with the given statements than they are to disagree with them. In particular, they rate the alignment between the examination and ILOs (and thus the adherence to constructive alignment) quite high. The second highest score was given for the technical support and communication, suggesting that this aspect of creating a supportive learning environment (Principle 9) was rather successful. The score given for the rewarding nature of theoretical teaching and learning activities was only one decimal lower, which suggests that in this aspect, we were successful in emphasizing relevant knowledge and skill (Principle 1). However, the score concerning the practical aspects of teaching and learning activities was considerably lower (though still closer to six than one), suggesting that there is more room for improvement in terms of practical tasks and assignments, as some comments also confirmed. Another way to address the score is to communicate more clearly towards students that building a complete web-based or desktop NLP application is beyond the scope of this introductory course. Another area where there is more room for improvement is regarding the input of instructors supporting student learning (Question 3.1).

Lastly, the overall assessment of the course by students is shown in Table 4. While, the overall scores are encouraging for us (in particular the question regarding the overall impression of students about the course - Question 4.3), there is still scope for improvement in all sections, and our goal for future installments of the course is to achieve even higher student satisfaction scores.

5 Conclusion and Improvements planned for the future versions of the course

Here, we discuss the course and the improvements we plan for the future course.

5.1 Conclusion

This paper discusses how the course was designed, organized, and delivered online at the university. We followed the pedagogy principles in all these phases of the course. We argue that we can deliver the course fully online even after the pandemic as we delivered the course up to a satisfactory level. To be precise, we hypothesized that our course

Table 1: Students′ self-assessment regarding the NLP course

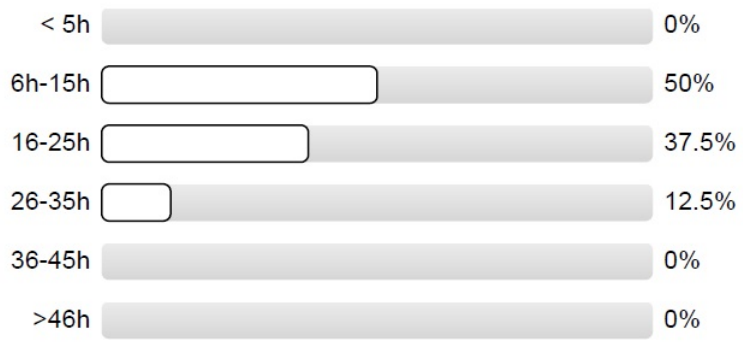
No.	Question	Average score
1.1	 How many hours of study have you in average dedicated to this course per week, including both scheduled and non-scheduled time?	
1.2	I am satisfied with my efforts during the course.	4.5
1.3	have participated in all the teaching and learning activities in the course.	4.0
1.4	I have prepared myself prior to all teaching and learning activities.	3.3

Table 2: Evaluation of achieving ILOs and aim of the conducted NLP course

No.	Question	Average score
2.1	The intended learning outcomes of the course have been clear.	4.9
2.2	The contents of the course have helped me to achieve the ILOs of the course	4.5
2.3	The course planning and the study guide have provided good guidance	4.25

Table 3: Evaluation of the course delivery and the exam of the conducted NLP course

No.	Question	Average score
3.1	The teacher's input has supported my learning.	4.0
3.2	The teaching and learning activities of the theoretical nature have been rewarding	4.6
3.3	The practical/creative teaching and learning activities of the course e.g. labs, field trips, teaching practice, placements/internships, project work have been rewarding.	4.0
3.4	The technical support for communication, e.g. learning platform, e-learning resources, has been satisfactory.	4.7
3.5	The examination was in accordance with the ILOs of the course.	5.0

Table 4: Overall assessment of the NLP course by the students

No.	Question	Average score
4.1	The workload of the course is appropriate for the number of credits given.	4.3
4.2	Given the aims of the course the level of work required has been appropriate	4.1
4.3	My overall impression is that this has been a good course	4.6

would adhere to the LTU's pedagogical principles and other pedagogical theories refereed in this paper and delivered online at the same time. This could be verified from the students' response report; The average scores (Table 4) greater than 4 support our hypothesis. In fact the scores in Tables 2, and 3 also support our hypothesis. However, there is always room for improvement. We figured out many things to improve even before the course was finished. The students' response report gave us a clear idea of where to put more energy to improve the course, e.g., as observed from Table 3, we will improve on teachers' efforts and projects related activities. The planned improvements are listed below.

5.2 Improvements planned

Here we discuss the improvements planned for future iterations of the course based on student feedback and pedagogical principles.

5.2.1 Two-layered course

Our course design started to be for multiple initiatives, for people from the industry and people from academia, people with no background in AI and maths, and people with a strong background. This ended up in designing a general course that can be used for all people with different backgrounds and goals. One track of 3 credits for industrial students and one track of 7.5 credits for academic students. Although this idea never came to real life, we would like to mention our final thoughts of it as one of the possible future works.

Students from the industry most often have different backgrounds, limited knowledge in mathematics, and stronger motivation, looking for specific applications. On the other hand, academic students have a better knowledge of mathematics. They have sufficient background in the field and are interested in learning a broad range of applications and topics.

Thus, we designed the course to cover theories, concepts, applications, and their implementation. For example, for a topic like neural networks, the materials should include mathematical background, practical usage, and possible tweaks and configurations. The choice of two tracks will be taking theoretical subtopics only for academics and practicalities for both. In the end, all who finish the course have a broad understanding of various applications in NLP that should satisfy their interests.

5.2.2 Other Improvements

- Better naming convention of the videos for clarity
- Adding subtitles to the videos for better understanding (the video lectures are delivered in English, but none of the lecturers are native speakers).
- Adding quizzes between videos for better student activation and learning.
- Removing handwritten notes from the lecture videos and slides, as in some cases students found that difficult to read.
- Multiple practical tasks with different levels of difficulty can be provided to cater to the students' different levels of programming experience, so each student can pick the task applicable to them.
- Splitting the project into subtasks aligned with the NLP pipeline.
- More live sessions to support students' learning.
- Giving more to the point references to the content related to the theory and project implementation.
- A tutorial on specific libraries to use during the course and their setup.
- Additional tutorial on building a usable web app, e.g., for Hate speech detection, where anyone can feed a text and classify it.

We hope that future versions of the course will be better in all aspects (planning, designing, organizing, and conducting) and perspectives.

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