Project-Based Learning as Innovation in the Subject of Didactics of Vocational Training

Nikola Straková[1], *Jan Válek*[2]

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Abstract

The paper proposes Project-Based Learning as an innovation in the subject of Didactics of Vocational Training within the Teacher Education study programme. The impetus for this innovation stems from Masaryk University in Brno's call to make teaching more interactive, alongside the European Union's efforts to promote holistic education at universities. The paper outlines the benefits of project-based learning, presenting examples of good practice from both the Czech Republic and abroad, with particular emphasis on teacher education.
The proposal for this innovation is based on the results of a survey that identified the changes students deem desirable in the current teaching concept. Drawing from theoretical knowledge and the survey findings, a new concept of project-based learning is introduced. The existing syllabus for the subject has been transformed into a major project, which involves detailed preparation for a teaching unit. This project will be divided into sub-parts that align with the individual phases of teaching in vocational education.

Keywords: Innovation, Project-Based Learning, Vocational Training Teacher Education

1 Introduction

Teachers at Masaryk University in Brno are encouraged to develop and innovate methods and forms of teaching in existing subjects of bachelor's and master's degree programmes. The introduction of simulation, project-based and inquiry-based teaching that will be sustainable and long-term is supported. Innovation in teaching aims to develop interactivity and/or create space for the introduction of distance elements into teaching.

[1] Department of Physics, Chemistry and Vocational Education, Faculty of Education, Masaryk University, Brno, Czech Republic.
E-mail: strakova@mail.muni.cz
[2] Department of Physics, Chemistry and Vocational Education, Faculty of Education, Masaryk University, Brno, Czech Republic.

The need for excellent and relevant university education is highlighted by the European Commission (2022) in its Strategy for Universities. Universities are challenged by the European Commission (2022) to holistic education and promote future skills such as critical thinking, problem-solving, creativity and entrepreneurial skills. The OECD (2018) distinguishes three types of skills that are essential for future education: 1) cognitive and metacognitive (critical and creative thinking, learning and self-regulation), 2) social and emotional (empathy, self-effective, responsibility and cooperation), 3) practical and physical (use of new information and communication technologies).

Project-based learning (PBL) is an educational strategy that helps students succeed in the 21st century. It focuses not only on educational content but also on the education and development of skills needed in the future. A good project is better able than traditional teaching to equip students not only with basic knowledge of the field but also with the skills for their successful lives (Larmer et al., 2015). The application of projects in teaching develops students' personalities at all levels, i.e. cognitive, social, emotional, motivational and volitional (Kratochvílová, 2016). In the course of working on their projects, students develop research skills, use existing knowledge and at the same time collect new ones, use new technologies, collaborate, solve problems, communicate and present their results (Bell, 2010). Projects by Larmer et al. (2015) give students many more opportunities to acquire 21st-century skills, including critical thinking and analytical reasoning, the ability to analyse and solve complex problems, the ability to communicate effectively orally and in writing, the ability to apply knowledge and skills to real-world environments, the ability to find, organise, evaluate information from multiple sources, the ability to innovate and be creative, Teamwork and cooperation skills, time management, independent inference, presentation skills, etc.

1.1 Project-based learning

According to the pedagogical dictionary, project-based teaching (PBL) is teaching based on a project method, in which students are led to work independently on certain topics (projects) and gain experience through practical activities and experimentation (Průcha, Walterová, Mareš, 2013). PBL is student-driven and supported by teachers who supervise its progress. Students solve real challenges, propose solutions, organize research, apply existing and gather new knowledge, skills, develop cooperation and communication skills (Bell, 2010).

Larmer et al. (2015) wrote in their book proven project elements and teaching procedures that should be included in a well-prepared project and called it Gold Standard PBL, see Figure 1. The Gold Standard PBL diagram describes the project elements for its successful and effective application in teaching simply and concisely. The authors of the PBL Gold Standard based their work on the original ideas of the founders of PBL, Kilpatrick and Dewey, and on the ideas of PBL professional educators. PBL is a systematic, organized activity that aims at a specific goal – to equip students with key knowledge, understanding of the field and at the same time 21st-century skills (skills of success). To successfully meet this goal, the following is required:

- solving a challenging problem or question,
- research solution of the problem – targeted research, investigation of the problem/question using a method that would be used in the adult world,
- authenticity, engaging, interesting for students,
- student voice and choice – opportunities for students to be involved in decision-making,
- reflection – looking for opportunities for improvement,
- providing constructive criticism and evaluation to improve individual and collective work,
- presentation of tangible results in front of an audience. (Larmer et al., 2015; Allen, 2015).

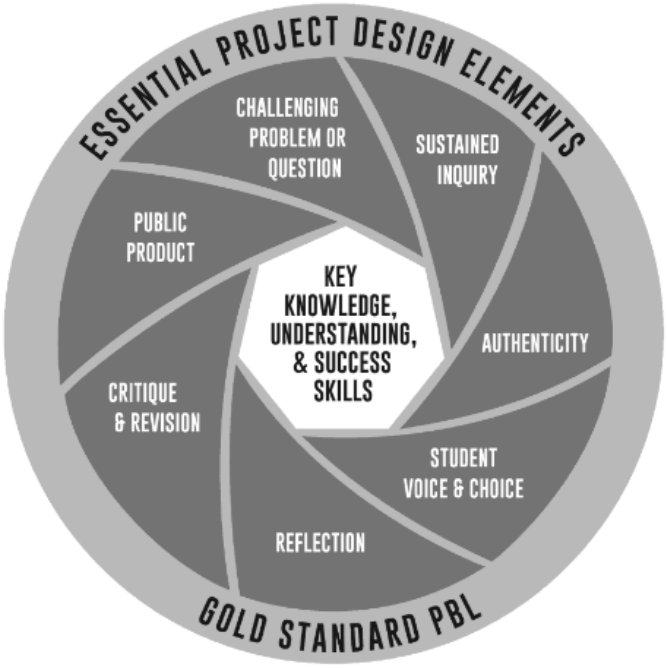

Figure 1: Gold Standard PBL (Larmer et al., 2015).

1.2 Project-based learning in University Education

PBL is nothing new in the world of education. Teaching based on the project method was promoted as early as the first half of the 20th century in the USA by representatives of pragmatic pedagogy J. Dewey and W. H. Kilpatrick. Since then, PBL has been implemented at various intensities at all levels of education in almost all education systems of the world. Universities are no exception. Projects are most often implemented at technically oriented schools, but also, for example, at faculties of education, as we mention in Chapter 1.3.

Successfully introduced PBL in bachelor's and especially master's studies at the Faculty of Transportation Sciences at the Czech Technical University in Prague is described by Votruba (2019). At the Faculty of Transportation Sciences, PBL has been introduced since the school year 1995/96 and the total number of hours of projects has increased from 40 hours per academic year to 65 hours per academic year 2000/2001 (Votruba, 2019). Votruba (2019) evaluates the experience with PBL significantly positively, based on the positive reception of the projects by students, teachers and cooperating entities. According to Votruba (2019), the dominant influence on the introduction of PBL is the support of the project leader (teacher) and the support of the relevant department, the longevity of the project (there is no 'self-learning' effect in short-term projects), the adequate number of students (2-5 students), the management of the project by an internal teacher and the introduction of multidisciplinary projects.

An example from abroad of the implementation of PBL in higher education is the Department of Mechanical Engineering at the University of India. Students in 17 groups of 4-5 students designed and then created a prototype of the product for one semester. The main advantages of the implemented PBL were perceived as follows: the possibility of students influencing the project result and the learning process, updating the knowledge of the topic in question, improving communication skills, data collection and analysis skills and presentation skills. The involvement of students in PBL was excellent, as was the achievement of the required technical and soft skills for the 21st century. (Pawar et al., 2020)

The next experience with project-based learning from Bartels and Stolz (2024) from the University of Applied Sciences Cologne confirms the positive impact of projects on learning outcomes and the improvement of soft skills, provided that certain prerequisites for the successful implementation of projects in teaching are ensured.

1.3 Project-based learning in Teacher Education

PBL in teacher education has two main objectives. The first objective is to activate students in teaching and to use all the benefits of PBL to engage students and positively motivate them to lifelong learning. The second objective is to try to make students understand and try to participate in PBL. If we want future teachers to implement projects in their own future teaching, they must first understand them.

Teachers prepare students, a new generation of citizens, for a future life in which they will be confronted with many complex problems. Such problems often do not have an easy solution and will all require sophisticated cooperation, varying expertise, creativity and perseverance. PBL provides opportunities for students to practice working together on valuable, meaningful and complex tasks. The transformation of traditional teaching towards PBL is desirable, but it will not be possible without adequate teacher education. A change in the way future generations teach is only possible in a situation of successful and high-quality teacher education. (Grossman et al., 2019)

Since the school year 1996/1997, theoretical and practical preparation for PBL has been part of the undergraduate training of teachers of the 1st level of primary school at the Faculty of Education at Masaryk University in Brno (FoE MUNI). Preparation for PBL is systematic and regularly adjusted, and its aim is: "*To equip students at primary school teaching at the 1st level of primary school with such competencies that they can design, implement and reflect on a project in practice.*". The innovative concept of the transformation of teacher education consists in the implementation of a so-called pedagogical project, which integrates the theoretical knowledge of the student ('I know ') with the experience gained in practice ('I can ') and with the use of reflection ('I know why '). In this case, the pedagogical project even partially replaces the unsatisfactory form of the state final examinations and is an important written basis for the successful completion of the state final examination. (Kratochvílová, 2016)

To demonstrate foreign experience with PBL in teacher education, we present the results of a study from Saudi Arabia. Alrajeh (2020) investigated at the University of Saudi Arabia the value that academics place on the use of PBL in preparing student teachers for K-12 teachers. In the study, Alrajeh (2020) concluded that academics have positive attitudes towards PBL and think they use PBL in their current teaching practices, but how they have explained their implementation of PBL in the classroom has not lived up to the essential characteristics of PBL. Academics have often confused problem-based learning with project-based learning. The results of the study resulted in recommendations for faculty members to improve a comprehensive understanding of PBL and subsequent successful implementation of PBL in teacher education programs. Overall, PBL is seen as a useful learning strategy and a major part of the learning process to help students develop their skills. (Alrajeh, 2020)

2 Methodology

2.1 Research Questions and Problem

Before the change of the concept of the traditional method of teaching to PBL in the subject Didactics of Vocational Training, we were interested in what change in the current concept of teaching is desirable on the part of students of vocational training. We asked the following initial research questions:

- What kind of teaching suits students in lectures?
- What methods and forms already applied in lectures would students recommend using in lectures in the future?
- What methods and forms of teaching are essential for future teachers in their teaching practice?

These questions led us to formulate a basic research problem:

- How do students perceive the current teaching strategy of the subject Didactics of Vocational Training?

From our point of view, student's perception of the current teaching strategy means finding out whether students prefer traditional education based on the transmission of knowledge or whether they would be interested in a more activating way of teaching based on the transformation of existing knowledge. Given that even in the current form of teaching, there have already been efforts on the part of the teacher to incorporate some activating elements into the lessons, we ask students which of them they are most interested in. Furthermore, we find out which topics of lectures (methods and forms of teaching) are best applicable to students' future teaching practice. The quantitatively oriented survey aimed to gain insight into the current teaching strategy in the subject of Didactics of Vocational Training.

2.2 Research Sample

The survey sample was chosen intentionally and consisted of full-time and part-time students of the subject Didactics of Vocational Training. This course is taught regularly in the spring semester in the 2nd year, and 3rd semester in the study program Teacher Education in Vocational Training and as part of the supplementary pedagogical studies at FoE MUNI in Brno. 21 students out of a total of 40 students enrolled in this course in the monitored period 2024 of the spring semester participated in the survey. This corresponds to a return of 53%.

2.3 Research Method

To answer the main and minor research questions, a quantitative survey was conducted among students at the end of the semester. Students were asked to anonymously fill out a questionnaire that contained 3 basic questions. For two questions, a 5-point Likert scale was used, which allows us to detect finer differences in students' perceptions, compared to simple yes and no answers. A value of 5 on the scale means I like it the most, and a value of 1 on the scale means I like it the least. In one case, multiple-choice questions were used. The online tool Google Forms was used to distribute the questionnaires and Microsoft Excel software to evaluate the results.

3 Results

In this part of the paper, we present the results of three items of the questionnaire survey, which determine students' perception of the current state of teaching:

1. comparison of students' interest in traditional and activating elements of teaching,
2. students' perception of the activities implemented in teaching so far,
3. methods and forms best applicable to educational practice from the student's point of view.

3.1 Traditional versus activating elements of teaching

It turned out that students prefer to learn in the traditional way. The students were most satisfied with the emphasis on information and the transfer of ready-made knowledge (transmission) with an emphasis on their applicability in practice. They were least interested in independent scientific research and finding out knowledge. From these results shown in Figure 2, we conclude that it is much easier for students to study the materials processed by the teacher, take the exam and get a grade than to take responsibility for their learning, look for their sources of information, analyse them, critically evaluate them and use them to create their result/product.

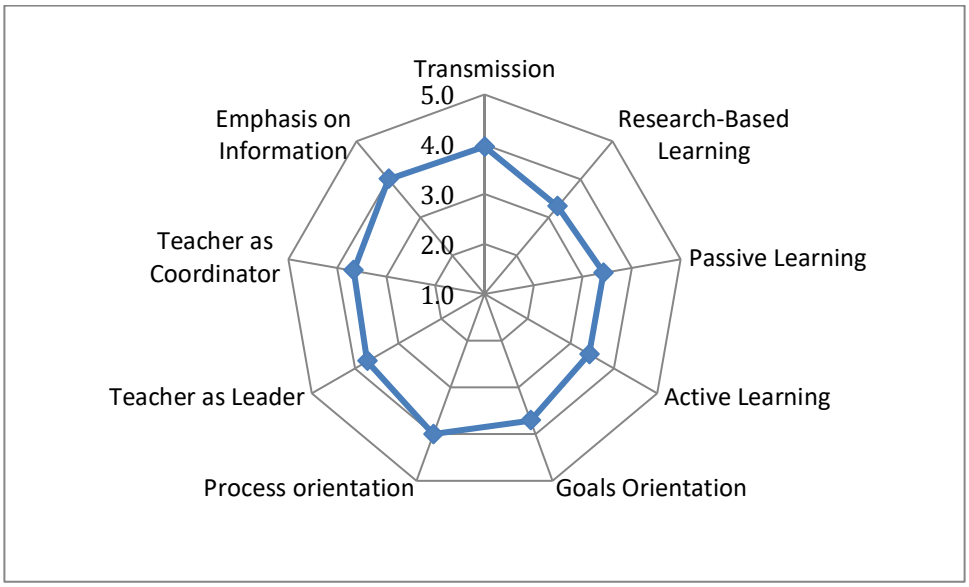

Figure 2: Comparison of traditional and activating teaching.

3.2 Activities implemented thus far

Among the teaching activities implemented thus far (see Figure 3), students have shown the most interest and enjoyment in working with online applications designed for reviewing and practising the curriculum. These include games, question-and-answer card selections, random question wheels, crosswords, sudoku, quizzes, and similar tools. Furthermore, students have expressed interest in engaging with artificial intelligence (AI), specifically the generative AI chatbot tool, OpenAI's ChatGPT. The students also perceived positively the analysis of good practice examples. Examples of role-playing, excursions, problem tasks and group work were discussed in the lectures. In its current form, students were not interested in the creation of mind maps, visualisation of curriculum by a concept diagram and independent work with text such as the study of pedagogical documents issued by the European Union and the Ministry of Education, Youth and Sports of the Czech Republic.

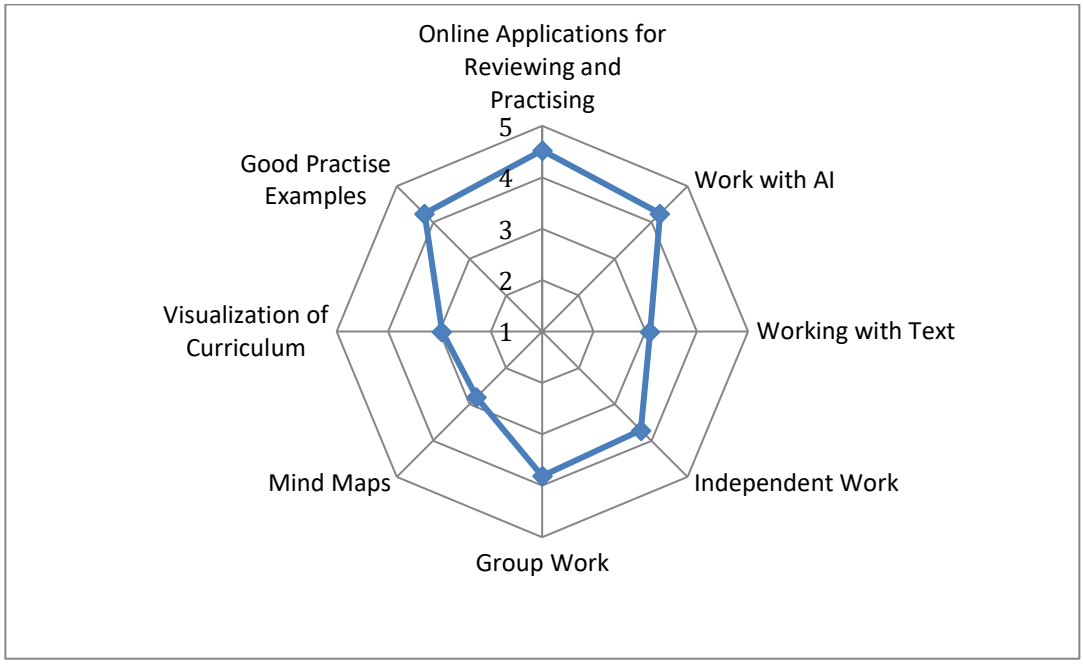

Figure 3: Current learning activities and their popularity.

3.3 Application potential of teaching

The methods and forms of teaching in which students see the greatest potential for future use in their own teaching practice are instruction, practical exercises, problem learning and group and cooperative learning as can be seen in Figure 4. From the students' point of view, the greatest emphasis should be placed on these methods and forms in the future.

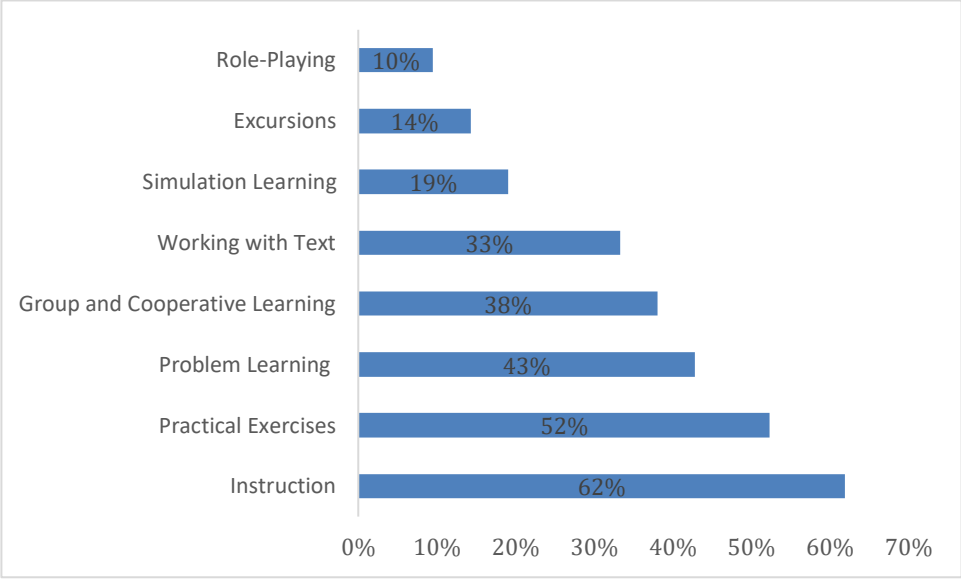

Figure 4: Methods and forms of teaching important for future teaching practice.

4 Proposal of PBL in Didactics of Vocational Training

The aim of the innovation of the subject Didactics of Vocational Training is the application of PBL in teaching. In PBL, students should be encouraged to work independently on certain topics (projects). In our case, students will work on one main project, which will consist of smaller sub-parts, while each sub-part of the project will have its theoretical and practical level of processing.

The main project will be detailed preparation for a teaching unit in vocational training. The sub-parts of the project are detailed phases of teaching, i.e.: introduction, communication of educational goals, motivation, exposure, fixation, evaluation and reflection. These phases correspond to the topics of the lectures (syllabus) of the subject of Didactics of Vocational Training. The breakdown of the main project into its sub-parts, including the division into theoretical and practical parts and the schedule of teaching, is shown in Table 1.

Main project	**Theoretical part**	**Practical part**
Detailed preparation for one teaching unit *1st – 2nd week, 4 hours*	Project assignment including evaluation criteria. Introduction to Didactics of Vocational Training. Principles of creating detailed preparation for the teaching unit in vocational training.	Brainstorming (individual/pair) to find a suitable topic of detailed preparation in the field of study. Presentation of selected topics and approval by the teacher.
Subprojects	**Theoretical part**	**Practical part**
Didactic principles *Week 3, 2 hours*	Identification of didactic principles with a close link to the effectiveness and quality of vocational training.	Definition of own didactic rules based on identified didactic principles, which students will implement in their teaching within one teaching unit.
Learning objectives *Week 4 – 5, 4 hours*	Familiarization of students with the hierarchy of goals for vocational training. Division of goals into cognitive, sensorimotor and affective areas. Learning the rules for correctly defining goals.	Students will create a list of specific goals for all 3 areas of student development, which will define the content and depth of their own teaching for one teaching unit.
Curriculum content *6th – 7th week, 4 hours*	Explanation of the process of selecting the content of the curriculum (reflection and analysis of teaching materials). Explanation of different systems and teaching procedures. Explanation of the 3 phases of learning in vocational training.	Students will create a visualization of the theoretical part of the teaching content for one teaching unit using a concept diagram. They choose a specific system of teaching. They think about specific practical activities acquired by students. They phase the acquisition of the curriculum into 3 stages.

Teaching methods, organisational forms and material resources *Week 8 – 9, 4 hours*	Introduction of basic methods, forms and material means with a close link to vocational training.	Students will choose their strategies for the appropriate mediation of didactically transformed curriculum content to their students within one teaching unit. This means that they choose suitable specific methods, forms and material aids for students to master the curriculum, including the method of evaluating results and feedback for students.
Presentation of complete detailed preparation for the teaching unit *10th – 11th week, 4 hours*	Review of the project assignment and evaluation criteria.	Presentation of comprehensive detailed preparation for the teaching unit, which will be created by the synthesis of continuously implemented sub-projects. Evaluation of students' project work. Peer review of students' detailed preparations. Evaluation of detailed preparations by the teacher.
Evaluation and reflection *Week 12, 2 hours*		Evaluation of the course of project-based learning by the teacher and students. Concluding binding and reflection.

Table 1: Design of the main project and its parts.

5 Discussion

In our view, the ideal implementation of Project-Based Learning (PBL) in the Didactics of Vocational Training should also encompass an implementation phase. During this stage, students would apply their project—detailed preparation for the teaching unit—in real teaching contexts. Compulsory internships for students in teaching fields could serve this purpose. This would involve a more demanding form of the initial phase of the project, requiring the harmonisation of the chosen topic for detailed preparation with the ongoing teaching of the specific class in which the students will undertake their practice. This would ensure the maximum applicability of PBL, as students would implement their prepared teaching with a real class at a specific secondary vocational school. Students could then supplement their project with class characteristics, documentation of their lesson preparation, materials they created for students, and photographic documentation.
Project-based learning would end with reflection (including self-reflection) on actual teaching. Students could be invited to self-reflect by answering questions such as:

- How did you manage to implement real teaching based on detailed preparation?
- Evaluate the fulfilment of the set learning objectives at individual levels (cognitive, sensorimotor and affective).
- Describe whether other goals that were not planned were met.
- Were there any changes during the real teaching compared to the preparation? If so, please describe which ones.
- How do you evaluate the choice of teaching methods and forms of teaching?
- The next time you prepare for class, what would you change?
- Can you formulate any interesting thing that surprised you during the implementation of the lessons?
- From your point of view, which key competencies and their sub-components were developed by the project?

This is how the project-based teaching described by Kratochvílová (2016) was practically completed. In our case, at least in the first year of innovation, the application of the projects to real teaching will not be implemented. If project-based learning proves successful, we will consider linking more subjects and increasing the number of hours; this could create space for trying PBL in real education.

6 Conclusion

The results of this paper can be summarised in several points. Firstly, the main advantages of Project-Based Learning (PBL) were highlighted, including the introduction of domestic and foreign examples of good practice. Secondly, the students' perception of the current strategy for teaching the subject 'Didactics of Vocational Training' was presented. The survey showed that students are more comfortable with traditional education based on the transmission of knowledge. Among the teaching activities implemented thus far, students were most interested in online applications suitable for reviewing and practising the curriculum, working with artificial intelligence, and analysing examples of applications and good practices from real-world scenarios. The methods and forms of teaching that should be the most emphasized in the future from the student's point of view are instruction, exercises, problem teaching and group and cooperative teaching.

Thirdly, the concept of Project-Based Learning (PBL) for the subject 'Didactics of Vocational Training' was outlined. The main project was defined and divided into several sub-parts, each corresponding to topics in the syllabus of this subject.

Lastly, the potential expansion of PBL to other subjects within the Teacher Education in Vocational Training study programme and supplementary pedagogical studies at the Faculty of Education, Masaryk University in Brno, was discussed.

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