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Модель проектно-ориентированного обучения в подготовке инженеров: исследование возможностей построения индивидуальной траектории обучения с точки зрения студентов и преподавателей

Введение. Проектный подход в подготовке инженерных кадров представляет собой передовую образовательную практику, являющуюся примером реализации стратегии ЮНЕСКО по внедрению таких практик в образовании во всём мире. Актуальность исследования обосновывается тем, что реализация проектно-ориентированного обучения сопряжена с построением индивидуальной образовательной траектории студента, что отвечает запросам на конкурентоспособных специалистов в автомобилестроении. Исследование было направлено на изучение возможностей построения траекторий обучения студентов в сопоставлении с формальной эффективностью модели проектно-ориентированного обучения и выявление вопросов для её совершенствования.

Материалы и методы. В ходе исследования был использован метод анализа предыдущих исследований и формальных показателей результативности проектной деятельности Центра машиностроения, в котором была запущена пилотная подготовка инженерных кадров в Тольяттинском государственном университете (ТГУ, Российская Федерация). Для сбора эмпирических данных были проведены онлайн-опрос среди 118 студентов инженерных специальностей (значение альфа Кронбаха для опроса достигло α = 0,84), неструктурированное и фокус-интервью среди студентов-кураторов и руководителей-преподавателей проектов. Для обработки полученных количественных данных были применены методы дескриптивной статистики и пакет программ IBM SPSS Statistics 23.

Результаты исследования. Количественные показатели результативности модели демонстрируют в целом положительную динамику от внедрения проектного обучения в подготовку инженеров с 2017 года по настоящее время. Была выявлена общая удовлетворённость от участия в проектах Центра машиностроения (74,1%), при этом большинство студентов (71,9%) положительно оценивают возможности построения индивидуальной траектории обучения. При этом была обнаружена корреляция между ролью в проекте и осознанием возможностей проекта (r=0,23; p<0,05): все студенты-кураторы проектов рассматривают работу в проектах как возможность реализовать образовательную траекторию. Тем не менее, обнаружена доля участников, не считающих проект таковым средством (14,9%). В ходе фокус-интервью были выяснены причины такого выбора.

Заключение. В исследовании показано, что соотношение положительной динамики формальных показателей и оценок возможностей построения индивидуальной траектории обучения обнаруживает необходимость совершенствовать внедрённую модель в плане поиска оптимального соотношения количества и качественного содержания проектов. Перспективным вопросом является формирование готовности и внутренней мотивации студентов к участию в инженерных проектах. Опыт ТГУ по оценке возможностей формирования образовательной траектории студентов посредством участия в проектной деятельности может быть полезным для использования в других российских вузах, где внедряется проектно-ориентированное обучение.

Ключевые слова: инженерное образование, проектно-ориентированное обучение, индивидуальная траектория обучения, «Формула Студент ТГУ»

The project-based learning model of training engineers: exploring opportunities for building an individual learning trajectory from the students’ and instructors’ perspectives

Introduction. The project-based approach into engineering training is an innovative education practice that exemplifies the UNESCO strategy for implementing such practices in education worldwide. The motivation of the study is justified by the fact that the implementation of project-based learning involves building a student learning trajectory, which meets demands for competitive specialists in the automotive industry. The research aimed to investigate opportunities for building students’ learning paths in correlation with the formal performance of the project-based learning model and to elicit issues for its improving.

Materials and methods. The study used analysis of previous research and formal performance indicators of the project activity at the Mechanical Engineering Center, where pilot engineering training was launched at Togliatti State University (TSU, Russian Federation). To collect empirical data, an online survey was administered among 118 engineering students (its reliability reached Cronbach’s alpha 0.84), and unstructured and focused interviews among student advisors and project supervisors were conducted. Methods of descriptive statistics and IBM SPSS Statistics 23 package were employed to process the obtained quantitative data.

Research results. Quantitative performance indicators of the model demonstrate overall positive dynamics in engineers’ training from 2017 to the present. The study discovered project satisfaction at the Mechanical Engineering Centre (74.1%) and the majority of students (71.9%) evaluate positively project opportunities. The correlation between the project role and the awareness of project opportunities was found ($r = 0.23; p < 0.05$): all student advisors considered project activity as an opportunity to develop their learning trajectory. However, 14.9% of participants did not consider such project prospects. The focused interview clarified reasons for this choice.

Conclusion. The study shows that the correlation between the positive dynamics of formal indicators and assessments of the opportunities of building an individual learning trajectory reveals the need to improve the introduced model in terms of finding the optimal balance between the number of projects and their quality. The study prospects include the formation of students’ readiness and internal motivation for participating in engineering projects. The TSU experience in evaluating the opportunities of forming students’ learning paths through project participation can be helpful for other Russian universities where project-based learning is implemented.

Keywords: engineering education, project-based learning, individual learning trajectory, “Formula Student at TSU”
INTRODUCTION

The present study was carried out in the context of the UNESCO strategy for improving the quality and relevance of teaching and learning that declares “identification, analysis and dissemination of innovative solutions and best practices in the application of technology to improve the quality of learning in formal and non-formal education” [1, p. 4]. The educational process in the context of modern trends is not only the transfer of fundamental knowledge and mastery of basic general engineering competences, but it is also the formation of basics of a graduate’s systemic professional thinking and other universal competences that are in demand in the economy of knowledge and modern production: readiness to master new technologies independently, to find and analyse the necessary information, to work in a team, etc. As Wu and Wu [2] remark, new education practices should meet the demands of modern society, dynamic development of markets and competitive production.

In the last decade, there has been a lot of discussion on the ways of developing engineering education, which should eliminate its main contradiction – the gap between theory and practice [3]. In 2021 Pokholkov [4] presented a concept of Russian engineering education that included a mission, a strategic goal, principles and approaches. Based on this concept and ensuing discussion [5], the authors of the present research were motivated to explore project-based learning as a fundamental principle of engineering education. The authors of the present study hold to one of the key ideas of project-based learning as to redistributing students’ learning time from lecture load to project team work, thus allowing students to design their own learning paths [6].

The motivation of the study lies in the fact that it provides comprehensive evaluations of opportunities for choosing an individual learning trajectory from the students’ and instructors’ perspectives in correlation with formal performance indicators of project-based learning in the context of engineering majors at a Russian university. Thus, the object of the investigation is a model of project-based learning (PBL) implemented at the Mechanical Engineering Center (MEC) where the project activity of TSU students is arranged. The focus of the researchers’ attention is on the correlation of the formal performance indicators of the PBL model and the engineering students’ and instructors’ evaluations of opportunities for building individual learning trajectories (ILTs) at the MEC. The aim of the study is to explore opportunities for building students’ learning paths in correlation with the PBL model performance and to elicit issues for its improving. Accordingly, we use the following research questions to organise and guide our exploration:

- What PBL model is implemented at the MEC and what do its formal performance indicators imply? (RQ1)
- How do students’ and instructors’ evaluations of opportunities for building students’ ILTs via project-based learning correlate with the formal performance indicators of the PBL model? (RQ2)

Thus, the following objectives were put forward to pursue the study questions: 1) to analyse sources related to issues of introducing project-based learning and building ILTs; 2) to describe the implemented model of PBL and its performance of from 2017 until present; 3) to match the obtained empirical data with the performance of the implemented model of PBL, to draw conclusions and outline prospects. The relevance for evaluating the developed
PBL model is confirmed by activities of the strategic “Development and organisation of innovations” project that is part of the TSU road map as a member of the federal programme “Priority 2030” [7].

LITERATURE REVIEW

A review of sources on the issue of modernisation of Russian engineering education shows an active creative search for effective solutions, including building on the best traditions of the Soviet times which do have common ground with foreign CDIO [8; 9] and STEM approaches [10]. While discussing them, Rudskoi et al. [11] argue that these approaches reveal the existence of project training in the Soviet Union in the 1980s, which once again confirms the idea that everything new is well-forgotten old. Analysis of the experience of the Soviet engineering school testifies that the basis of the Western technologies of training is the borrowed ‘Russian method’ of training elite engineers [12]. Sysoev et al. suggest that “… the basis of the new model of engineering training should be the student’s activity, close to the real innovative engineering activity” [12, p. 98], which brings the student closer to using cutting-edge technologies. The instructor in this model is the main designer in the learning situation and advisor for the students. PBL finds different ways and forms of implementation. Previous studies report the urgency of the implementation of real interaction of the university and industrial enterprises via organising virtual multidisciplinary teams to perform projects for industrial enterprises [13]. Thus, the example of Peter the Great St. Peterburg Polytechnic University’s long-term successful experience reveals an algorithm of such interaction with leading domestic and foreign industrial enterprises, “using problem- and project-based approaches as the main way of effective training for professional activities; development of new education formats...” [13, p. 58]. Borovkov et al. state that “the problem-oriented approach to teaching engineering majors along with the innovation-oriented approach allows us to focus students’ attention on analysing, researching and solving a particular problem, which becomes the starting point in the learning process” [13, p. 52]. The activity-simulation technology of engineering training in the training of innovative technology development engineers which was developed and tested at National Research Nuclear University (MEPhI), deserves attention [12]. This technology was proposed as a starting point for a new stage of nuclear engineers training. The student engineering project centre at Moscow Automobile and Road Construction State Technical University (MADI) is also an example of PBL implementation with emphasis on its role in solving a number of pedagogical problems and in revealing students’ creative abilities [14]. At the same time, Ushakov et al. [15] emphasise that special attention should be paid to the organisation of core departments that use online training for the implementation of practice-oriented programmes contributing to the development of targeted training. Fedyukina et al. [16] present a model of interdisciplinary through-training of future engineers in the field of technosphere safety (MADI) which appears to be an interesting case of “pedagogical design, carried out in accordance with the design-target approach and developed by the authors concept” [16, p. 39]. The concept relies on a flexible choice under the influence of external conditions and a training model consisting of the interconnected system of training a future professional engineer and training systems in the desired field and subsystem. The model is built within selected “competently related disciplines” of natural and humanitarian sciences. It is also worth noting the experience of implementing project-
based training for future space industry specialists on the basis of scientific and educational centers (SECs) at Reshetnev Siberian State University of Science and Technology [17]. To fulfill real production tasks, SECs and university departments ‘are integrated’ into project-based teaching, which allows to provide high quality training of specialists. A number of publications highlight issues of applying of practice-oriented approach in teaching disciplines [18; 19]. Marnewick [20] describes how PBL assists students in learning and acquiring new skills. Filatova et al. [21] suggest developing separate competences while Fresemann et al. [22] employ the practice-oriented approach for developing groups of competences.

The issue of the individual learning path is discussed in a number of academic publications, too. Individual educational trajectory is defined as an individual path in education, built and implemented by a student on their own. It is expected that the spread of personalised learning in Russian tertiary education will be promoted by economy’s demands in high-profile specialists, universities competition and other factors. Klimova and Krasinskaya [23] argue that despite certain difficulties in introducing individual learning trajectories into the educational process, the designing of learners’ paths is an effective tool for optimising learning process. Pogosyan [24] highlights the role of Competence Centers at Moscow Aviation Institute that help students to form their learning paths, providing an opportunity for practice and mastering additional engineering, technological and managerial competences. Li et al. [25] present a method to form personalised learning paths based on learners’ personas concluding that learning paths saves learning time and improves learning achievements. Cuevas-Vallejo et al. [26] suggest a hypothetical learning trajectory to bridge school and university learning. Purković and Prihoda [6] prove the dominating role of PBL in pursuing individual learning paths via a quasi-experimental intervention study.

So, the main trends in modern engineering education cover a very wide range of educational innovations: from practice-oriented teaching of individual disciplines and programmes to innovative approaches implemented in the form of models, technologies and algorithms of the educational process on the basis of problem- and practice-oriented, project-based, interdisciplinary and other approaches. In addition, the importance of building student learning paths cannot be overestimated in vocational training in various contexts. In regard with specific objectives of the research, we found out that the ‘crossing’ of two issues – project-based learning and individual learning paths – is not sufficiently elaborated both in theory and practice. Therefore, this study is intended to throw light onto this matter.

**MATERIALS AND METHODS**

This qualitative and quantitative study was conducted in normal university environment during 2021-2023 and adopted combined methods of:

- analysis of previous research;
- describing the PBL model and analysing its performance;
- an online student survey based on a 5-point Likert scale, ranging from 1: strongly agree to 5: strongly disagree (using a Yandex questionnaire at https://forms.yandex.ru/u/659582b090fa7b93f91e7d1e/);
- an unstructured interview and a focused interview;
- descriptive statistics using the IBM SPSS Statistics 23 package.

The participants were 118 volunteering 1st-4th year undergraduate students and master students from TSU. All of them had from 1 to 11 semesters of project activity classes and
participated at least in one of the MEC projects. The authors also interviewed 8 student advisors. All the students were made aware that their responses would be anonymous and would not have any influence on their course grade.

Survey questions were in Russian and split into three parts. The first part contained 3 questions about demographic information (project role, year of study and duration of student’s participation in a project(s)). The second part included 12 questions about project satisfaction, motivation for participation, project opportunities, project results, and project aspirations. The third part was meant for comments.

Three instructors – project supervisors – were also interviewed to complement the research data. All these volunteering participants were clearly instructed about the purpose and possible outcomes of the research. The validity of the present research can be proved by the following facts:

- Duration of the experiment. It was conducted during a period of over 3 years.
- One hundred percent responsiveness in the online survey.
- Sample representativeness. All the study participants represented different roles, academic groups, academic years, and courses of study.
- Researchers’ involvement. At the stage of teaching project activity classes, they worked as insiders, but were physically absent while the students were completing the online survey.
- Interviews with student advisors were held by two co-authors of the article who were not their project supervisors.
- Sufficient qualification and teaching experience of the instructors and student advisors’ expertise interviewed within the research.
- Homogeneity of measuring instruments. The questionnaire consisted of close-ended questions formulated in a similar way and had a limited number of identical response options. Its reliability reached Cronbach’s alpha 0.84.

RESEARCH RESULTS

To answer RQ1, we present a brief description of the PBL model and its performance throughout the period from 2017 to present. We should mention that before 2017 the PBL model was based on the activity of only one student engineering team, Togliatti Racing Team (TRT). Since the autumn of 2017, by the decision of the university management the project activity (the entrepreneurial activity since 2022) was allocated in all the curricula of bachelor and master programmes. Since then the team began to ‘develop’ student projects not based on Formula Student Rules, thus becoming the core of the project activity at the Mechanical Engineering Center that was also established in 2017. The inclusion of project activity as an independent academic discipline in the educational process in all areas of training at TSU contributed to the improvement of the MEC performance. Currently, the management hierarchy is structured as follows: the director – project activity supervisors (TSU professors) – student advisors. It is noteworthy that all the roles are represented by the authors of this article. The PBL model emerged as a result of the diversification of the TRT activities into many project teams implementing 4 types of projects: 1) engineering projects based on Formula Student Rules; 2) engineering projects in other areas (interdisciplinary projects); 3) socio-humanitarian (pedagogical, translation) projects; 4) socio-humanitarian projects based on Formula Student Rules.
The share of engineering projects is about 88% of the total number of projects. The different types of projects make it possible to significantly expand the programmes of interdisciplinary practices, linking project activity with the implementation of relevant modules in the educational process. During the entire period of study, students consistently implement one or more types of projects as part of their project activity. Furthermore, at each stage, all projects undergo a sequential ranking of the engineering solutions developed by the project team, and then the stage of their scaling, i.e., from the prototype to the startup stage. Their project work is coordinated by a student advisor who is usually a member of TRT. An example of interdisciplinary engineering projects is “Off-Road Trike”, a student startup aimed at designing, manufacturing and selling a three-wheel electric trike. Engineering and translation studies students work together in a socio-humanitarian project aimed at creating a multimedia English-Russian thesaurus on the design of a passenger car and a Formula Student race car.

In terms of content, the model is formed around competence-based, interdisciplinary and student-centered approaches. Disciplines with project-based modules include: mechanical engineering technology, CAD in mechanical engineering, fundamentals of engineering analysis in computer-aided design systems, automobile theory, automobile design, etc. Successful engineering solutions obtained within the framework of project activity are used in student research work, course projects and bachelor theses (Fig. 1). The introduction of end-to-end design technology into the programs of academic disciplines and all types of practices made it possible to shift the focus of training to professional project work of students in a team, where a redistribution of educational functions occurs, thus allowing the student to act as the designer of their learning trajectory with the possibility for moving from a project under the supervision of a TRT member to the team itself on a permanent basis or to another MEC project.

Figure 1 PBL model at the Mechanical Engineering Center, TSU
To describe the model performance since 2017, a few key indicators were selected: 1) the number of projects and students participating in them; 2) the number of project-based bachelor theses; 3) the number of published papers, reviews and patents received; 4) employment of graduates. According to indicator #1, the analysis shows that there is a positive trend for the number of participants and projects increasing from 6 projects with the total of 105 participants in the 2017/2018 academic year to 17 projects with the total of 239 students in the 2023/2024 academic year. This diversification of project activity can be illustrated by such engineering projects as Smart Moto Challenge (an electric motorcycle), Solar Regatta (a solar-powered boat), and the first startup “Off-Road Trike” initiated by a student engineering team in 2022-2023 and funded by the Federal Agency for Youth Affairs (Rosmolodezh). A qualitative feature related to indicator #1 describes the MEC as the basis for the development of a series of projects for junior engineering students, which resulted in the increase of the number of students, taking into account the fact that all of them have the right to choose any university project or to initiate their own.

According to indicator #2, there is a tendency for varying the number of bachelor and master theses related to both Formula Student and other areas from 13 to 23 over the period in question. It is clear that this amount is comparatively small if we take into account the number of student participants varying from the minimal 66 to the maximal 119 (excluding the 2023/2024 academic year because of the absence of data for theses). As for indicator #3 (research work), over the past 6 years over 80 articles have been published by project participants. This indicator shows not only an increase in the quantity, but also an increase in quality of published material: from reports to original research articles in journals indexed in the RSCI and Scopus databases. Furthermore, over the past 6 years, over 10 patent applications were filed, and 9 patents had been received by 2023.

According to indicator #4, all engineering MEC graduates are employed by federal and regional employers including Prototype, CompMechLab (Computer Engineering Center of Peter the Great St. Petersburg Polytechnic University), AVTOVAZ, Renault, Kamaz Master, Kama, ATOM and many other engineering and industrial companies. Summarising these formal performance indicators, they represent the ‘quantitative’ side of the learning process which is rather prospective. But what is behind the positive statistics?

To answer RQ 2, we analysed 118 valid questionnaires that were received from students of engineering majors by splitting all the responses into 3 categories: project satisfaction, project opportunities, and project aspirations. The majority of respondents showed high satisfaction with their project activity (74.1%). At the same time, 71.9% of participants positively evaluated opportunities provided by the MEC projects, and 44.5% had aspirations for participating in startups or in “Formula Student at TSU” and similar big-scale projects (Fig. 2).

Nevertheless, 14.9% and 14.6% of responses from the categories project satisfaction and project opportunities show that these students are unaware of opportunities for ILTs, whilst 29.4% respondents do not wish to reach the level of startups or big-scale projects which is the ultimate goal of building ILTs. Some respondents are not sure of project opportunities (13.2%) and their aspirations (26.1%).

When comparing the students’ replies according to various variables, we discovered some significant variances, for instance, a positive Pearson correlation between the project role (‘You are a student advisor / project participant’) and questions related to project opportunities (‘I believe that working on one / different projects enables me to build my learning path’) in Table 1. Correlations are significant at the 0.05 level (2-tailed). They may
illustrate the dependence between awareness of opportunities for building ILTs and a project role. According to this variance, all student advisors agreed with questions about project opportunities.

![Figure 2: Students’ evaluations of opportunities for building their ILTs](image)

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<th>Table 1: Correlation between a project role and project opportunities</th>
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At this stage, the authors conducted a 40-minute focused interview with 8 student advisors who are TRT members and experienced in supervising students’ project apart from their main functions in the “Formula Student at TSU” project. Together as a group, they discussed a few questions to evaluate students’ project activity in terms of conditions for building students’ ILTs. Seven participants agreed that project activity at a university scale is essential for learning process. All of them said that students project activity is a possible way for choosing a learning trajectory. Participants #1, 2 remarked that “those students who are initiative and interested, who want to find opportunities for self-development and gaining new skills will definitely get it” (participant #6). Participant #8 said that “projects help to build an ILT” and emphasised “the crucial role of project activity in choosing a learning path, and that “there is always a space for personal growth as there are always teachers who are ready to help you develop your project into a course project and thesis”, and “a range of the MEC projects gives an idea of what to choose from”. As for increasing the number of projects, “it does not always translate into their quality for some reasons” (participant #1). One of them is that student advisors being involved in a few engineering projects “do not have enough time to get thoroughly prepared for each of them” (participant #1). The other reason was about “making too much fuss about so many projects being partitioned because of the demand to complete as many projects as possible” (participant #2). Besides, low motivation with some portion of project participants was emphasised by all the interviewed student advisors as a factor impending the project performance and acquiring new skills.
Within the study three project supervisors were interviewed and answered the following questions: 1) Do students need project activity? 2) Do project objectives match the participants’ readiness or the level of their skills and knowledge? 3) Is there an opportunity for developing, acquiring new knowledge and skills, especially for freshmen or those who first joined the project? 4) In your opinion, does the work in the project help the participant to build their ILTs: to choose the topic of a course project or thesis, give talks at conferences, perform successful ongoing tasks in disciplines? To what extent? 5) Would you like to change anything in the organisation or content of students’ project activity at the MEC regarding students’ ILTs? All the interviewees gave positive responses to Questions 1-4. Answering Q2, supervisor #2 specified that not all students are ready, even graduate students are not always ready to work out innovative technological solutions. This problem is solved by organising individual learning within projects, e.g., acquiring skills for working with CAD software. Answering Q5, supervisor #2 highlighted the necessity to provide conditions allowing students to understand the project content, its complexity and objectives as well as the competencies it may develop before applying to a particular project. Supervisor #1 expressed a wish to credit more project tasks as being performed for other engineering disciplines. Supervisor #3 remarked that PBL allows students to immerse themselves in the studied subject, combine project work studying specialist disciplines and perform high-quality assignments.

**DISCUSSION**

The study was devoted to describing and analysing the PBL model which accords with some principles of Pokholkov’s concept [4], namely practice-oriented nature and effectiveness. Increasing students’ involvement is ensured by integrating project activity into training of bachelor and degree students, as well as master students. Similar integration is present in other engineering universities, for example, at Moscow Polytechnic University. Some principles of organising project activity, embodied in this university [27], were also applied at TSU, when project activity was made a compulsory discipline. The starting point for the creation of the MEC was the Engineering Development Center (later transformed into the School of Advanced Engineering Studies of Electric Transport) of Moscow Polytechnic University. The PBL model at TSU also reveals certain similarities with Bauman Moscow State Technical University in terms of setting and solving real production problems as described by Simonyants [28] in relation to their case of continuous research and production practice as part of project-based learning.

The design and implementation of the presented PBL model confirm the conclusions made by Sysoev et al.: “... a well-designed learning process within the framework of a real engineering project contributes to students’ interest in the creative process, the desire to achieve better results, thus forming motivation relevant to engineering activity” [12, p. 98]. This conclusion matches our findings because this kind of motivation is generated within the core project “Formula Student at TSU” and is then passed on by its participants to other students working on engineering problems of different complexity levels, but in each case the student sees their own contribution and prospects, which along with the creative atmosphere in the team should develop and support students’ motivation, too [12]. Here we faced the need of more intensive junior students’ engagement in comprehensive and productive project activity which is supported by the focused interview findings.
Our study corroborates the assertions posited by Purković and Prihoda [6] regarding the advantageous effects of PBL on student exceptional achievements due to designing their learning paths.

Having answered all the research questions, the current findings can be summarised as follows.

1. The PBL model was described from the viewpoint of its structure, content, and formal performance indicators.
2. The majority of respondents are satisfied with their project activity (74.1%) and view the MEC projects as ways for developing their ILTs (71.9%) and achieving project aspirations (44.5%).
3. Evaluations of opportunities for building ILTs demonstrate that they are not fully (13.2%) or completely (14.9%) exploited by engineering students at the MEC, which depends on the student’s role in a project. The findings also elicit the necessity for searching for the optimal correlation between the number of projects and their content.

Interestingly, the number of bachelor and master theses based on projects is much fewer than the number project participants. Evaluations of opportunities for building ILTs (71.9%) are contrasted with a comparatively small share of project-based theses, e.g., the biggest number was 23 against the total of 77 theses in the 2021/2022 academic year. This implies that not all students strive for making results of their project activity as topics for their theses.

Having analysed all the data, we can conclude that, on the one hand, the analysis of formal performance indicators of the PBL model reveals the overall positive dynamics. On the other hand, the correlation between the statistical and empirical data is not one-to-one, thus showing ‘strong’ and ‘weak’ points and suggesting some improvements for the implemented model of project-based learning.

CONCLUSION

This pioneering research was aimed to show how the implemented PBL model promotes opportunities for building students’ ILTs by contrasting formal indicators and empirical data. Using the example of the flagship “Formula Student at TSU” and its decomposition into many projects, we attempted to illustrate how the ultimate goal of project activity – transformation of projects into innovations and startups with commercialisation potential – can be achieved.

The research findings imply that students’ motivation for engineering projects is key to exploiting the available opportunities for building individual learning paths. Thus, the issue of exploring ways for its increasing as well as some other related factors should be considered as one of the major prospects of the study. Although the study was limited to engineering students’ evaluations, the TSU experience in assessing prospects for individual learning paths via students’ project activity might be helpful for other universities where project-based learning is implemented.

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