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CREATIVITY IN THE EDUCATION PROCESS OF LOGISTICS STUDENTS: A CASE STUDY

Paweł ŚLASKI ✉

Department of Security, Logistics and Management, Faculty of Security, Logistics and Management, Military University of Technology, Gen. Sylwestra Kaliskiego str. 200–908, 46, Warsaw, Poland

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Abstract. The article deals with the issue of creativity and the creative process in the education of students. The key to successful thinking is creative teamwork. The power of "team creativity" lies in cross-inspiration, which is of particular value in the case of interdisciplinary teams. The more the students associated with a project differ personally, the more chance there is for them to come up with creative solutions. The article also presents a case study. It presents an example of a 4-step creative process, using *Visual Basic for Applications* programming. In teams students solve a task related to the analysis of selected economic measures. In the subsequent stages of the process, they solve the problem set by the lecturer using the so-called "collective mind" ideas. The case study was preceded by an analysis of surveys in which students referred to their knowledge of creative teaching methods and assessed their attractiveness. The literature study conducted analyzed teamwork in the process of student education and the creative process that fosters creative thinking. Two economic metrics were analyzed to determine the product group's contribution to the company's profitability and demand profile. Using *Microsoft Excel* spreadsheet, two procedures using *Visual Basic for Applications* computer programming were developed and verified in a case study based on quantitative data.

Keywords: creative process, creativity, economic indicators, logistics, students, *Visual Basic for Applications*.

✉Corresponding author. E-mail: ***pawel.slaski@wat.edu.pl***

1. Introduction

To meet the demands of the modern world, teachers are moving away from the traditional model of memorizing and testing content to educate open-minded and creative students capable of solving complex problems. Drucker (1992, 2005), founder of the modern management theory and practice, defines creativity as an opportunity to undertake new ventures and services, so it represents a new value or quality introduced to achieve better results. Creativity, according to de Bono (2008), is a creative action or the products of that action more than an internal attitude or disposition.

According to Porter (2010), a 21st century organization must add knowledge management and creativity to the classic factors of competitive advantage. Porter believes that a creative organization gives it a chance to gain a competitive advantage.

Creativity is a key factor in enhancing employability in any industry or job sector. The need for future job candidates to possess creative thinking skills has prompted the need for universities responsible for educating students to adapt to the demands of the business

sphere (Epstein et al., 2013; Zhou, 2007). Universities should equip students with the tools to think and create creatively, especially since they are a good space for promoting teaching and learning through creativity (Burkšaitienė, 2018).

Students believe that teachers can support their creativity in several ways. First, they believe that curricula should include content to develop students' creativity, and the role of university teachers in this process is to support this development. Second, creativity can be fostered by introducing a special course of study to strengthen students' skills, and third, team learning and innovative events at the university can have an impact on their creativity (Burkšaitienė, 2018).

The complexity of the tasks facing society today requires teamwork and collective problem-solving. This is how research teams and developers of new technological solutions work today, which does not exclude the activities of those outstanding individuals who, especially in the field of art, do not need any exercise of creativity. Among others, Nęcka (1994) writes about the advantages of teamwork in creativity training. Describing the properties of the "collective mind", he points to the synergistic effect observed by many researchers, which occurs in the case of collective creative action, as a result of which the flexibility of collective thinking is not a simple multiplication of the creative abilities of group members, and its productivity is not a simple sum of the ideas of each of its members. In turn, Góralski (1996), in the course of writing about the opportunities of team thinking, mentions the advantages over individual creativity of the diversity of team members, the organization of its activities, the so-called audience effect and the free market of ideas. The same author points out that creative team activities should take place under the right conditions, which include mutual sympathy among group members, their curiosity about the task, a light-hearted mood for its execution, as well as a sense of security and freedom (Góralski, 1996). The most comprehensive tasks that train creativity among students are team project tasks.

2. Teamwork: a study of the literature

The ability to work in a team is one of the most desirable competencies for a potential employee by employers. This is indicated by a study by some authors (Budnikowski et al., 2012), in which employers listed the ability to work effectively in a team as the fifth most important trait in a candidate, on par with their language skills. Students' attitudes toward teamwork consist of three aspects (Juchnowicz, 2014):

- Cognitive (knowledge and opinion about such a mode of work);
- Emotional (feelings toward it);
- Behavioral, stemming from the first two (intention to act in a certain way toward the problem under study).

Research made by Ruiz Ulloa and Adams (2004) indicates that the students surveyed in them mostly did not have positive experiences with teamwork, and thus prefer individual work. However, the results also indicate that by implementing the principles of effective teamwork during student projects, positive changes in students' attitudes toward teamwork can be achieved (Ruiz Ullola & Adams, 2004).

Effective student teamwork brings a lot of positive results on three levels: individual, group and organizational levels (Cohen & Bailey, 1997). Therefore, the evaluation of the effectiveness of a given team should not only look at the quantity and quality of work done, but also at group and individual effects. For example, Cohen and Bailey (1997) developed three categories for evaluating team effectiveness:

- Results of the team's work (quantitative and qualitative assessment);
- Team members' attitudes, commitment and satisfaction;
- Their behavior: the behavioral effects resulting from working in a given team.

In turn, Stevens and Campion (1994, 1999) distinguished 14 requirements in terms of the skills and abilities that team members should have in order for their participation in teamwork to be effective. They divided the requirements into two categories (Stevens & Campion, 1994, 1999):

- Interpersonal skills, which include collaborative problem solving, or communication;
- Skills related to self-management, such as scheduling tasks or defining goals and directing activities toward results.

Loughry et al. (2007), after a series of literature and empirical studies conducted among students, concluded that team effectiveness of team members is related to specific groups of behaviors. Based on this, they developed the comprehensive assessment of team member effectiveness tool to assess the effectiveness of an individual team member based on five guidelines. These include (Loughry et al., 2007):

- Contribution to the team;
- Communication with its members;
- Ensuring that the proper direction of work is maintained;
- Striving for high quality work;
- Possession of the relevant knowledge, skills and abilities needed in the performance of the specific task.

Their practical application took place, among others, during a survey of students of the Faculty of Economics and Management at the University of Szczecin (Poland). Its purpose was for the researchers to learn how students understand the essence of teamwork, what attitude they have toward it, and how effective such a method of work turns out to be for them. The final score was achieved by calculating the average of the self-assessment and the rating given by each member of the project team to which the student belonged (Rudawska & Szarek, 2014). The results were not entirely conclusive and indicated, for example, that respondents did not know the difference between group and team work, and also reduced team work to a form in which there is no individual responsibility, that is, since the group is responsible for the results of the work, no one is really responsible for it. The efficiency, as well as the speed of execution in the context of such a mode of work was also not clearly positively evaluated in comparison with individual work. Among other reasons, this is because students prefer to be evaluated individually rather than as a team, and they trust themselves more with the task at hand. The study also found that students in a team communicate correctly and have the skills needed to complete the project task.

Worse results were observed in the case of striving for high quality work and contribution to the team's work, which is coupled with the lack of motivation to perform better than correctly provoked by being part of the team. Explaining the effects of teamwork to students,

requiring team members to construct a work plan and report on their progress (Pineda & Lerner, 2006), appreciating individual members for their contributions, encouraging teams to hold social gatherings to get to know each other better, and including team performance evaluation alongside the task evaluation itself (Brutus & Donia, 2010) can all be helpful in this case.

However, the study showed that the negative evaluation of teamwork by students is not unequivocal, and it is worth investigating the problem more broadly, taking into account other Polish students and various aspects of the problem, such as the mundane nature of the issue, like the lighting of the room, its space, or its equipment (Kołodziejczyk, 2014). In any case, but especially in the case of teamwork, the key to more effective communication between the instructor and students is using language that can be understood by each addressee of the message, encouraging students to ask questions, share concerns. In addition, instructors are encouraged to emphasize the benefits of teamwork, reinforce the importance of the team while respecting the individuality of its members, and encourage care for interpersonal relationships within teams (Bogdanowicz, 2019). This is because it emphasizes the importance of effective teamwork in future experiences related to a future career path, or the ability to find oneself in a leadership role. Students faced with teamwork can try their hand as leaders, and compare their vision of the leader's task with actual guidelines. This is very important, because young need to learn that they will not do much on their own, they need to learn to work in teams, they need to know their place in them, because once they can lead a project, and other times they will be just a small, but very important cog in it. It is good practice to reward student activity if it contributes something to the discussion. However, it is also necessary to set a framework and rules for the discussion to keep it under control. For example, ensure to stimulate the ability to draw conclusions in the student based on information sources, as well as to look critically at one's rationale (Carnegie, 2018).

As for the evaluation of the results of individual work in a team, it is worth pointing out the advantages of assigning specific responsibilities to specific people, and in the context of shared responsibility for the results of the team's work, to form in students a sense of responsibility for the independently completed part of the project. Finally, it is useful to inform each group about the evaluation of their work, provide individual guidance, point out the strengths and weaknesses of the work done, and encourage cooperation rather than competition within and between groups (Bogdanowicz, 2019). In her analysis, Moczydłowska (2008, p. 45) also suggests as a solution to

> "consider supporting teachers in various forms – from consultations to workshops on organizing teamwork and team management in the context of shaping students' social competencies to enhance their career opportunities".

In addition to its advantages, teamwork also has disadvantages.

The main weaknesses of teamwork in project-based learning, as described in a publication (Alves et al., 2012), mainly relate to the lack of clear alignment between the expectations of team members and the actual role of the supervisor. Key problems of teamwork during project implementation include time management problems, lack of commitment of some people in the team, the emergence of a hierarchy and a leader, as well as conflicts, increased time for decision-making and lack of motivation to work. The joint work of students can become a critical problem, as it requires much more effort than individual work.

On the one hand, in surveys described in a publication (Saghafian & O'Neill, 2018), students highlighted challenges that led to negative team experiences, including evasion of tasks by team members, conflicts related to the process of solving project tasks, and lack of participation in team meetings. On the other hand, in an article (Hassanien, 2007), the research shows that students consider inadequate communication between participants in the team and poor attendance at team meetings as the main challenges they face during teamwork.

The purpose of the article was to analyze and evaluate teamwork in the context of advantages and disadvantages. Based on a case study, during teamwork with logistics students, an attempt was made to creatively solve the research problem posed by the lecturer, which is as follows: How to creatively, during teamwork, solve a complex economic problem?

The task was to determine economic indicators individually in a classical way, and then in teams using computer programming and creative (lateral) thinking according to de Bono's (2008) six thinking hats scenario.

3. Research methodology

The main part of the research was preceded by a literature study to analyze and evaluate teamwork, and then determine its role in the process of student education and the creative process that fosters creative thinking.

The preliminary research also made it possible to determine the essence of teamwork, its advantages and disadvantages.

The following methods and research tools were used in the study:

- The survey was conducted on a group of 74 students. It included 20 questions aimed at conducting an analysis of students' familiarity with and attractiveness of selected innovative teaching methods. The questions were based on a five-point Likert scale – from least to most attractive. Questions were also used to create a hierarchy of the best ways of doing things. The entire results were presented using box, pie and bar charts;
- Analysis of economic indicators. Two economic indicators were analyzed to determine the contribution of the product group to the company's profitability and demand profile:
  - The first indicator: direct product profitability (DPP) refers to the contribution to company profits made by a specific product, which is calculated by: adjusting the gross margin for each product to reflect contract terms, deductions, discounts, identifying and examining costs that are directly attributable to a specific product;
  - The second indicator: the coefficient of variation (CV) determines how a group of observations varies with respect to a certain characteristic, such as demand. It is used to check whether a characteristic is statistically significant, that is, whether it is sufficiently variable.
- *Visual Basic for Applications* (*VBA*) computer programming. *VBA* as a programming language allows the creation of macro-commands, which are complex functions that allow several operations to be performed simultaneously. *VBA* is used to solve both simple tasks, such as entering large amounts of data into a document, and complex problems. Using *Microsoft Excel* spreadsheet, two procedures using *VBA* computer programming were developed and verified in a case study based on quantitative data. The article also presents a case study. It presents an example of the 4-step creative process according to Griffin (2024).

4. Research

4.1. Creativity in teamwork: survey results

After analyzing the literature on teamwork, a survey was conducted among students in the logistics field related to this problem.

The purpose of the survey was to gather information on student satisfaction with logistics education, as well as to identify students' familiarity with creative teaching methods and assess their attractiveness. The survey, containing 20 questions, was conducted on a group of 74 respondents. 30% of respondents were women, 69% were men, 1% of respondents were unwilling to indicate gender. The key question in the survey concerned the hierarchy of teaching methods, indicating which of the above-mentioned teaching methods should be implemented into the educational process. Based on the survey results, it was concluded that teamwork and innovative forms of transferring knowledge by instructors are important for students in the education process (Figure 1).

In the questionnaire, students commented on the hierarchy of teaching methods, indicating which of the listed teaching methods should be implemented in the educational process. They overwhelmingly (91%) indicated that the implementation of teamwork elements in practical classes would make the classes more attractive. Students also showed interest in participating in the creativity incubator, a series of workshops led by creative thinking coaches (Figure 2).

Based on the results of the survey, it was concluded that teamwork and innovative forms of knowledge transfer by instructors are important to students in the educational process. According to survey responses, students place the greatest importance on the teacher-student relationship, believing that the university teacher should be the student's guide in the journey for knowledge. They believe that a good teacher should allow them to develop, succeed and

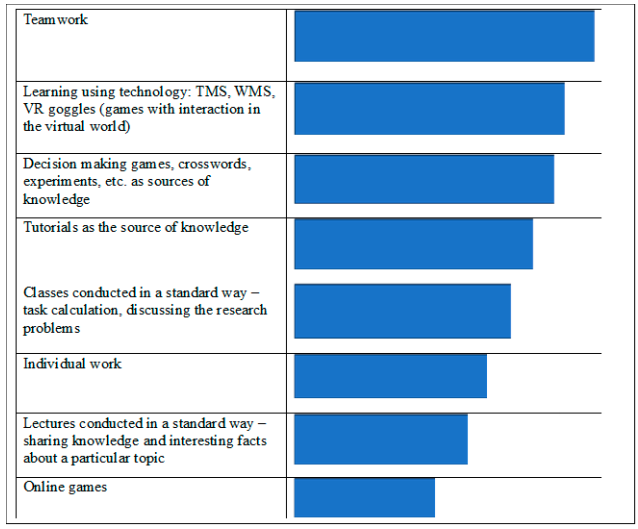


Figure 1. The hierarchy of the way classes are conducted (source: created by author)

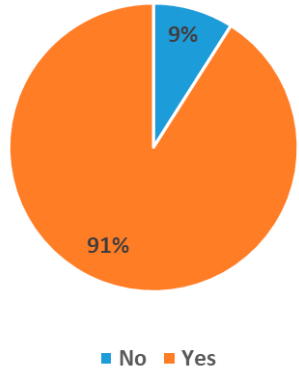


Figure 2. Teamwork as the best way to teach (according to students) (source: created by author)

build self-esteem. They should be aware that the class includes students, each of whom is an individual, with their own dreams, hopes, strengths and weaknesses. Respondents also provided answers regarding the most peculiar teaching methods they encountered. 68% of respondents indicated that none of their classes were implemented using innovative forms of teaching during their studies.

Student responses to the survey indicated that there is a real need for the development and implementation of class plans based on creative teaching methods.

4.2. The creative process in teaching: a case study

The case study relates to practical classes conducted with students in the logistics field. Students in teams solve a problem on the analysis and evaluation of selected economic indicators according to a 4-step creative process. According to Griffin (2024), the creative process consists of four stages:

- Preparations;
- Maturation;
- Insight;
- Verification.

In the preparation phase the academician plays a major role. They familiarize students with the theoretical aspects of the problem under study and enable them to quickly begin their thoughtful creative work. At this stage, the lecturer (teacher) explains to students the essence of selected economic indicators and discusses how to use them in practice. Griffin (2024) believes that formal education, as an effective way to get acquainted with the body of knowledge and scientific research, and the involvement of a teacher can be one of the effective ways to ensure a good start and the beginning of creative work. Two indicators were analyzed:

- DPP;
- CV.

DPP determines the contribution to the company's profits made by a particular commodity. After adjusting the gross margin of the product and determining the costs attributable to

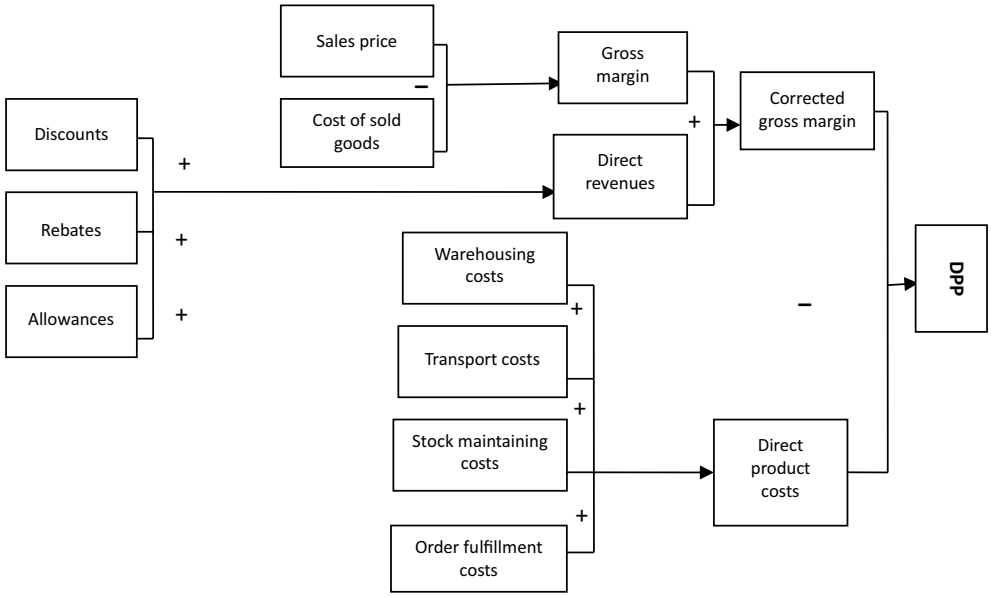


Figure 3. Direct product profitability algorithm (source: created by author, based on Bookbinder & Zarour, 2001, p. 185).

a particular commodity, it is necessary to examine whether it is more cost-effective from the point of view of reducing the cost of service to change the product feature (type of packaging, loading unit, *etc.*), or, for example, to increase the frequency of deliveries or streamline certain logistics processes (de Luca, 2018, pp. 43–76; Bookbinder & Zarour, 2001) (Figure 3).

The CV is a measure of relative variability. It denotes the ratio of the standard deviation to the mean:

$$CV = \frac{\sigma}{\bar{S}}. \tag{1}$$

It belongs to measures of dispersion (it is included in both classical and positional measures) and helps determine the degree of variation in the value of a variable. It also allows assessing the risk for an investment. In addition, it is an excellent tool for making the best investment decision (Abdi, 2010; Calif & Soubdhan, 2016; Jalilibal et al., 2021).

In the maturation phase, unlike in phase I, students begin working in teams. Their ideas gained in the preparation phase develop and guide them. The essential phase in the creative process is the insight phase, also called the spontaneous breakthrough. It is an amalgamation of all the students' ideas carried over from the maturation phase. Applied to the team, "brainstorming" groups all thought patterns, into one completely new idea. In this phase, students "under the watchful eye of the lecturer" solve the studied problem in a different way, *i.e.* using the advanced capabilities of *Microsoft Excel* spreadsheet. For the first of the metrics discussed – DPPs use the "function" procedure in *VBA* for programming. The developed so-called user function called DPP has the following form (Figure 4).

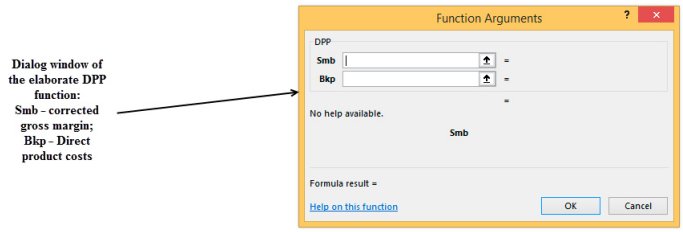


Figure 4. Arguments of the direct product profitability function (source: created by author)

The macro-command code controlling the developed function is as follows (Figure 5).

```
(General)

Function DPP(smb As Double, bkp As Double) As Double
DPP = smb - bkp
End Function

Sub mb()
Range("j9") = Range("i11") - Range("j111") + Range("k11")
Range("m9") = Range("l11") + Range("l12") + Range("l13")
End Sub
```

Figure 5. Direct product profitability function macro-command code (source: created by author)

In turn, the CV was developed in the same application, but using the *sub* procedure (Figure 6).

```
(General)                                                    v

Sub v()
Dim i As Integer

Range("i10").Activate

ActiveCell.Offset(13, 0).Select

For i = 1 To 11

ActiveCell.Value = WorksheetFunction.StDev(Range("i10:i21")) / WorksheetFunction.Average(Range("i10:i21"))

ActiveCell.Offset(0, i).Value = WorksheetFunction.StDev(Range("i10:i21").Offset(0, i))
/ WorksheetFunction.Average(Range("i10:i21").Offset(0, i))

Next i

End Sub
```

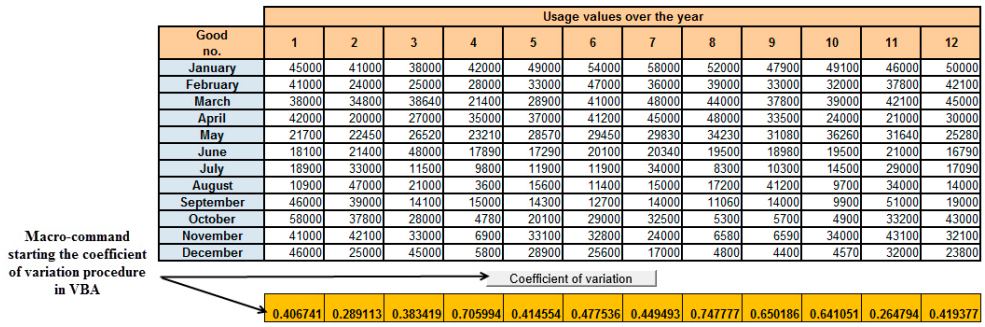
Figure 6. The coefficient of variation function macro-command (source: the authors' own study)

For the DPP function, the range object was used, while the form loop was used to develop the CV function: for *i... to... next I* and *VBA* functions: standard deviation and average (mean).

In the verification phase students determine whether their ideas ("insight") actually lead to the expected results. They verify their applications by numerical example, while being aware that the ultimate test of a creative idea is verification based on real data at the recipient of the service (Figures 7–8).

Corrected gross margin			Direct product costs			
1700			480			
Sales	Purchase	Discounts, allowances	Transport costs	Warehousing costs	Provisioning costs	Stock maintaining costs
2500	1000	200	120	180	100	80

Figure 7. Verification of the direct product profitability function macro-command (source: created by author)



Good no.	Usage values over the year											
	1	2	3	4	5	6	7	8	9	10	11	12
January	45000	41000	38000	42000	49000	54000	58000	52000	47900	49100	46000	50000
February	41000	24000	25000	28000	33000	47000	36000	39000	33000	32000	37800	42100
March	38000	34800	38640	21400	28900	41000	48000	44000	37800	39000	42100	45000
April	42000	20000	27000	35000	37000	41200	45000	48000	33500	24000	21000	30000
May	21700	22450	26520	23210	28570	29450	29830	34230	31080	36260	31640	25280
June	18100	21400	48000	17890	17290	20100	20340	19500	18980	19500	21000	16790
July	18900	33000	11500	9800	11900	11900	34000	8300	10300	14500	29000	17090
August	10900	47000	21000	3600	15600	11400	15000	17200	41200	9700	34000	14000
September	46000	39000	14100	15000	14300	12700	14000	11060	14000	9900	51000	19000
October	58000	37800	28000	4780	20100	29000	32500	5300	5700	4900	33200	43000
November	41000	42100	33000	6900	33100	32800	24000	6580	6590	34000	43100	32100
December	46000	25000	45000	5800	28900	25600	17000	4800	4400	4570	32000	23800
	0.406741	0.289113	0.383419	0.705994	0.414554	0.477536	0.449493	0.747777	0.650186	0.641051	0.264794	0.419377

Figure 8. Verification of the coefficient of variation function macro-command (source: created by author)

5. Discussion and conclusions

The overall conclusions of the survey are as follows.

Students perceive the university as a center that can contribute to the development of their creativity. Students believe that creative thinking should be fostered through appropriate curricula and assignments designed to reveal students' creative potential. They also claim that teachers can support their creativity by introducing unconventional teaching methods. Based on the results of the study, teamwork and innovative forms of knowledge transfer by instructors were found to be important for students in the educational process.

According to the author of the article, a key aspect in the education of the student-future engineer will be the creation of their own learning path, monitored by the academic teacher academic, allowing, thanks to the involvement of the student, to move into the area of independent work using the available research and teaching potential. It is important that the future engineer learns about the possibilities, and is able to choose the right solution for him or herself and map out decisions in future professional work. The role of teacher will be to indicate how to read the developed decision map, without suggesting and imposing a way to solve the problem.

Mareque et al. (2019) emphasize the need to promote the development of creativity among students. They believe that this type of competence should be promoted by universities and considered an essential tool for successful integration in the current competitive job market, especially in the business world. Spanish researchers believe that the problem at universities is that there is currently no organized, planned and conscious training in creativity. This problem is also confirmed by Burkšaitienė (2018), she also believes that universities should equip students with tools for creative thinking and creation, especially since they are a good space for promoting teaching and learning through creativity.

Researchers from universities in Spain, Lithuania, and Poland agree that facilitating relationships between students and the business world through conferences, workshops, courses, debates with business people and visits to companies play a key role in their creation of creative thinking. Students should develop original projects in project teams that could be implemented in their future business activities, and academics should support their internships and work placements during the course of their studies.

Challenges arising in society in the 21st century require the development of creativity as a competence that will be very difficult to replace with artificial intelligence. The development of creativity in students should serve the practical purposes of preparing them to solve unusual problems, deal with ambiguity, and take risks responsibly. Creative activities are often associated with chaos, a series of ad hoc activities. In reality, however, they require a well-thought-out plan and a defined structure to ensure that the learning objectives are achieved. Of course, the dynamics of the group and the course itself determine the unforeseen changes that every teacher should be ready for, but it is in the deliberate use of creative methods and a good idea for the activity that the effectiveness of the lesson lies.

Creative lessons are characterized by an individual approach to students, a different structure each time and work dynamics adapted to the needs of the group. Creative lessons are a field of experimentation for students that allows them to: gain future competencies, explore and develop individual talents, prove themselves in new roles, participate in innovative projects, and much more. Creative lessons are a field for building creativity in the broadest sense, developing the ability to use imagination, targeting purposeful creative activities, creative implementation of innovations.

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