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IDENTIFYING AND DEVELOPING AN INNOVATIVE DESIGN THEME WHEN WORKING IN A STUDENT TEAM

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Abstract: *There are different interpretations of the concept of creativity and the use of methods of stimulating the technical creativity of engineering students. The development of automotive manufacturing requires an increase in the design capacity of future engineers, with more efficient use of student team spirit and creative availability. The purpose of the research was to reveal the extent to which teamwork and the application of different methods to stimulate the technical creativity of students in vehicle design are effective in identifying innovative solutions. It was intended to follow how, in the conditions of teamwork, different methods of stimulating technical creativity can be used, and innovative solutions to the problems addressed can be identified. The brainstorming method was used to formulate several innovation themes by the members of each student team. The logigram method highlighted the steps required to solve an innovative design theme. The study proved the effectiveness of teamwork and the methods used to stimulate the students' creativity in identifying innovative technical.*

Key words: *master's students, car design, teamwork, creative solving, innovative theme.*

1. INTRODUCTION

Currently, *teamwork* is considered essential in the corporate world, being appreciated as a decisive factor in solving problems and efficiently using group creativity [1-5].

It can accept that teamwork refers to several people's collaborative efforts to contribute to achieving a common goal.

Examining the existing information in the literature, Bravo et al. noticed fewer studies on the correlations between teamwork processes and the results obtained when applying such processes [6]. They stressed the importance of the transitional stages of explaining and convincing students about the need for teamwork.

In another research paper, Bravo et al. highlighted the need for cohesiveness for effective teamwork [7]. They showed that cooperativeness and collaboration make teamwork more effective than workload and task complexity.

Curşeu and Plut observed that teaching activities in higher education generally focus mainly on the individual benefits of collaborative learning [8]. Their research led to a model in which the quality of teamwork mediates the impact of certain differences between team members on the quality and efficiency of teamwork.

Lloyd and Jackson investigated and confirmed the collaboration possibilities of the higher education institution with the inner-city educational authority [9]. They highlighted these structures' capabilities to work together to form teamwork.

Collaboration and involvement in dialogues between teachers enrolled in a master's degree university program were appreciated by Rönnerman and Olin as factors that can influence the development of professional knowledge and skills, including by considering a teacher team [10].

The characteristics of a virtual team were investigated by Charteris et al. [11]. They appreciated that in the current conditions, three characteristics could be appreciated as presenting a strategic interest for learning and professional development: relevance, collaboration, and future focus.

Knowing the characteristics and advantages of teamwork is increasingly important nowadays because fulfilling many complex tasks in the most varied fields makes teamwork necessary.

There are many different criteria for classifying the ways of working in a team, and some aspects of detail will be addressed in this regard.

The technical universities have as objectives, among others, to train future engineers to develop research and design activities. Moreover, according to the opinions expressed in the last decades, the design activity, or some of its components, is considered an applied research activity.

In principle, the design activity aims at preparing the documentation for the subsequent materialization of an object, equipment, process, or another system of activities to which the project name is assigned.

We will notice that creativity is a valid concept both within the individual designer and team. Teamwork can be a way to stimulate creativity both at the individual level and within a team's members.

In the training activities of engineers, universities have the task of providing future graduates with knowledge and skills in terms of individual and group creativity [12-17].

The design activities corresponding to the different university matters follow the training of the future engineers in the direction of the efficient use of *individual creativity* and, respectively, of *group creativity*, in the case of working in teams.

An investigation conducted by Peng, Zhang, and Gu [18] revealed certain inconsistencies between the teaching activities corresponding to the university master's training in an engineering field and the real needs of the industry. The analysis led to the identification of five competencies that must be developed through university training.

2. THE CREATIVE COMPONENT OF THE DESIGN ACTIVITIES

Over the years, differing points of view have been elaborated on the significance of the concept of *creativity*.

Thus, it is considered that the Polish poet and theoretician Maciej Kazimierz Sarbiewski (1595-1640) was the one who first used the concept of *creation*.

Many years later, the English mathematician and philosopher Alfred North Whitehead (1861-1947) resorted to creativity when explaining his metaphysical scheme [19].

The American psychologist Gordon Willard Allport (1897-1967) attempted to define the concept of *creativity*.

In a paper published in 1937, Allport appreciated that creativity refers to an integrative way in which the human being managed not only to understand, reproduce and solve the many problems generated by life, profession, and environment but also to a set of qualities likely to lead to the identification of new and original solutions [20].

Waks and Merdler highlighted the circumstances that can stimulate creative thinking among Israeli students while approaching design activities [21]. They considered to be essential the sensitivity to the detection of less investigated areas and the ability to develop numerous and different innovative ideas to solve engineering problems.

Lassen and Nielson investigated some ways in which advanced academic knowledge and creativity can be combined through the activities of a creativity camp [22]. They appreciated that an efficient manifestation of the abilities to develop and implement innovative ideas is possible under the analyzed conditions.

Establishing the design topic is usually placed among the first stages of design activity. The design topic can be an imposed task, and then creativity intervenes at a higher level than the designer, the coordinator of a design structure.

At other times, the designer himself must establish his design topic.

Although no one can deny the importance of individual researchers' and designers' efforts, the reality has proven that in most situations, the research and design activities make collaboration necessary for the specialists involved, so the actual existence of *teamwork*.

The automotive field is a field of acute current interest. Creative design and future engineers' training must be better known and applied.

Through this paper's content, we aimed to highlight how some issues regarding establishing and developing creative design activities within groups of students from a master's training programme in the car design field or fields related to it were addressed and solved.

The research activity aims to develop investigations to identify and systematize new or improved knowledge in various fields specific to human society.

The opinion that there are two main ways of materializing a design activity was expressed: *routine design* and *creative design*.

When a project has to be completed quickly, the routine design is used when there is no need or obligation for the completed project to contain new or improved elements compared to known solutions.

The realized project must not infringe intellectual property rights even if known solutions are used.

Sometimes, achieving improvement or a fundamental change through the project is a straightforward task compared to the known solutions. In this case, we must consider a creative design.

The continuous evolution of the material civilization of humanity is based on the active practice of creative design.

3. HYPOTHESES

The master's degree programme in car design conception and management was intended to provide graduates with the knowledge and skills necessary for research and design activities in the field of cars and the context of testing and maintenance of cars.

It was assumed that students enrolled in the master's programme have a high potential for creativity, and this potential could be used more effectively. Many students showed a real interest in improving their knowledge of car design, when they were previously involved in research and practice activities relating to this field.

It was also considered the hypothesis that, through their efforts, teams of 3-5 students could identify, address, and develop innovative topics related to car design and management. It was taken into account that the coordinating professors of the different specialized matters could ensure general monitoring of the project work, but transferring to the student teams the responsibility of making decisions on how to solve the various problems that may be encountered.

The professors were asked to help students acquire critical thinking and problem-solving skills handy to identify and develop innovative topics.

The sample included 10 groups of students (about 200 students, for a period of 10 years) who attended a master's program in the field of car design, at the "Gheorghe Asachi" Technical University in Iasi, Romania.

One of the main objectives of a group project and team assignments was to improve the students' skills and their willingness to work in teams. A student teamwork in the automotive field, established for didactical purposes, should activate as *a corporate team*. The team performance criteria are similar to those of the corporate team.

4. DESIGN AND METHODS

The team activity evaluation is done according to the quality of the project deliverables (technical report, business plan, executive summary, or poster), team synergy, ability to work to deadlines, and creative and innovative skills.

Project deliverables or team's documents include a list of innovative ideas generated through the brainstorming session, a diagram of ideas for choosing a technical solution, calculus and CAD modeling, branding items (team logo, product logo, team slogan, or a simple logo and slogan), market analysis and financial information.

Usually, the individual evaluation is difficult to make because the team members' activity and involvement are different within the same team. The teamwork obtained results are more than the sum of the working alone results only if the synergistic effect is achieved. Student teams do not face administrative issues, but it is possible to have social loafing or conflict negotiation issues. Somewhere the students lack building

effective teams, and it is suggested to incorporate team building as a subject in the curriculum of all professional courses [4].

The first step in building effective teams is *choosing the team members*.

Due to the prominence of teamwork in organizations and companies, the team's members have worked together for a long time. On the other hand, team members in universities usually do not know each other well, which often influences their activity.

It is possible to choose the team members in three ways: aleatory, voluntarily students coming together (social groups), and team members defined by teachers. Each solution has its advantages and disadvantages, and the selected way influences the results. Neither students nor employees usually work in a friendly environment.

Regardless of the pre-existing relationship between team members, the ability to work in teams should not affect the project results. Some principles of the delicate and challenging task of appointing the team were analyzed in [5], where the two major aspects for designing effective teams are presented: *team human capital* (resources of team members in knowledge, time, know-how, attitude*)* and *the social capital of the team* (quality and quantity of the relationships within the team and between the team and the social field).

Another approach proposes a questionnaire as a simple method for forming effective teams [16].

To stimulate the faster familiarization of the team members with each other, some facilitators granted self-selecting credit in compliance with certain conditions. For example, Mello recommends self-selection but encourages students to use interviews with potential future team members to assess their compatibility with the topic's requirements and objectives to be solved [23].

Bahr et al. proposed a scale that practitioners can use to assess professional learning. The scale considers five factors for assessing problem-solving effectiveness [24].

In terms of team structure, which is established in a period of working together [12], three categories of teams can be identified: *fragmented team* (members constitute a set of small entities rarely collaborating), *the team in halves* (team members are divided into two small teams which work separately) and *the team as a whole* (the team members collaborate as a single unit).

The leadership established between the team members has a significant influence on the team structure. Contrary to corporative teams, where the teams have a definite leader, in a student team, the leader is developed during the first period of working together in the forming stage.

Approaching the so-called *flipped classroom instructional approach*, Baughman et al. have developed research on the assumption that there may be differences between this approach and the specific flipped settings when team conflicts are considered [25]. They found that although the two approaches had no significant differences, higher satisfaction levels corresponded to students participating in the flipped course.

The training requirements of future engineers, both to solve the advanced technical problems they face and, at the same time, to be leaders in their areas of responsibility, have been taken into account in the elaboration of university curricula. Jablokow highlighted the possibilities of using the cognitive framework for problem-solving [26].

Natishan et al. considered that increased teamwork efficiency is possible by developing a standardized team-training format, usable by both students and faculty [27].

5. ESTABLISHMENT OF THE STUDENT TEAMS AND ASSIGNING RESPONSIBILITIES

Coming from the need for efficient teams and a high-performance working environment, two different setting-up methods have been applied during the first ten years since the new car design master's degree was implemented*: self-selection teams* and *teacher-assigned teams*. It has been found that each of these two methods has advantages and a series of challenges to deal with.

Thus, in the first years, the master programme students came from several mechanical, electrical, and computer science profiles and did not know each other. The professors built the

teams to achieve a certain diversity in gender and area of expertise essential in the innovation process and a more balanced distribution of resources in knowledge between teams.

Subsequently, the composition of the group of students from the master study has changed to a great majority of male students, mainly graduates of bachelor programmes in automotive engineering. In this situation, the self-selection team method was considered the most appropriate choice due to pre-existing relationships between team members from the teaching activities carried out during undergraduate studies.

The following were noted as the main advantages of self-selected teams:

- an early cohesion of the student team was achieved; this was a significant advantage, hard to gain by less functional teams, given the relatively short period for project development (14 weeks);

- the students already knew what skills, time resources, and willingness to work their teammates have so that the partitioning of tasks and the allocation of activities within the team were somewhat easier;

- students felt more responsible for team problems and complained less about the difficulties generated by the team composition;

- self-selected teams tended to have similar knowledge and abilities, which led to better team performance.

However, the remaining players represented the major problem of self-selected teams.

The few students from other study programmes have generally been looked at with uncertainty and have not even been included in the teams, mostly of automotive engineering students.

The professor needed to intervene in their assignment in the already formed teams, in which case, usually, the other students in the

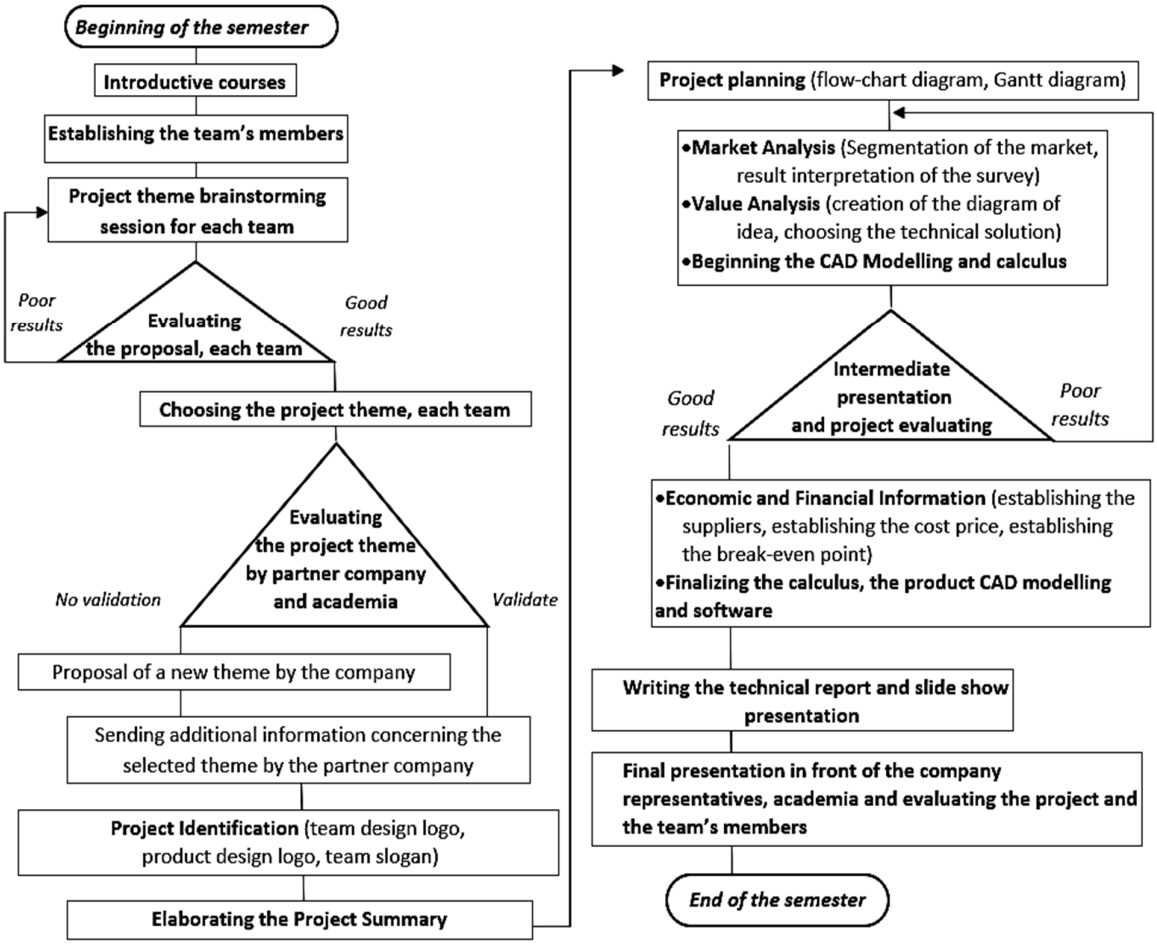

Fig. 1. Project Logigram – template.

team did not try or invest efforts for their integration.

Even though Romania's education is free and some students have a scholarship from the government, most students enrolled in master's programmes work in parallel with their studies. The ambition and sometimes the need to cover the living costs in the university town and the large job offer launched by local companies cause such a situation.

Consequently, for both ways of setting up project teams (self-selection teams and teams assigned by the teacher), the time allocated to project work and finding convenient meeting hours for all team members were still severe. However, it must be admitted that the students' professional occupations brought to their projects a more professional and realistic approach to the studied problem.

The master's programme in automotive engineering has about 20 students yearly, and they are organized into teams of 3-5 members. The team size was set to literature recommendations regarding the size of effective teams [28] and the learning objectives pursued in the project development.

7. DEFINING THE PROJECT LOGIGRAM

A flowchart could usually be a graphical representation that includes all the details regarding the organization, subordination, and, by extension, connections within a company or institution.

In Figure 1 can be observed *a logigram* elaborated by the professors.

The aim was for the team members to form a general image regarding the activities to be completed. Subsequently, the students could elaborate and finalize their organizational chart, which was closer to the activities that were to be completed until the end of the project.

An example of such a logigram elaborated by the student team members and located the activities supposed to be necessary for the development of the project is presented in Figure 2.

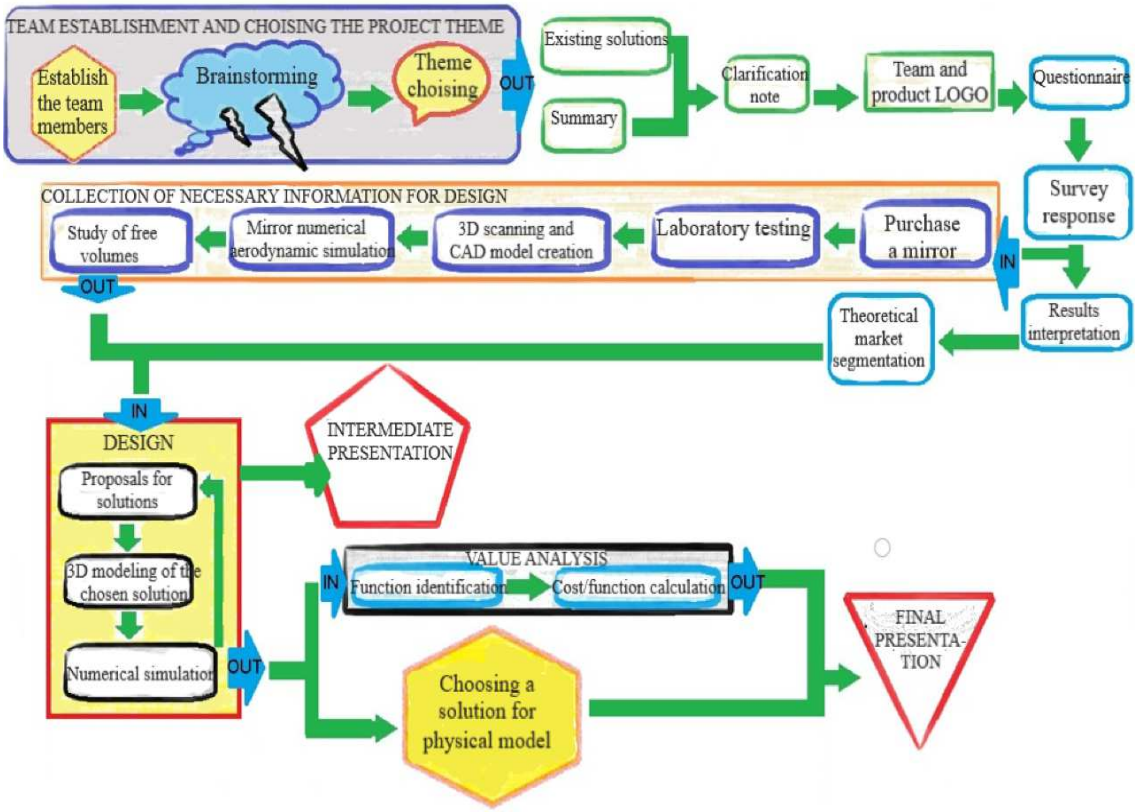

Fig. 2. Logigram corresponding to the project flowchart elaborated by a student team in the case of a solution for better vision in side view mirrors (adapted from the project having as authors Balinca, N.R., Crâşmaru, F.C., Dorin, G., Ruxandari, O., 2012).

Since this logigram was finalized in the last part of the project, when the preparation of deliverables was necessary, it is assumed that it has been corrected by considering the activities addressed in solving the project problems.

6. CHOOSING THE PROJECT THEME

Project activities carried out in technical universities represent about 15% of the total semester hours. Usually, a specific task is assigned to each student by the teacher, and a set of rigid guidelines must be followed.

The project stages are completed without any creative input from the students, only focusing on the project outcomes and final grades. This seems acceptable as long as the main or even single purpose of the students' project in engineering studies is to develop their technical skills. Issues such as potential applications, customer needs, potential market, profitability, or entrepreneurial aspects were not usually addressed in the vast majority of such activities (especially in technical projects).

All this emphasizes the lack of a broader perspective of the design activity, which should combine the project's technical aspects with the economic ones. In other words, economic arguments/reasoning to spend resources on product development are not provided.

The car design master's programme, through the curriculum and the applied pedagogical methods, was at the level of 2007, when it started operating, a premiere in technical higher education in Romania.

A particular aspect was the fact that the students were allowed to choose the project's theme.

By applying this way of working, they will be more competitive, more involved in developing the project, and more motivated to obtain the required results.

The only constraints were referring to the field they had to choose their topic from, namely automotive engineering.

The final result to be obtained, i.e., an innovative product or service, had to be described from a technical point of view and the costs involved. Another project requirement was to anticipate a potential market for the product/service [29].

Some particular aspects regarding generating the list of innovative ideas and observations derived from the experience gained in the last ten years are mentioned.

From the beginning, the students are presented with an overview of the project objectives: development of an innovative product or service in the automotive field; integrating the experience and knowledge from other courses and applying them to this project; acquiring teamwork skills.

The framework in which the project will take place is also described: lectures and tutorials held within the university's teaching spaces, teamwork meetings in a more relaxed, informal environment, and individual study sessions.

Once the teams are formed and the project is framed, students will move on to the idea generation stage through subsequent brainstorming sessions. The first stage of individual brainstorming is followed by a team brainstorming session to maximize the number of ideas that can be generated.

The scope is of creating a stimulating environment in which everyone's contribution is valued. Thus, all the students are engaged, and the team member's full experience and creativity are used. After the brainstorming sessions, students were asked to review and assess all of the ideas generated by their team.

In the first phase, the comparison of ideas between them to eliminate redundant ideas takes place. Furthermore, ideas should be compared with similar products/services in the current market, giving up those already implemented. In the second phase, the students identify the most likely idea to succeed in project development.

A set of evaluation criteria helps students make a significant decision: novelty, complexity versus team competencies, and complexity versus time allocated to the project. Within the debate framework, students are encouraged to stand up for their points of view and negotiate with teammates.

Finally, the idea accepted by all as the most promising to serve as a project topic is chosen.

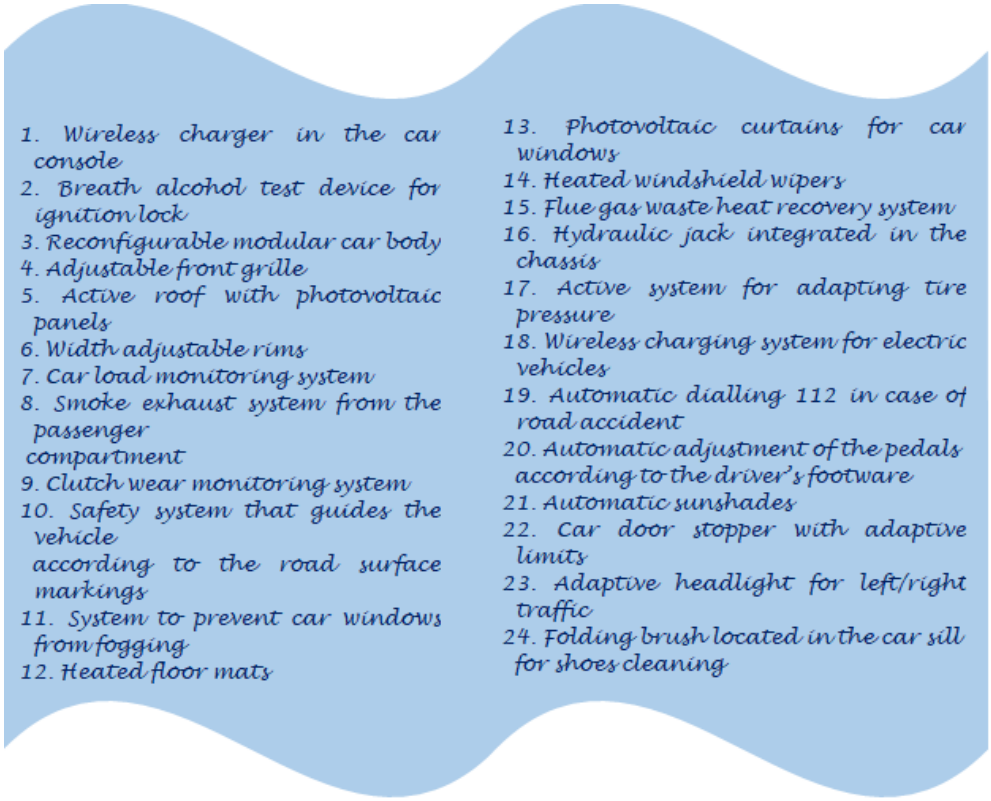

Fig. 3. Example of a list of ideas developed in a brainstorming session (adapted from the project having as authors Amarandi, A., Negru, M., Nicu, L., Țibuleac, L, 2019).

An example of a list of ideas likely to be developed by one of the student teams and which resulted, in fact, in the context of a brainstorming session, can be seen in Figure 3. The theme that was finally adopted for development within the project was the clutch wear monitoring system.

7. CONCLUSIONS

A master's degree programme was established at the university to better train future graduates in designing various subassemblies of cars or equipment whose operation was related to the existence of cars. Following the beneficiary company's requirements and those specific to a higher level of engineering training, groups of students were created. Their tasks were to identify and address innovative topics in the curriculum field. Although teachers coordinated these groups of students' activities, students' ability to make their own decisions was stimulated, from selecting from a list also developed by them the design theme and sometimes to the materialization and testing of some of the designed equipment. The teachers involved in the students' activities had in view the assimilation by the students of some knowledge and competencies able to facilitate the manifestation of their creative availabilities. In this way, it was possible to promote some interesting alternatives, positively appreciated. Patent applications have been developed for some of the alternatives identified and promoted by students. In the future, the identification and use of new methods and tools to stimulate students' technical creativity and the ability to solve through their efforts the set of decision-making issues specific to automotive research design activities will be addressed.

8. REFERENCES

[1] Galloway, P.D., *The 1st-century engineer. A proposal for engineering education reform*. American Society of Civil Engineers, Reston, VA, 2008.

[2] Slătineanu, L., Munteanu, A., Coteaţă, M., *Team and team member in the innovation process*, Proceedings of the 6th International Conference on Management of Technological Changes, Book 2, edited by C. Rusu. Alexandroupolis, Greece, September 2009, 733-736.

[3] Meredith Belbin, R., Management teams: why they succeed or fail, 3rd ed, Butterworth Heinemann. http://www.belbin.ie/management-teams-why-they-succeed-or-fail/

[4] Lather, A.S., Khatri, P., Jain, S., *Importance of teaching team-building as part of the curriculum: A need gap analysis of the student teams*, Academia Journal of Educational Research 2 (9): 142-150, 2014.

[5] Contu, A., Pecis, L., Groups and teams at work. Chap. 4 in *Introducing organizational behaviour and management*, edited by D. Knights and H. Willmott, 116-157. London: Thomson Learning, 2007

[6] Bravo, R., Lucia-Palacios, L., Martin, M.J., *Processes and outcomes in student teamwork. An empirical study in a marketing subject*, Studies in Higher Education 41 (2): 302-320, 2016.

[7] Bravo, R., Catalán, S., Pina., J.M., *Analysing teamwork in higher education: an empirical study on the antecedents and consequences of team cohesiveness*, Studies in Higher Education, 44 (7): 1153-1165, 2019.

[8] Curşeu, P.L., Pluut, H., *Student groups as learning entities: The effect of group diversity and teamwork quality on groups' cognitive complexity*, Studies in Higher Education 38 (1): 87-103, 2011.

[9] Lloyd, C., Jackson, C., *Working together to improve learning: CPD collaboration between higher education institutes and local education authorities*, Journal of In-Service Education 29 (3): 451-472, 2003.

[10] Rönnerman, K., Olin, A., *Practice changing practices: influences of Master's programme practice on school practices,* Professional Development in Education, 2021, https://doi.org/10.1080/19415257.2021.1910978

[11] Charteris, J., Berman, J., Page, A., *Virtual team professional learning and development for practitioners in education*, Professional Development in Education, 47 (1), 1-13, 2021. https://doi.org/10.1080/19415257.2021.1879215.

[12] Berglund, A., *Learning computer systems in a distributed project course: The what, why, how and where*, PhD Thesis, Uppsala, Finland: Uppsala University, 2005.

[13] Salas, E., Cooke, N.I., Rosen, M.A., *On teams, teamwork, as well as team performance: discoveries and developments. Human Factors*, The Journal of the Human Factors and Ergonomics Society 50 (3): 540–547, 2008. doi:10.1518/001872008X288457.

[14] Dodun, O., Panaite, C.E., Hennequin, X., Munteanu, A., *Concerning the introduction of project pedagogy in engineering education*, Proceedings of the 6th International Conference on Management of Technological Changes, Book 2, edited by C. Rusu, Alexandroupolis Greece, September 2009.

[15] Panaite, C.E., Dodun, O., Gonçalves-Coelho, A., *Evaluating the process of introducing project-based learning in the curriculum of engineering students*, Applied Mechanics and Materials, 657: 1078-1082, 2014.

[16] Odell, K.E., *Team-based learning and student performance: Preliminary evidence from a principles of macroeconomics classroom*, International Review of Economics Education 29 (C): 44–582018.

[17] Choe, N.H., Borrego, M., *Master's and doctoral engineering students' interest in industry, academia, and government careers*, Journal of Engineering Education, 109 (5): 325–346, 2020.

[18] Peng, L., Zhang, S., Gu, J., *Evaluating the competency mismatch between Master of Engineering graduates and industry needs in China*, Studies in Higher Education 41 (3): 445-461, 2016.

[19] Meyer, S., *Introduction: Whitehead Now*. Handbook of Whiteheadian Process Thought, edited by M. Weber and W. Desmond. Onto Verlag, Frankfurt, 2008.

[20] Căpâlneanu, I., *Intelligence and creativity* (in Romanian), Editura Militară, Bucharest, 1978.

[21] Waks, S., Merdler, M., *Creative thinking of practical engineering students during a design project*, Research in Science & Technological Education 21 (1): 101-121, 2003.
[22] Lassen, A.H., Nielsen, S.L., *Developing knowledge intensive ideas in engineering education: the application of camp methodology*, Research in Science & Technological Education 29 (3): 275 290, 2011.
[23] Mello, J. A., *Improving individual member accountability in small work group settings*, Journal of Management Education 17 (2): 253-259, 1993.
[24] Bahr, M.W., Heather, L.Q., Mirth, C.A., Birkett, K.A., Gillum, M.E., Underwood, H.M., *A tool to support the professional learning of problem-solving teams: a pilot study on the problem-solving team effectiveness scale*. Professional Development in Education 46 (3): 391-404, 2020.
[25] Baughman, J., Lesya Hassall, L., Xu, X., *Comparison of student team dynamics between nonflipped and flipped versions of a large-enrollment sophomore design engineering course*, Journal of Engineering Education 108 (1): 103–118, 2019.
[26] Jablokow, K.W., *Developing problem solving leadership: a cognitive approach*, International Journal of Engineering Education 24 (5): 936-954, 2008.
[27] Natishan, M.E., Schmidt, L.C., Mead, P. Student focus group results on student team performance issues. *Journal of Engineering Education* 89 (3): 269-272, 2000.
[28] Alexander, P.M., *Virtual teamwork in very large undergraduate classes*, Computers and Education 47 (2): 127-147, 2006.
[29] De Coster, R., Taib, S. M.. The *Commercialisation of University Engineering Projects: Entrepreneurship Processes and Practices*. In Competitive Strategies for Academic Entrepreneurship: Commercialization of Research-Based Products, edited by Szopa, A., Karwowski, W., and Barbe, D., IGI Global, 70-99, 2015.

IDENTIFICAREA ȘI DEZVOLTAREA UNEI TEME DE PROIECTARE INOVATIVE ÎNTR-O ECHIPĂ DE STUDENȚI

Rezumat: Există diferite interpretări ale conceptului de creativitate și utilizarea metodelor de stimulare a creativității tehnice a studenților la inginerie. Dezvoltarea producției de automobile necesită o creștere a capacității de proiectare a viitorilor ingineri, cu o utilizare mai eficientă a spiritului de echipă al studenților și a disponibilității lor creative. Scopul cercetării, a fost să evidențieze măsura în care lucrul în echipă și aplicarea diferitelor metode de stimulare a creativității tehnice a studenților din domeniul proiectării vehiculelor sunt eficiente în identificarea unor soluții inovatoare. S-a urmărit modul în care, în condițiile lucrului în echipă, pot fi utilizate diferite metode de stimulare a creativității tehnice și pot fi identificate soluții inovatoare pentru problemele abordate. Metoda brainstorming-ului a fost folosită pentru a formula mai multe teme de inovare de către membrii fiecărei echipe de studenți. Metoda logigramei a fost aplicată pentru a evidenția pașii necesari în identificarea rezolvării unei teme de proiectare inovativă. Studiul a demonstrat eficacitatea lucrului în echipă și a metodelor utilizate pentru stimularea creativității studenților în utilizarea tehnicilor inovatoare.

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