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Selection of methods used in industry mentoring for students of mechanics with the use of fuzzy logic

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Abstract. The paper presents the assumptions and experiences during building an e–mentoring platform in the project SEAfarers Experiential Knowledge Based MENTORS – SEA MENTORS [1]. Authors focus on showing the adaptation of industry mentoring to the university environment, emphasizing its practical dimension. We indicate the guidelines for building an e–platform based on breaking the asymmetric master-student relationship characteristic of mentoring in order to increase the individualism of the mentee in the selection of content and forms of expanding the knowledge acquired during studying., The authors decided to use the fuzzy logic tool for the analysis of the questionnaire performed among students at the Polish Naval Academy. For this purpose, a simple base of rules describing the opinion of the respondents about Mentoring was used. The rules were created on the basis of the authors' experience in this subject and were aimed at determining the need for a website and classifying the respondents into appropriate thematic groups. This is the first step in the Erasmus SEA MENTORS project.

1. Introduction

The fluid reality described by Zygmunt Bauman shows that the process of lifelong learning, understood as the constant updating of knowledge, skills and adaptation to the needs of the labor market, becomes necessary for full participation in social reality. It also conditions the chances of finding a position in the labor market that is satisfactory for an individual. It is visible today that the concept of lifelong learning has evolved from an idea where this concept was "rather a general vision and philosophy of approach to education" [2], towards a pragmatic strategy of action to serve as "an instrument for matching the supply and demand of competences on the labor market" [2]. This change forces individuals to take responsibility for shaping the course not only of their educational path, but much more broadly – their own life, including professional career. This change forces individuals to take responsibility for shaping the course not only of their educational path, but much more broadly – their own life, including professional career [3]. Moreover, the future professional careers of students will no longer be seen as a lifetime commitment to a single employer or even a profession. Rather, they are seen as selling a service or set of skills to specific employers at the right time, taking into account the tendency to destabilize them from long-term to short, individualized and tailored to the needs of individual job roles [4].

2. Mentoring in education

Traditional educational policy is based on teaching methods developed over the centuries, not always taking into account the current market needs and the students' approach to acquiring knowledge. In order to improve the quality of education and adjust the model of student education to the labor market, authors decided to introduce mentoring understood as a form of continuous improvement and improvement of competences as part of the process of continuous learning [5]. Unfortunately, the lack of formal procedures and mentoring rules, the vagueness of definitions and the multitude of forms of mentoring mean that these practices, which are used in companies, are not common at universities in Poland. The aforementioned imprecision of the definition is related to the common use of this term and its diversity. L.T. Eby pointed out that the diversity of definitions depended on the different approach to the issue itself, the multiplicity of goals, research methods, the quality of the analyzed data or the context of the research being conducted [6]. The elements causing this diversity include: the diversity of the social context of mentoring activities, the diversity of goals both on the part of stakeholders and participants of the process, the dynamics of the process itself or the formality of its conduct [7].

In author's view, mentoring is understood broadly, as a kind of "art of supporting people who want to transform dreams into goals and make the effort to achieve them" [8]. It is to become one of the good practices of support and care in science, providing alternative paths of improving its quality. The mentoring process that authors propose is built on the basis of several criteria important from author's point of view.

The first is the formula of meetings held by participants, taking into account the use of technological tools. Authors decided on virtual mentoring [7] also known as e-mentoring [8] carry out in the form of an e-mentoring platform with discussion forums, chat rooms, materials, recorded lectures, materials, programs and scientific videos available to students. This form was chosen by students as attractive due to the greater availability of materials at any time and place. It is also perceived as more attractive due to the logistics related to the lack of the need to travel to meetings to specific places and greater availability of mentors at any time for both parties. The e-mentoring formula of meetings gives a wider chance of matching the second criterion, which is the needs of the mentored. The selection of various forms of support has been analyzed in the context of education, which today constitutes an individual need in the process of education, training and professional development. Here we see learning as a permanent, complex, multi-faceted process, becoming more spontaneous than it used to be [8]. It can be compared to complex "educational episodes of various length and significance, scattered along the entire biographical line of an individual, sometimes taking a surprising sequence and located in multiple social circumstances" [10]. The mentoring platform is flexible, taking into account various models of cooperation and support and giving the mentee the possibility to choose various forms, content and types of additional activities going beyond the traditional school system [11] [12]. Thanks to this, it is limited the reduction of individualism by imposing actions by mentors, giving the mentee the possibility to choose various forms of support adapted to their current biography. Students have the opportunity to set short–term goals related to the acquisition or completion of specific specialist knowledge in the field of marine mechanics or related fields of study. Authors were based here on specialist mentoring consisting in shaping specific competences of students in accordance with the assumed area of knowledge, i.e. mechanics. Students will be able to acquire and expand knowledge in the field of: theory and construction of a ship, ship engines, ship power plants, technical mechanics, auxiliary devices, materials science, ship automation, electrical engineering, repair technology, alternative energy sources, Computer Aided Design / Computer Aided Manufacturing, artificial intelligence, but also specialties related to mechanics, such as navigation, logistics, weapons, security and transport. A distinctive feature of mentoring in science is also its open character associated with focusing on more than one goal and long–term nature. Therefore, participants in the process have the opportunity to redefine their knowledge, expand their skills and soft competences, and set long-term goals in the area of work organization and planning, career, and communication and relationships in the work environment. Here come to the third

important criterion for selecting a mentoring model – forms of support. Mentors will be able to improve the workshop of their work using various tools proposed on the platform, such as: forum conversations with mentors, thematic interviews with a mentor (recorded interviews that can be played at any time), individual conversation with a mentor – asking questions in the form of a chat, online meetings with employers (webinars), videos on professional topics, applications and programs supplementing knowledge in a given topic, helpful links to websites and portals dedicated to their specialty, dedicated to specialist literature and scientific journals.

It is visible that the area of content and forms of assistance in the mentoring process has been expanded to familiarize the mentored with the work environment in the mechanical industry. It can be stated that industry mentoring was transferred to the space of science, and aim at emphasizing its practical dimension of the knowledge acquired during learning, i.e. adapted to the realities [13] [14]. In this practice, a mentor is appointed to support students wishing to obtain or upgrade a specific qualification [7] from both of the above-mentioned areas (hard and soft skills). Here are a few words about the hierarchy, i.e. the mentor-mentee or master-student relationship, or actually breaking them. During designing the mentoring platform, an important element was to break the master–student relationship in order to increase the individualism of the mentee in choosing the content and forms of expanding the knowledge acquired during the studies. In many structures, mentoring is asymmetric in nature, i.e. the mentor is at a higher level of professional or scientific development, also has more professional experience or a higher level of knowledge of the discipline that represents. These are his undoubted advantages inherent in the principle of being a mentor. However, they can also cause a kind of "asymmetry trap", which is often associated with university lecturer–student systems and their assigned unequal position. Meanwhile, the process that are designing assumes that industry mentoring conducted at universities is a form of relationship carried out outside the hierarchical structures existing within scientific institutions. Its goal is to create safe spaces for open discussion, joint planning of activities and exchange of ideas in a virtual meeting place together with industry experts. It is important that it is conducted in conditions free from elements occurring in the subordinate-superior relationship. Therefore, the program, apart from mentors from universities (lecturers), will be joined by external mentors, lecturers from universities from other countries and specialists from the mechanical industry from outside the university, who will share their professional knowledge, experience and work methods. They are to become "active companions" inspiring mentees to autonomous development. In order to take into account the independence and sovereignty of an individual in science, by designing the course of the monitoring process individually tailored to the mentee, we build an educational matrix [15] indicating the expectations of potential mentee and selecting adequate forms of communication based on fuzzy logic.

3. Fuzzy logic

The determination of the coefficient value is based on the fuzzy sets theory. This approach was presented by Zadeh in 1965 [16]. This is an alternative approach to boolean logic, in which, apart from the complete belonging of a given element to a certain set or non-membership, there may be intermediate states. In fuzzy controllers, the variables that input and output to the system, called linguistic variables, are subject to a blur or the process of blurring. Functions are defined to determine the extent to which the input and output variables belong to the corresponding language variables [17].

Most often, functions are defined as: trapezoidal, bell-shaped, triangular, Gaussian, and sigmoidal [18]. The fuzzy inference system is based on the premise – conclusion rules. They can be any logically complex sentences. The rule base is usually based on expert knowledge.

One of the results of fuzzy logic is the so-called educational matrix (Fig. 1). Using the educational matrix, you can find an answer to the question of what methods to apply to personal choices or problems and the appropriate way to adapt the educational tools to the needs of students [15]. The matrix concerns four common attitudes towards education, and thus towards making changes: freedom, directive, ready-made solutions and creative solutions.

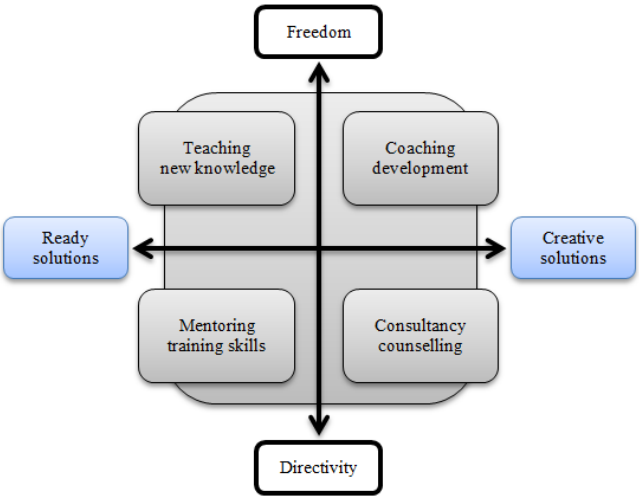

Figure 1. Educational matrix [15]

The rules fuzzy logic relationship were implemented in the LabVIEW development environment [19]. The designed program was presented in Figure 2.

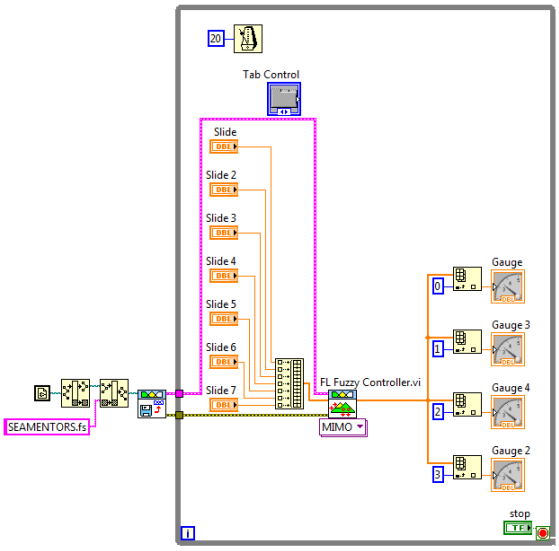

Figure 2. Program in LabView

Questionnaire was prepared and adjusted as input to the fuzzy logic algorithms. The questions concerned experiences related to the subject of mentoring, willingness to participate in the project, interest in the subject, and the question checking the mentor-mentee relationship. The tabs of the program with questions from the questionnaire were presented in Figure 3.

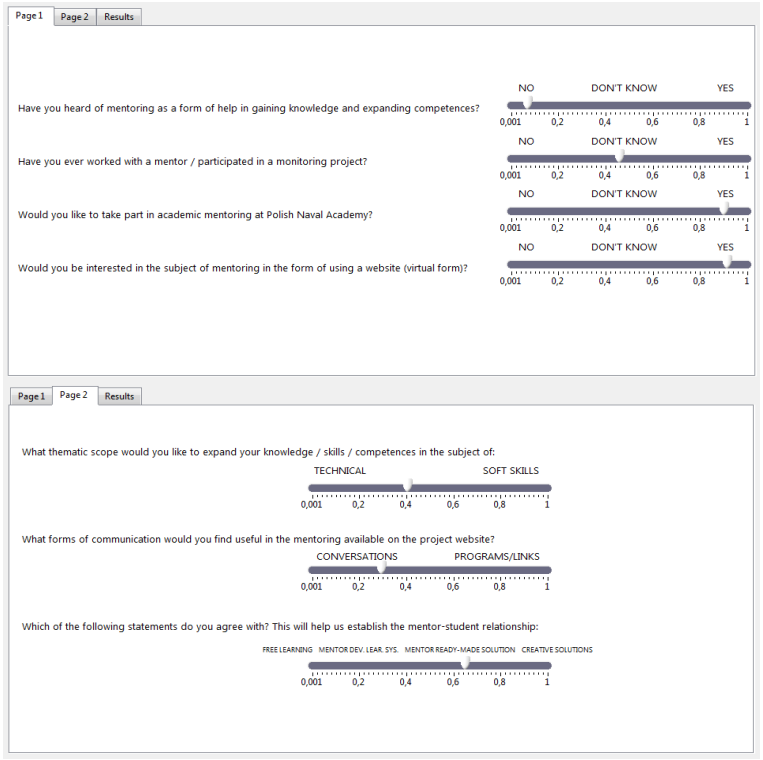

Figure 3. The screens of questions

Figure 4 shows a screen results of data entered into fuzzy logic algorithms. The results were presented in the form of indicators. These can then be used to build a participant database on the mentoring website. In the future, it is possible to use tools that use these data to make a detailed forecast of the expectations of people participating in the project and to meet the students' requirements on an ongoing basis.

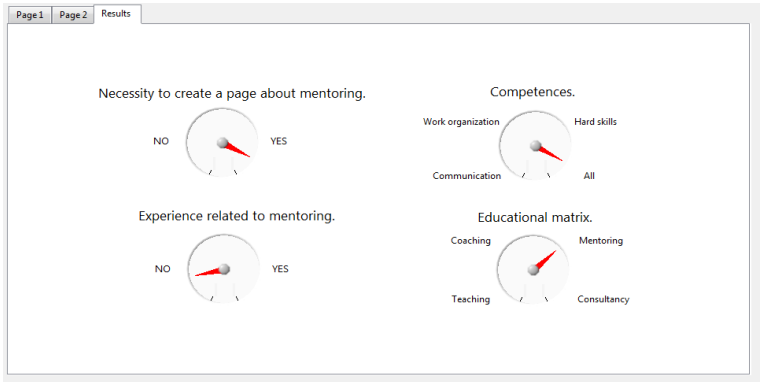

Figure 4. The screen of results

The Research were conducted among students of the Polish Naval Academy. The questionnaires were completed by students of technical and humanities departments. Most of the respondents study at the technical faculty and attend the military faculties. The data from the questionnaires were implemented to the fuzzy algorithms. All respondents see the necessity to create a mentoring page. Only 10 percent have had to do with mentoring in their lifetime. The vast majority chose all competences that would be included in the mentoring page, while the smallest group chose work organization (Fig. 5).

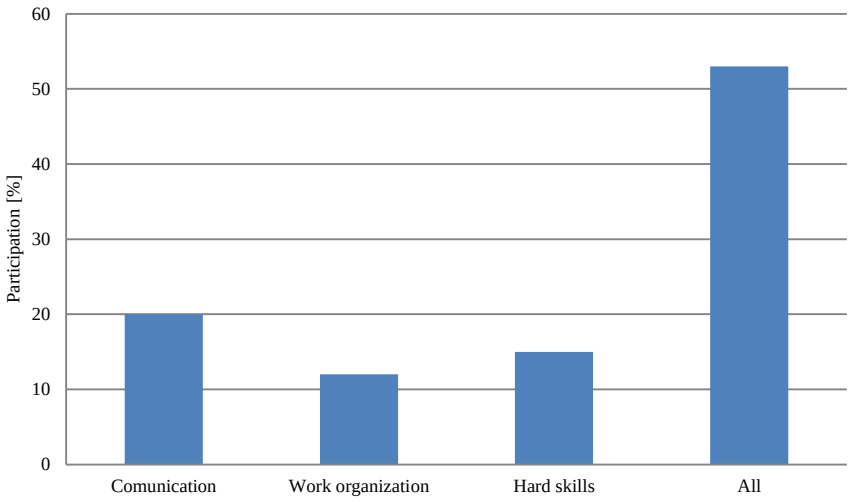

Figure 5. Results of competency research among students

In terms of the educational matrix, the vast majority of respondents were assigned to "Mentoring". On the other hand, "Teaching" constituted the smallest group (Fig 6). Such a result may indicate that the majority of the respondents belong to military students who are subjected to the rigors of military service.

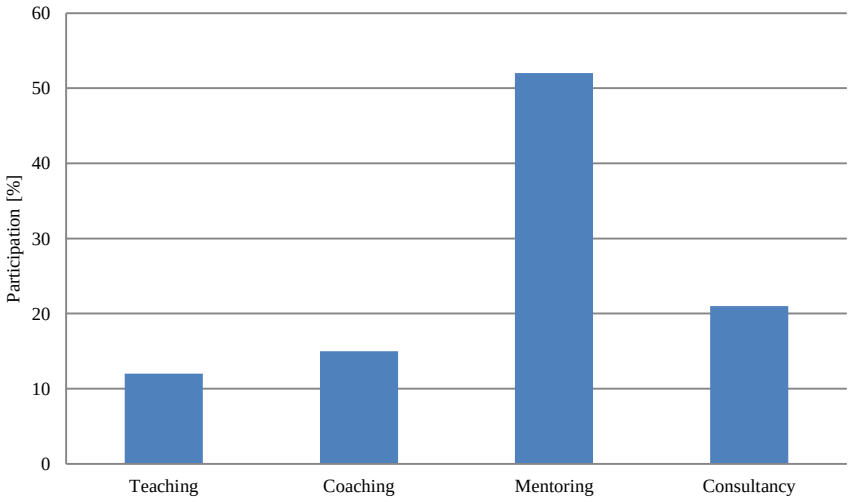

Figure 6. Results of **e**ducation matrix among students

4. Conclusions

The presented method of assessing the needs of academic students in the field of mentoring is one of the possibilities of using the fuzzy logic tool. In the dynamically developing Internet technology, the use of artificial intelligence methods supports the acquisition of as much information as possible from databases. Authors realize that mentoring programs have different goals or structure. The form which was presented in the paper could be transferred to other universities in the form of good practices. The further course of the SeaMENTORS project will result in the development of a set of guidelines that can be used in a wider social environment.

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