

FINDINGS ON MOTIVATION AND THE ENVIRONMENTAL AWARENESS AND PRACTICE OF FUTURE ENGINEERS IN ZAGREB

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ABSTRACT

This article is the result of a survey conducted on first year students of the Faculty of Mechanical Engineering and Naval Architecture in Zagreb. Heavy particles in the focus of this article are intrinsic and extrinsic motivation of students and their ecological awareness and practice. Accordingly, we wanted to examine which form of motivation was prevalent in students when choosing a career in engineering and the degree of environmental awareness and practice of those students. The results show that extrinsic elements of motivation were more important to students in terms of their future career. When it comes to environmental awareness and practices, results show a higher level of environmental awareness and practices among students. Conclusively, it can be noted that the dominance of extrinsic motivation for a career does not compromise the interest in environmental issues or environmental practices.

KEY WORDS

extrinsic and intrinsic motivation, ecological awareness and practice, mechanical engineering students

CLASSIFICATION

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INTRODUCTION

The study of mechanical engineering in Croatia, as part of a broader field of technical sciences, has gone through changes over the last twenty years, despite the specific circumstances of transition in Croatian society that similar studies all over the world have gone through or are currently experiencing. There are far too many similarities to be ignored: the decrease in interest for studying mechanical engineering in the 90s and the deindustrialization, both indicators of the state of the national economic development, the inefficiency of study and sometimes labored adoption of the Bologna model of higher education, the critical reevaluation of, not only the traditional academic engineering program which implied opening brand new areas of education and research (e.g., sustainable growth), but the professional identity and role in society of the engineer. It is not surprising then, that when addressing the need for change in the context of Croatia in the late 90s Čatić [1] uses almost the identical phrase as Beder [2] does for the context of Australia (and wider), claiming that engineering is at “a turning point”.

Research on professions, especially of mechanical engineering, is barely existent in Croatia. The situation is best encompassed by the term “white spot” of knowledge that Županov [3] used to describe the lack of research on other areas of interest in scientific research in Croatia. The situation is similar with research that might answer questions about the public perception of mechanical engineering, that is, the impressions Croatian students have in mind when making the decision to study mechanical engineering. The latter, how Croatian engineering students, freshmen that have only begun their careers in the academic world, view the study and profession of mechanical engineering, was the incentive for the research whose results are presented in this article.

The shaping of the conceptual framework of such a research is no easy task as it is carried out in a complex matrix of consulted research from all over the world, a small number of referential research in Croatia, personal research experience and the understanding of the problem based on information which should always be approached with caution, official statistics from the Croatian Employment Bureau and media speculation on the chances of employment in mechanical engineering.

In the text that follows, an overview of previous relevant research which was referenced, basic information on methodology, the sample and tools that were used, the results and finally a discussion with conclusion will be presented.

THEORETICAL FRAMEWORK

If this were a classic study on the factors that influence the career choices of future engineers then surely the starting point would be referencing already undertaken research and following already established paths. The best research to serve that purpose would be the one carried out by Reed and Case [4] in 2003 as it is a summation of the achievements in the field of mechanical engineering in the last twenty years. The authors establish four macro-categories based on the research of their predecessors and the ten categories through which the aforementioned factors are presented (which correspond to a smaller or higher degree). These categories and the research by Reed and Case are not relevant in their entirety as the scope of implies a much broader scope than the subject of work of this article. They are, however, important in those segments that help further expose the determinants of the specific area that this research entails, the category of *activities related to mechanical devices*. This implies both the physical and intellectual activities focused at interacting with devices, like personal activity in fixing, assembling or constructing new devices and the thinking up and thinking

through the theories and concepts of how hypothetical devices do or might work. Another category implied is that of the *personal career vision* which entails a specific plan of a career, flexibility and challenge in terms of intellectual stimulus and opportunity for employment diversity, rewards relating to career and the choice of that particular career as the best or least uninteresting option [4; pp.6-8]. In some ways this division into categories is too broad for this article, that is, the two categories, formed with regards to previous research, surpass the scope of this research.

On the other hand, it is necessary to take a step back and reduce the aforementioned in the context of *relative career value*, i.e. the intrinsic and extrinsic factors which are crucial for the individuals career choice as mentioned in the study by Dick and Rallis in 1991 [5]. These factors are not the focus of the study in themselves but are used as guidelines in this instance for the reader's better understanding of the research corpus. To sum up, the relative value of a career in mechanical engineering lies in both the personal vision of the career and in activities relating to technical devices. With the central point of the research now defined, next comes the description of its content.

MOTIVATION, THE EXTRINSIC AND INTRINSIC ASPECT OF ENGINEER'S CAREER CHOICE WITH FOCUS ON ECOLOGICAL AND SOCIAL ISSUES

Motivation may be defined as the willing investment of effort in aim of accomplishing a goal. Motivation, in a broader sense, is the incentive to act [6]. Based on the conditioning of that incentive we can make the distinction between external and internal factors which means we are talking about extrinsic and intrinsic motivation, respectively. Intrinsic motivation relates to the involvement in activities or endeavors for their inherent satisfaction that the individual experiences solely for participating in the act. Extrinsic motivation is related to participating in activities or endeavors for their instrumental value or recognizable expected outcome [7]. It is common place in recent times to advocate and value highly intrinsic motivation as opposed to extrinsic motivation. The reasons for this are bountiful, mostly ideological but there are also reasons that apply to many modern professions (however, this is not the subject matter of this article) whose research is almost impossible. One of the aims of this research is to show the structure of motivation in terms of extrinsic or intrinsic without going into value judgment. It should be stressed that this classic dichotomy of motivation elements in no way implies mutual exclusion or a negative correlation between the two. This dichotomy is better phrased as a scale, revised in various ways, modified [7, 8] and incorporated into various theoretical models.

In regards to the above stated, indicators of intrinsic motivation in this research are organized in five distinct groups. The groups are as follows: the statements of examinees about satisfaction and inclination towards typical perceptions about the study and profession of mechanical engineering, those statements relating to the satisfaction of solving, both mentally and physically, technical problems, the interest towards science and technology, the interest towards studying and professional activity, the willingness to acquire new professional knowledge and skill, and the individuals initiative outside the institutional environment towards professional achievement and interaction with technical devices. Indicators of extrinsic motivation are shown through "instrumental" statements about the need for a good pay, reputation, power and quick advancement.

When talking about the motivation to enroll in a college program, that is, the motivation towards a career, it is important to address the subject of ecology. This is mostly due to the fact that environmental issues, subjects of sustainable growth, are key components in the curriculum of students of mechanical engineering and naval architecture. Environmental awareness may also be regarded as important when it comes to future job responsibilities of

engineers. An engineering career often includes positions in which important decisions or project evaluations are carried out which frequently entail conflicts between personal and social interests [9]. Although there is not adequate evidence of a connection between environmental awareness and enrolment in a mechanical engineering course, environmental issues, and especially the topic of sustainable growth, have dominated the public debate on the relationship of man and the environment. It has been stated back in the 1992 document Agenda 21 that „education is key for the promotion of sustainable growth and the development of people’s capacity for handling the challenges of sustainable growth“ [10]. Many authors stress that the education of future engineers is still at an unsatisfactory level when it comes to those segments regardless of noticeable advancements. Subjects of sustainable growth are often heard at conferences [11], and there are tendencies of incorporating such subjects into schooling [12].

Consequently, the education of engineers on environmental subject, but also on subjects relating to sustainable growth, is of crucial value for the adequate preparation of mechanical engineering students for modern professional requirements. Thus, a career and career motivation imply focusing on the social aspect of the engineering practice as an integral part of a responsible and conscientious orientation towards new (sustainable?) social development.

PREVIOUS RESEARCH

Only a limited amount of data relevant for this research can be found in the scarce history of direct and indirect studies of the reasons and motivation for enrolment into college in Croatia¹. Although not completely comparable and illustrative for the purposes of this study but relatable in its subject matter is the study that shows that the motives of enrolling (journalism course) are preceded by *active (“entrepreneurial”) aspects* that examinees hold true for their profession (communication with people, information research, social impact), and *work in a chosen profession*. When it comes to expectations related to a certain field of study, examinees value *a good and adequate education* the most while finding employment in their branch is least important² [13; p.122].

Indicative for this article is the data that shows that when it comes to selecting a college, in the context of the University of Zagreb, 89 % of students’ choices was based on *the desire for a specific occupation or interest related to that occupation*, 18,5 % was based on *accident or failure at a different college*, and lastly, 16,6 % was based on *the influence of another person* [14; p.271]³.

The research most thematically linked to this one is the one in which Kesić and Previšić [15] state, among others, the motives of enrolling into economics and electrical engineering studies. Concrete questions that draw a parallel to this research are ones pertaining to the *sources of information and influences on choice of college*, a very high rate of influence by friends, students enrolled into a college and the media, and on the other hand, a very low rate of influence of professional services. Furthermore, another interesting aspect is that, *according to the time of making the decision to enroll into a certain college*, the senior year in high school is in first place, followed by the time *before enrolling into high school*. What these authors highly stress, in relation to this research, is that when it comes to statements about the *motives of enrolment/choice of college* (with statistically significant differences between faculties) the interest for a scientific area comes first, followed by the chance for employment and pay, and job appeal [15; pp.736-740]. The distinction between hedonistic (implying satisfaction in employment in a chosen field and subject of interest) and utilitarian (implying a good pay and employment possibilities) motives that these authors [15] have established relies directly on a fixed theoretical framework, but also on one of the central intentions of this article.

Along with the motivation to enroll into college and motivation towards a career, the dimension of knowledge must be observed. Knowledge about a certain subject may be linked to interest to that subject as Beder [9] has shown on the example of environmental issues. Beder [9] showed in her initial research of mechanical engineering students that students realize the importance of sustainable growth and environmental issues after receiving education in them. After the aforementioned education, 75 % of students estimated that those subjects were important for their further education.

Regardless of the knowledge of the examinees about the structure of the curriculum, it is important to reiterate that a program of study commits students to the study of a certain number of subjects relating to ecology.

The research that Azapagić [10] conducted on future mechanical engineers has shown that there is an awareness of environmental issues among students, especially those pertaining to local circumstances. Additionally, the research has pointed out that examinees perceive environmental issues as legitimate. Hence, it can be asserted that there is fertile ground for the further research of environmental consciousness and practice among future engineers as they have already acquired some initial knowledge of environmental issues before enrolling into college. The research of the mentioned subjects will provide insight into the thinking and attitudes of students towards environmental issues and the degree of adoption of certain environmental practices.

THE RESEARCH

The data for this research was collected through a questionnaire in October 2013, on a sample of 282 freshmen of The Faculty of Mechanical Engineering and Naval Architecture at the University of Zagreb. Since the total number of freshmen is 425, the sample may be regarded as representative. The sociodemographic characteristics of examinees are given in Figs 1-5. Seeing that the ratio of men to women is heavily in favor of the men, this is reflected in the sample of 81,5 % males and 18,5 % females (Fig. 1). Further charts indicate some characteristics of social background of examinees, i.e. the type of high school completed (Fig. 2). This shows that the population is dominated by high school students with 69,5 %, while vocational schools represent 29,4 % of the population. Furthermore, the number of household members (Fig. 3) shows that 87,4 % examinees live in families of four or more members. The average monthly incomes of households (Fig. 4) are very varied and can only be taken into consideration in correlation with the number of household members. Lastly, the level of education of parents (Fig. 5) shows that when it comes to lower levels of education, mothers are slightly more represented than fathers. The situation is reverse when it comes to higher levels of education.

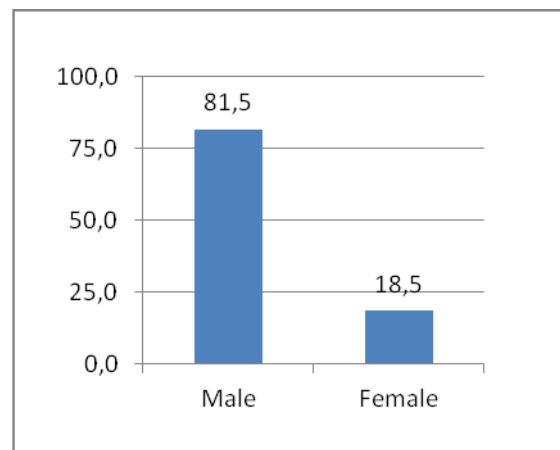


Figure 1. Sex of the examinees in percentages.

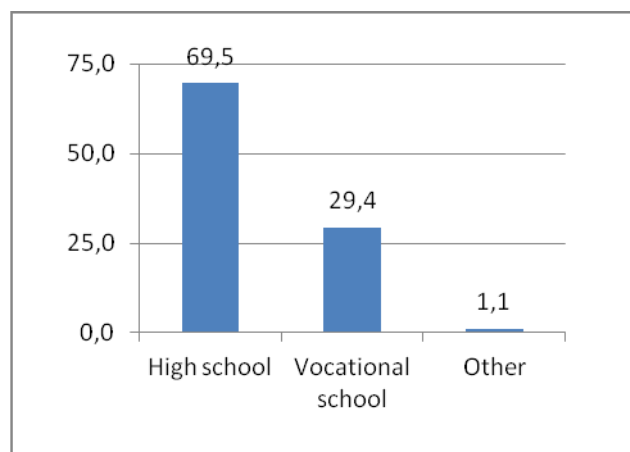


Figure 2. Secondary education of the examinees in percentages.

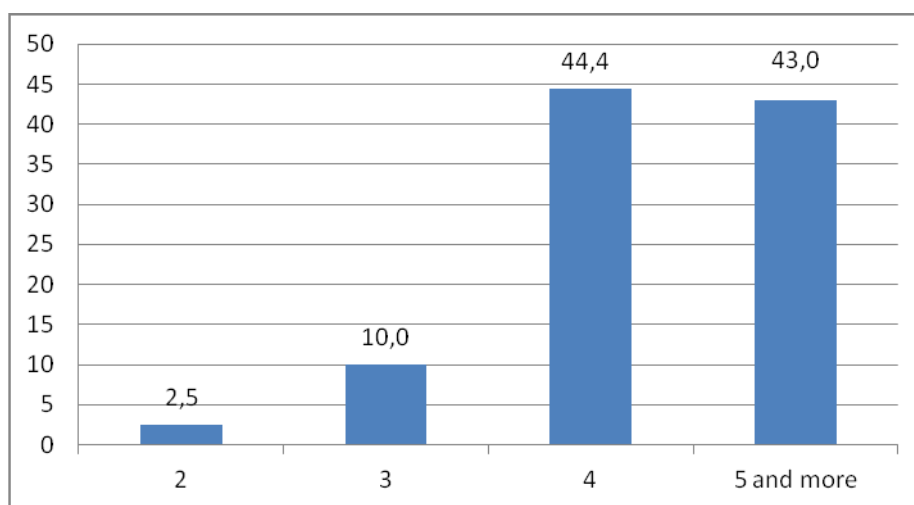


Figure 3. Number of household members in percentages.

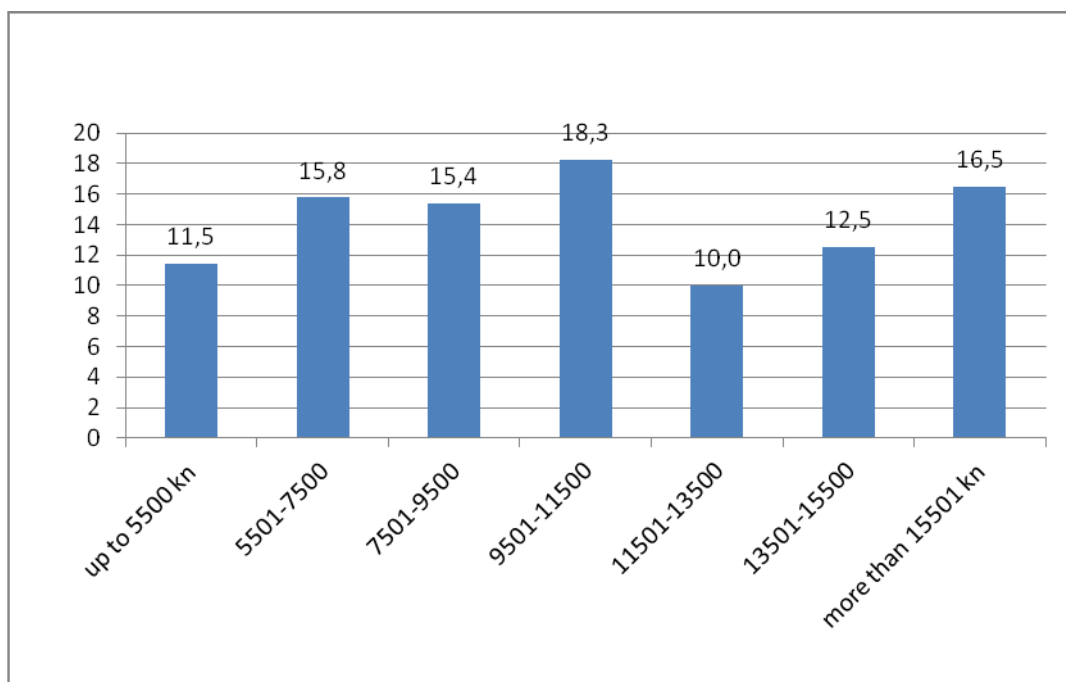


Figure 4. Average monthly household income in percentages.

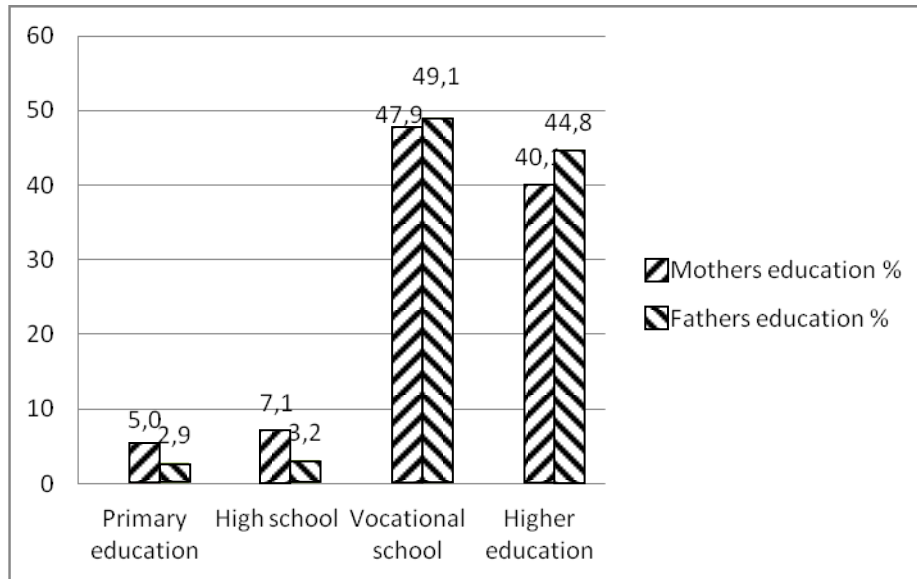


Figure 5. Parents level of education in percentages.

The questionnaire contained previously stated questions about sociodemographic characteristics of examinees as well as questions about their graded point average (GPA), Fig. 6. It is transparent from the data that there is an equal amount of A students (55 %) and B students (45 %). When it comes to priority of enrolment in potential colleges (Fig. 7) nearly 4/5 of examinees (79,6 %) stated that The Faculty of Mechanical Engineering and Naval Architecture was their first choice, with 18,3 % stating that is was their second. When asked about having engineers in close relation (Fig. 8) nearly half of the examinees (44,8 %) replied that they have an engineer as their close relative. Finally, it is shown (Fig. 9) that more than half of examinees list high school as the period in which they opted for The Faculty of Mechanical Engineering and Naval Architecture, 1/5 (21,1 %) made the decision immediately before graduation (IB in Fig. 9). What is most interesting is that 18,3 % made the decision during or after graduation (D/A in Fig. 9), which is matched by the number of students who listed The Faculty of Mechanical Engineering and Naval Architecture as their second choice for enrolment. This may be an indicator of the importance of the possibility choice change during the graduation process.

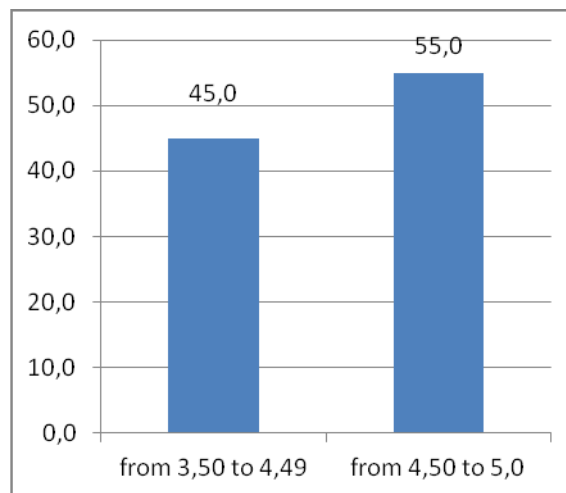


Figure 6. GPA in percentages.

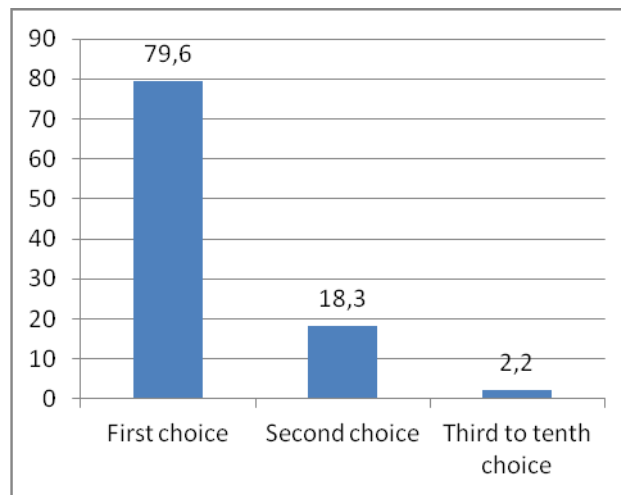


Figure 7. Priority of choice of Faculty of Mechanical Engineering and Naval Architecture, in percentages.

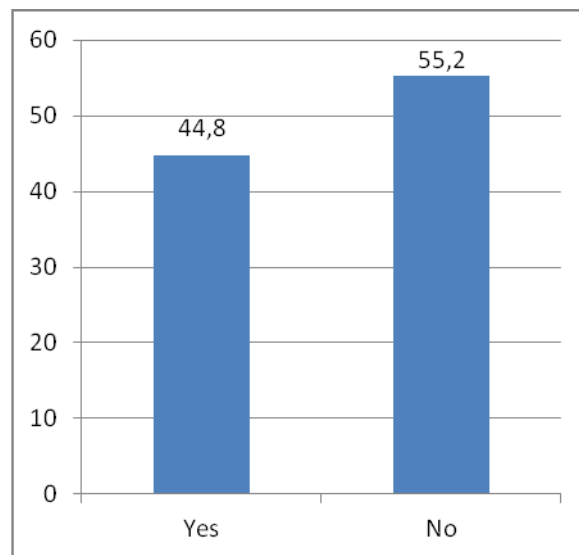


Figure 8. Percentage of examinees with an engineer in close relation.

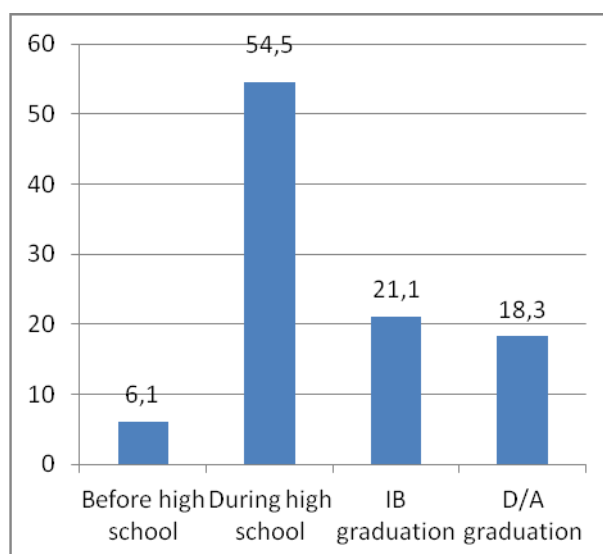


Figure 9. Moment of college choice in percentage.

Further questions, represented in four batteries relating to various influences, reasons and motives of enrolment were given to examinees. They were asked to assess on a scale from one to five: (1) to which degree each of the offered factors influenced their decision to enroll, (2) the level of motivation they have for their college of choice and potential professional future, (3) to which degree their preconceptions match certain statements about their chosen profession, (4) to what degree they were interested in proposed environmental issues and to what degree they practiced eco-friendly action. The following data is extracted from sets of questions listed from (1) to (3): (5) the indicators of influence of extrinsic and intrinsic motivation for choice of college and potential professional future. Specifically, to get a sense of extrinsic motivation, examinees had to mark, on a Likert scale (from 1 to 5) the degree to which their choice was influenced by: the possibility of quick employment in Croatia ($M = 3,4$, $SD = 1,23$), the possibility of quick employment abroad ($M = 3,79$, $SD = 1,12$), the possibility of finding an above-average paying job ($M = 3,97$, $SD = 0,94$), the possibility of quick career advancement ($M = 3,75$, $SD = 1,03$), reputation in society ($M = 3,15$, $SD = 1,31$), the possibility of decision making and influencing society ($M = 3,03$, $SD = 1,3$). The stated data is presented in Figure 10 with the summation of all factors being the variable called “extrinsic motivation”. Correspondingly, as can be seen in Figure 11, examinees were asked to determine, also on a Likert scale (from 1 to 5) the degree to which they agreed with statements relating to elements of intrinsic motivation for choice of college and career. The examinees had to assess their: interest in science and technology ($M = 4,31$, $SD = 0,8$), willingness to understand the functioning of mechanical devices ($M = 3,62$, $SD = 1,05$), tendency to attend to matters relating to objects rather than people ($M = 3,4$, $SD = 1,29$), enjoyment in solving mathematical problems ($M = 2,98$, $SD = 1,28$), tendency to solve complicated but concrete problems ($M = 3,75$, $SD = 0,95$), tendency to fix devices ($M = 3,33$, $SD = 1,16$). They were also asked to assess their agreement with the statements like: “I have always wanted to be an engineer.” ($M = 2,8$, $SD = 1,31$), agreement with the statement “This college will aid in the development of my personality.” ($M = 3,61$, $SD = 1,03$), “Whether the job interests me or not is more important than the amount of pay.” ($M = 3,36$, $SD = 1,13$). The summation of all the stated factors gives the variable “intrinsic motivation”. The indicators

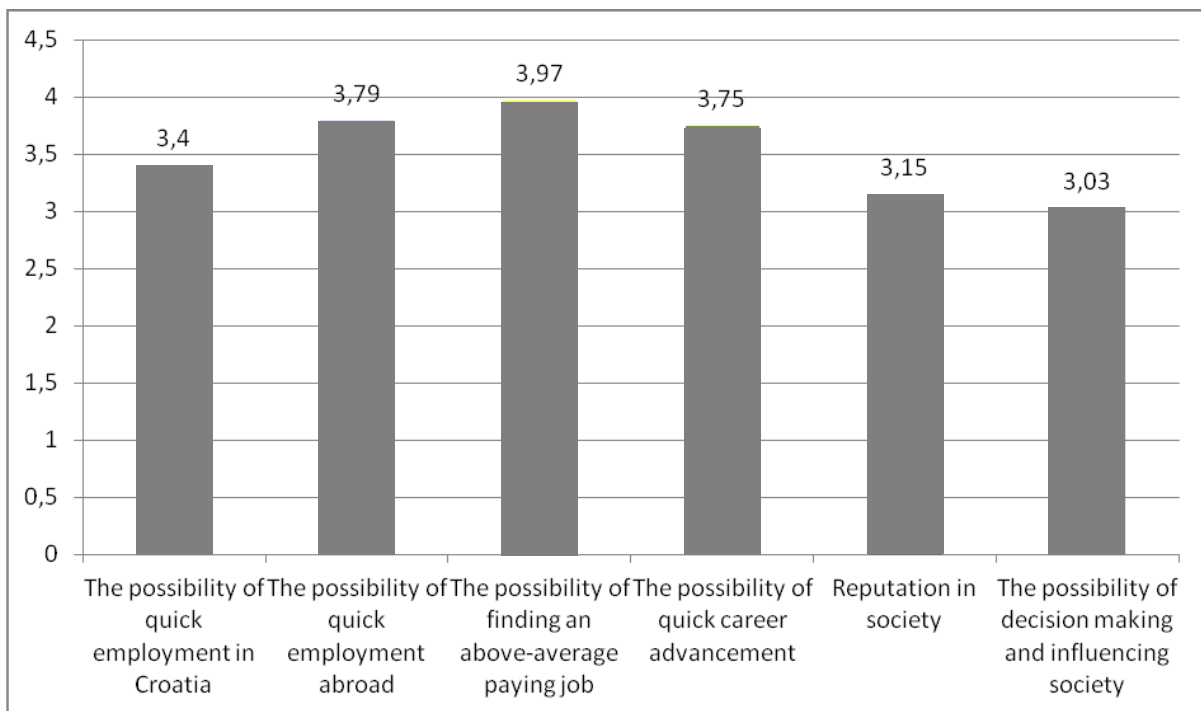


Figure 10. Arithmetic means of extrinsic motivation components.

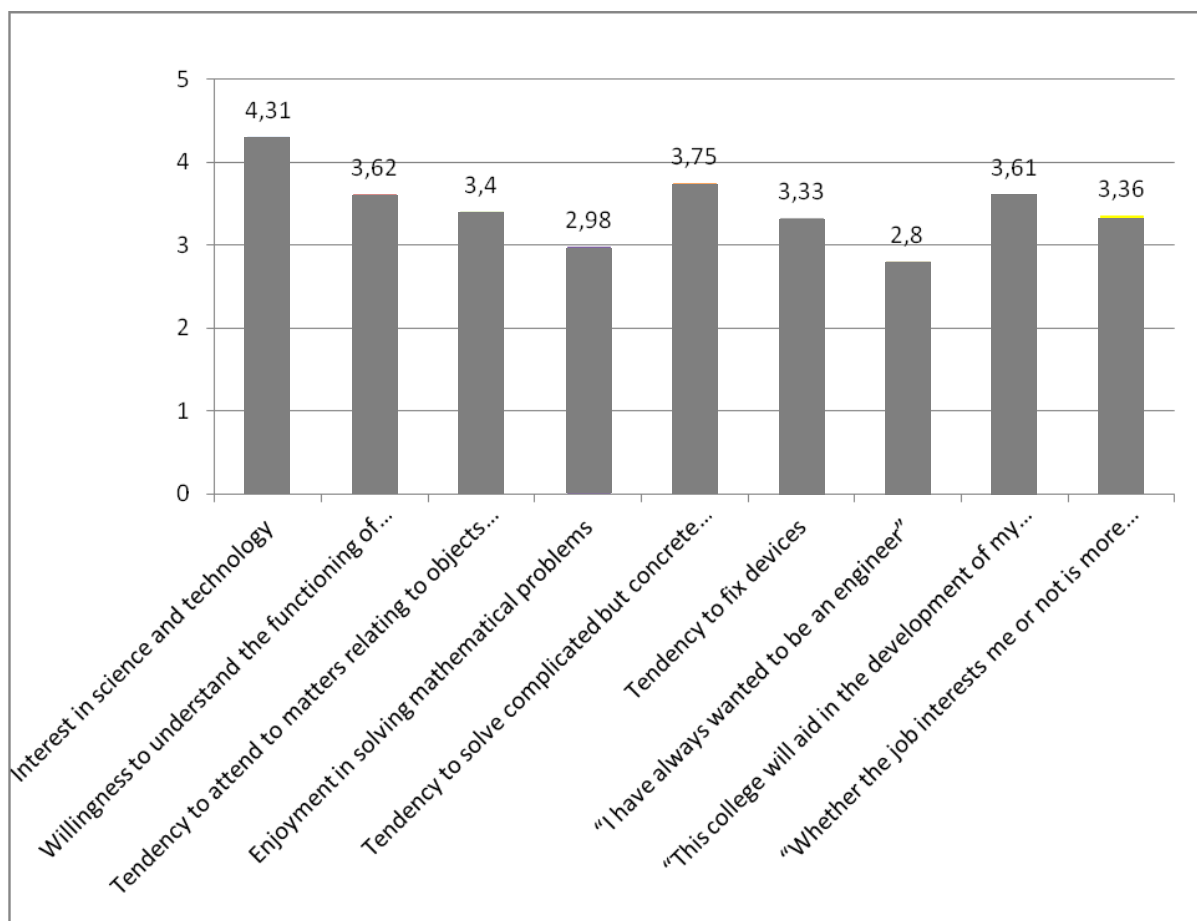


Figure 11. Arithmetic means of intrinsic motivation components.

for component (5), the extrinsic and intrinsic motivation component is derived from following the example of aforementioned authors (paragraphs on the theoretical framework of the research) [4-5], that is, their category of relevance in career choice.

The fourth battery of questions dealt with the relationship students have towards ecology. The battery was divided into two categories, that is, the summation of indicators gave two distinct variables: environmental awareness and eco-friendly practice. The first variable is the summation of 7 indicators. The examinees were asked to assess their agreement with given statements, based on a Likert scale (from 1 to 5) which ranged from *I strongly disagree* to *I strongly agree*, Fig. 12.

The statements were used in order to investigate the following indicators: *I keep track of environmental issues* ($M = 2,26$, $SD = 1,07$), *environmental issues are real* ($M = 3,95$, $SD = 0,93$), *environmental issues are exaggerated in the public* ($M = 3,21$, $SD = 1,12$), *the economy is more important than environmental issues* ($M = 3,89$, $SD = 0,97$), *society takes sufficient care of the environment* ($M = 2,1$, $SD = 0,97$), *environmental issues are important for public debate* ($M = 3,8$, $SD = 0,88$), *environmental issues need to be addressed at The Faculty of Mechanical Engineering and Naval Architecture* ($M = 3,18$, $SD = 1,17$).

The second variable was composed of four indicators by which the eco-friendly practice of examinees, whether current or past, was investigated (Fig. 13). The indicators that made the variable of *eco-friendly practice* were: *previous part-taking in eco-friendly activity* ($M = 3,39$, $SD = 1,51$), *recycling of waste* ($M = 3,12$, $SD = 1,35$), *conscientious energy consumption* ($M = 3,58$, $SD = 1,24$) and *conscientious waste production* ($M = 2,81$, $SD = 1,25$).

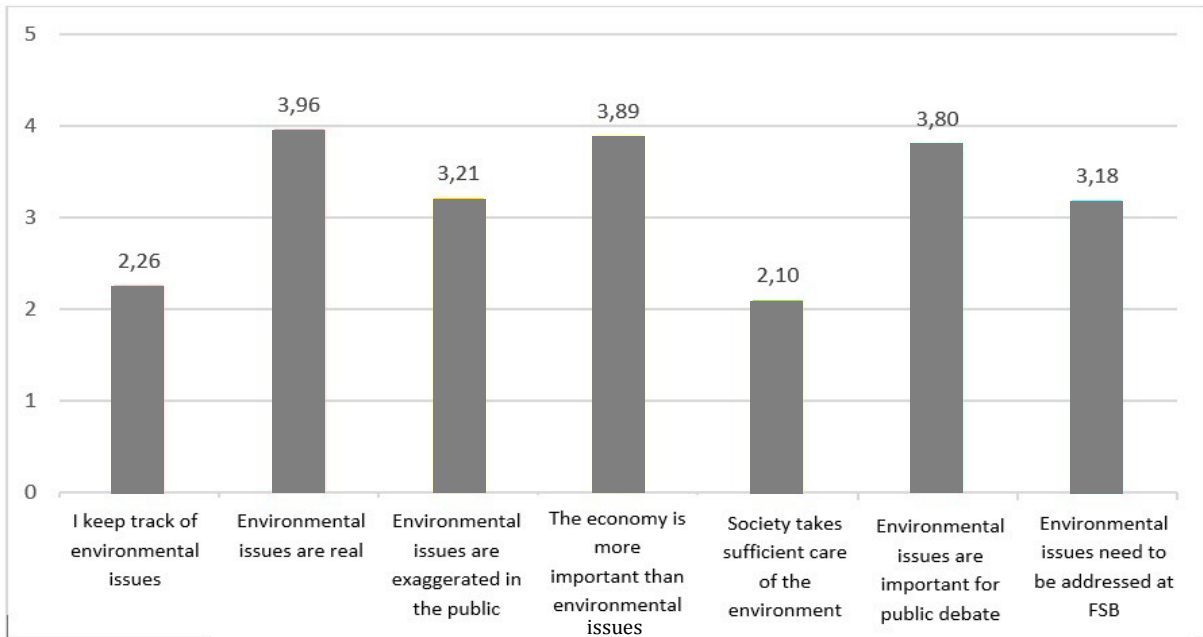


Figure 12. Arithmetic means of environmental awareness components.

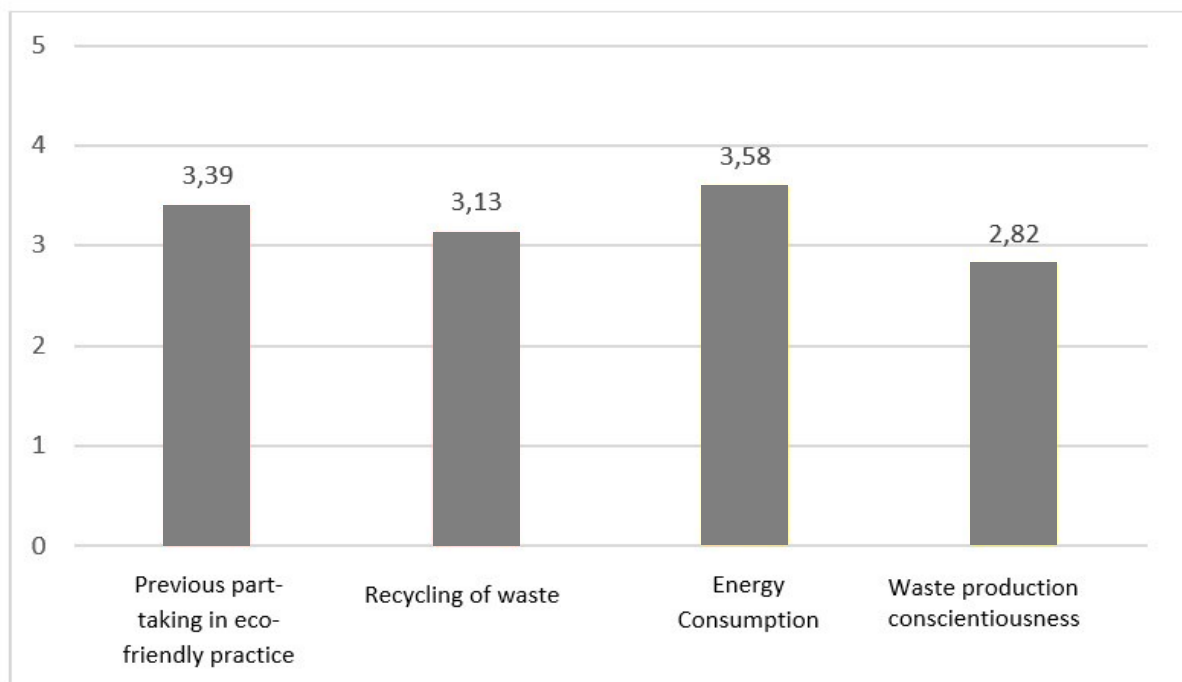


Figure 13. Arithmetic means of eco-friendly practice.

COMMENTARY AND OPERATIONS ON AGGREGATED VARIABLES

The variables relating to typical preconceptions about The Faculty of Mechanical Engineering and Naval Architecture in Zagreb were taken as indicators of extrinsic motivation for enrolment into the college. These indicators were presented in statements which imply potential rewards and benefits like material gain, reputation and power of an engineer in relation to the college and associated professions. In accordance with everything aforementioned in the paragraphs relating to motivation, the variable „extrinsic motivation“ was formed ($M = 3,64$, $SD = 0,69$). A series of statements was also provided in relation to the

enjoyment of studying mechanical engineering and naval architecture for its internal value. The variable extracted from those factors is called “intrinsic motivation” ($M = 3,47$, $SD = 0,58$).

At first glance and by simple comparison it is evident that the variable “extrinsic motivation” gives the greater value which would indicate that the motivation of future engineers is mostly extrinsic rather than intrinsic. However, the question remains whether the difference in value between the variables can be seen as statistically significant. To answer this a t-test of paired samples was conducted and yielded the following results: when intrinsic motivation ($M = 3,48$, $SD = 0,57$) and extrinsic motivation ($M = 3,63$, $SD = 0,68$), then $t(260) = -2,985$, $p < 0,005$. Chi-squared is 0,33 which shows that even though the difference in value, in favor of extrinsic motivation, is statistically significant, it is still small. Additionally, the Pearson coefficient between the two variables, though small ($r = 0,161$, $p < 0,05$), is of a positive sign, which further enforces the statement expressed that intrinsic and extrinsic motivation cannot be mutually excluded.

These results might be potentially worrying as they indicate, according to Inglehart’s division of materialistic and post-materialistic values, the valorization of economic growth and security in favor of environmental care and protection. It could be posited that the placing of personal gain and benefit before one’s impact on society and the environment points to the heritage of materialistic values. These materialistic values, on which the industrial society was built, are a sort of atavism which brings into question the survival of the entire human race [16, 17]. It is for that reason that the developed (post)industrial society tries to stimulate environmental awareness and sensibility in the individual. However, the data to follow will show whether the questioned students’ environmental awareness and eco-friendly practice is really endangered by elements of extrinsic motivation. To posit it differently, do those elements negatively affect the variables? As was the case in the research conducted by Azapagić [10], due to possible problems with interpretation of the term *sustainable growth* it has been decided that the focus of the research would be narrowed to the attitudes of examinees towards environmental issues and their previous engagement with them.

Figure 14 shows the summation of answers that can be classified as relating to *environmental awareness*. That category shows the degree to which students are interested in environmental issues and how important they consider them.

On a Likert scale of agreement with statements, the numeral 1 designates the lowest, while the numeral 5 designates the highest degree of agreement. The numeral 3 designates an indifferent attitude towards a statement.

The arithmetic mean of attitudes towards environmental issues is $M = 3,19$ with $SD = 0,54$ which suggests that the results are in favor of a positive attitude towards them. Therefore, it can be said that students are aware of environmental issues and consider them important. The overview of distribution of answers within a category gives a more precise insight into data that the arithmetic mean does not reveal at first glance. Should we extract the single statement that deviates from the pattern of eco-friendly attitudes from the summation, the result is a larger arithmetic mean $M = 3,23$ with $SD = 0,92$ which shows a significant inclination towards eco-friendly attitudes.

The aforementioned deviation is reflected in the distribution of answers to the statement *I often read about and watch content related to environmental issues*. More than half of students (64,2 %) expressed disagreement with the statement while one fifth (19,5 %) remained indifferent.

The positive lean of the arithmetic mean towards a positive attitude towards environmental issues is further confirmed by the data acquired. Most of the students partially or strongly

agreed with the statement *society does not take sufficient care of the environment* (70,9 %), however, only a negligible amount of students stated that *the influence that can be had as an engineer on the environment* influenced their motivation to enroll. More than half (57,8 %) either partially or strongly disagreed with the statement *the influence that can be had as an engineer was one of the motives for enrolment*.

The summation of the extent to which students participated in eco-friendly activities such as recycling, conscientious consumption, etc., gives the variable *eco-friendly practice* which yielded somewhat unexpected results, Figure 15. In that variable, the results ($M = 3,23$) lean

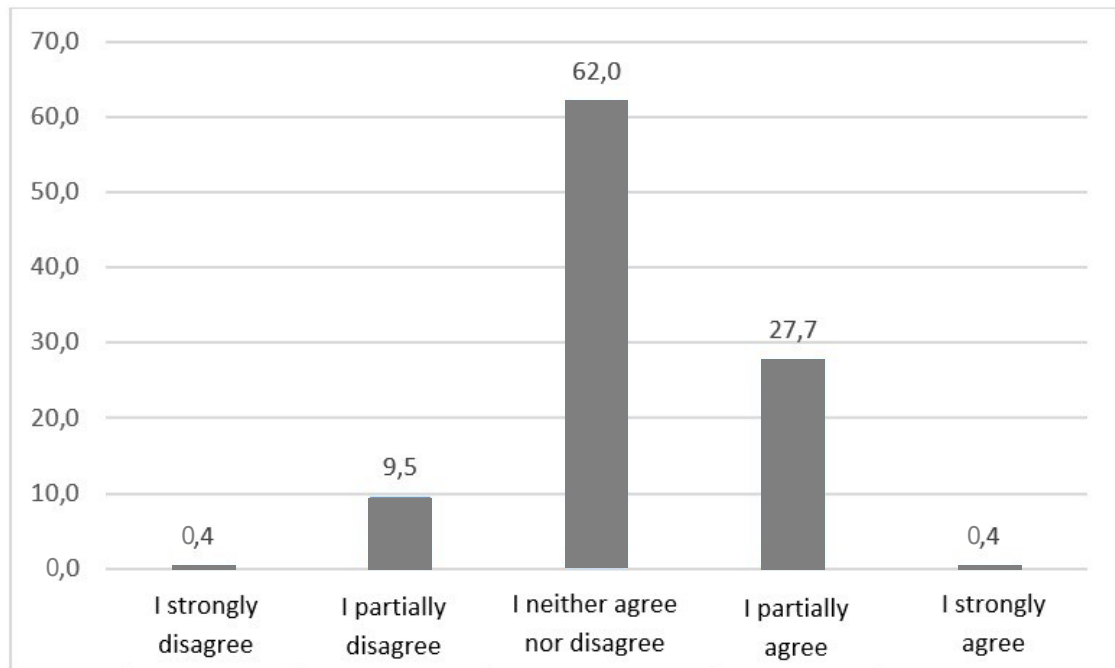


Figure 14. Degree of agreement with environmental awareness statements in percentages.

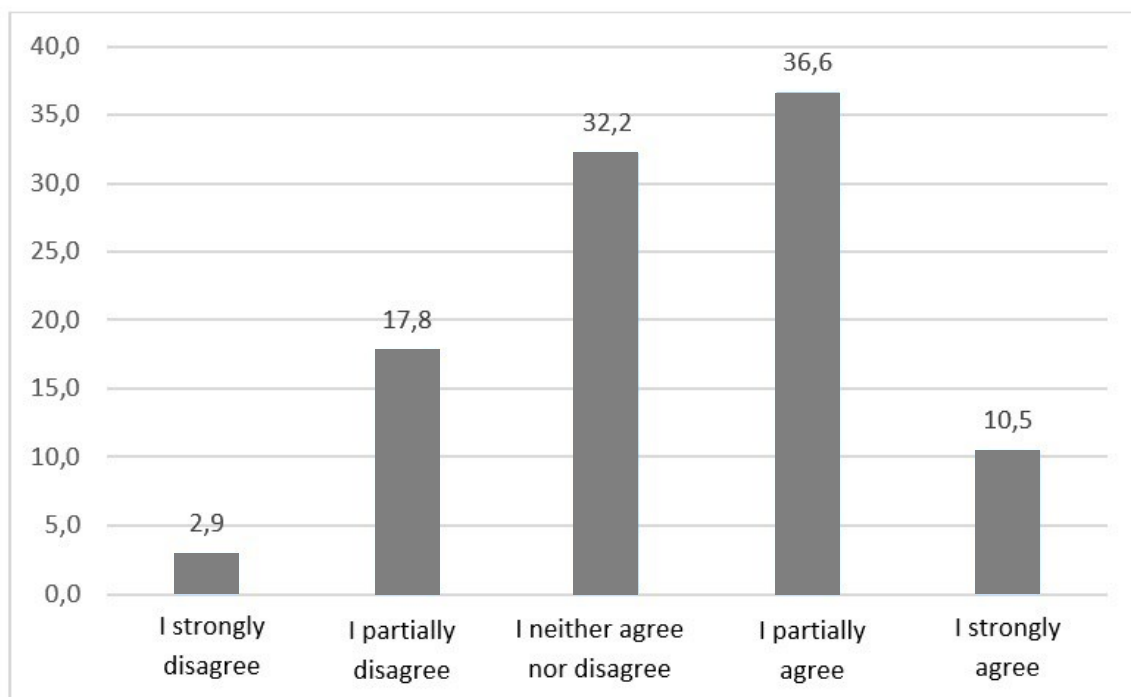


Figure 15. Degree of agreement with eco-friendly practice statements in percentages.

heavily in favor of eco-friendly practice, even stronger than in the category of attitudes towards environmental issues. It is assumed that such a set of answers is conditioned by various eco-friendly activities that were made available to students during primary or secondary education and that these were what they understood as *participating in eco-friendly practice*.

However, the justification of such an assumption is questionable considering that nearly a third of student (29,5 %) did not express agreement with the statement of ever participating in any activity related to eco-friendly behavior. On the other hand, some everyday eco-friendly practices are more frequent than was assumed. For example, a significant amount of students recycle (46,9 %) and are mindful of energy consumption⁴ (63,1 %).

The question of whether students considered environmental issues as important for their education was investigated through a series of questions. They were asked to assess the relevance of those issues and assess what percent of the curriculum should address environmental, and what percent should address social issues. The percent of desirable environmental issues was in average 16,73 %, while the arithmetical mean of desirable social issues was 13,95 %.

DISCUSSION AND CONCLUSION

A career choice is a very important, deciding point in the life of a young person. The already lengthy academic discussion on the structure of motivation for a career is relevant in its conclusions. As was already mentioned, in modern society the intrinsically motivated professional is desirable. Since this research was conducted on freshmen, this article is based on their preconceptions about the college and possible career ahead of them. Accordingly, the maintenance of intrinsic motivation will depend on their expectations related to those preconceptions. It is habitually understood that, through dedication and sacrifice, individuals will be willing to contribute creatively, take initiative, have a sense of purpose and achieve self-realization and liberation through their career. The process of professional socialization is subject to subsequent rationalization, hence, it is not expected that the level of intrinsic motivation should decrease if the preconceptions not match the practice. However, it is unfounded to expect the elements of extrinsic motivation not to influence the choice of career. It is not odd to posit the question why an individual would choose a career he or she considers unappealing, irrelevant or poorly paid. After all, those indicators show societies recognition and valorization of a profession, and it also speaks to the individual's need to participate in and actively affect society. Besides the already stated, it is also very important to keep in mind that which was clear to Marx and Maslow. Individuals will strive towards higher goals only when their basic needs are met. In our case, it is visible that nearly 90 % of examinees have 4 or more household members, and the distribution of average monthly household incomes does not reveal much. It can be said, without hesitation, that the experience of living in "larger" households amplifies the need for financial security, though this was not statistically proven in this research. In the structure of extrinsic motives, a good or above-average pay comes first, followed by quick employment abroad and quick career advancement. Based on the perception of an average pay as insufficient or the notion that an above-average pay is the appropriate social reward for engineer, an above-average pay may be variously interpreted. Whether the latter can be attributed to the effects of the global economic recession in Croatia, or the inclination towards respectable multinational companies is hard to say. Quick career advancement definitely points to careerism and the need to prove oneself in a professional environment, since the examinees prescribed least significance to decision making and influencing society. Such results point to the examinees' inclination towards the professional setting and much less to the world outside that setting. In other words, they value greatly the achievements within the professional setting and less the

ways they might influence society through their career. On the other hand, most value, among components of intrinsic motivation, is given to interests regarding science and technology, the solving of complicated but concrete problems and interest in the functioning of mechanical devices. A high level of interest for science and technology ranked first, the result, not at all surprising, can only be an indicator of the understanding of mechanical engineering as a profession in which such elements are realized. The tendency towards solving complicated but concrete problems indicates the conception of engineering problems as concrete, empiric, practical, clearly defined and yielding clear results. In accordance, when it comes to the variable of intrinsic motivation, the least valued component was the inclination towards mathematics which often includes many complicated operations before yielding concrete results. Interest in the functioning of devices, in the context of career choice, may be seen as the expanding of practically acquired knowledge in the sense of typical, legitimately channeled, human curiosity. It should be noted however, that the choice of college is highly valued as an agent of personal development in examinees. This latent function of higher education is recognized and fairly highly valued. If we examine the micro-history of previous research and assume that the results of that research, regardless of diverse colleges and careers, are compatible with the results of this research, we get an interesting continuity. However, unlike freshmen journalism students, the freshmen of engineering do not apostrophize active social aspect of their profession. The reasons may be many but two shall be listed. Firstly, engineering students do not regard their profession as socially oriented (dealing with people). Secondly, they recognize the social ordinates of their profession but ignore them. As an indicator of the latter, we can take the high average of examinees stating they would rather deal with objects than people. This however, does not exclude a third or multiple other options. To get back to the established continuity, the regularity in the results indicated that students' career choices are influences in the highest degree by *interest relating to profession* [7], *hedonistic motives* [8], that is, intrinsic motivation- *interest for science and technology*, followed by *good (above-average) pay* with a significantly lower average value. To conclude, statistically extrinsic motivation for choice of college and career prevails in our examined sample. This indicated that their choice is dominated by preconceptions about instrumental benefits of a profession and that the components of intrinsic motivation are in a subordinate position.

Dominate extrinsic motivation for choice of college indicates what Inglehard calls "materialistic values", which favor economic stability and growth are fundamental values. They are in contrast with "postmaterialistic values" which favor environmental awareness, a humane society and civil participation [16, 17].

On the level of environmental awareness and the influence future engineers might have on these problems, we may conclude that while students are aware of environmental issues they do not show a lot of interest for them. Considering the disproportion between the statements that society does not take sufficient care of the environment and the possibility of influencing the environment as one of the motives for enrolment we can posit some conclusions. The evident low interest students have for environmental issues may stem from lacking knowledge about the ways of affecting those issues as an engineer or even in everyday life. On the other hand, there is the possibility that despite participating in eco-friendly activity, students do not credit the result an individual's participation may yield.

It is evident that the dimension of knowledge is one that warrants further analysis for the successful interpretation of these problems. It is imposed as a prerequisite for all further research. The research conducted by Azapagić [10] suggests exactly that.

Results relating to the eco-friendly practices suggest that in the end, there is a promising (but not satisfactory) level of environmental awareness which further enforces the notion that

knowledge about sustainability, ecology and other social issues is the educational necessity of future engineers.

It is clear that there the willingness to learn about the mentioned issues exists and it is that which makes the results promising. The assumption is that the presented results would positively correlate with the expansion of knowledge about the stated domains as Beder [9] showed in her research. Hence, the question whether extrinsic motivation endangers environmental awareness may be answered negatively.

The mentioned results are especially interesting in that they reflect how the student opinions about the fitting amount of environmental and social issues is in accordance with the guidelines of international educational accreditation agencies. The assumption is that students were able to learn to valorize and value social and environmental issues through previous education and the media which is reflected, at least when it comes to environmental issues, in the expectations they have about their higher education.

It can be stated that future engineers are aware of environmental issues and that a significant number of them recycles waste and is mindful of energy consumption. There is the perception of engineering studies in the literature, as training devices for bureaucrats and modal employees as if it were some sort of ideology that sets the existing capitalist system as the means and material values as the measure of success. It is important to note that the question of sustainability is not that of an exclusive character. It is a wider socio-political question that warrants not only specific knowledge about social issues, but also an integrated, interdisciplinary approach to the education of engineers in order to form capable personnel with understanding of social dynamics [12]. Thus, the curriculum on social issues must be directly applicable to problems that engineers face [10]. Since it has been long clear that the idea of unlimited growth cannot be sustained over a long period of time, it is encouraging that there is fertile ground among examinees for dealing with social and environmental issues. Knowledge about those issues may be considered a necessity for the development of competent co-creators of a (hopefully) sustainable tomorrow.

REMARKS

¹It is appropriate to mention that a HEI in Zagreb conducted a large online research in cooperation with the web portal <http://www.srednja.hr> via the social network Facebook in the academic year 2012/2013. The research was targeted at high school seniors and college freshmen ($N \sim 5000$) and yielded some results that are of interest to this research. For example, 64 % of examinees enrolled into their first choice of college, and the motivation for enrolment reveals that 81 % opted for a college based on their personal affinity towards the subject matter of the college, 56 % because of better employment possibilities in a particular branch abroad, 51 % for the chance of a good pay in a branch, 49 % out of professional and social motives (attending college with similar colleagues, etc.), 44 % because of better employment possibilities in Croatia. When it comes to influence on choice of college, 16 % stated that acquaintances from a particular branch of study influenced their choice, 15 % that family influenced their choice, 10 % that it was older colleagues, and only 7 % states that the role of professors was influential. It is also important to mention that this online poll was carried out in methodologically unsound ways, and that the data presented was at times confusing and unusable. A request for cooperation and detailed insight into the data was, regrettably, denied. However, the data mentioned above is available to all at request to the authors of the study.

²It cannot be ignored that the sample of this study was “convenient” as it included only students that were present at lectures ($N = 121$), and from the overall sample only one category was taken into consideration, that of students of the first year, freshmen.

³The article does not mention which method was used to collect the data from which these categories were extracted and presented (an interview or some sort of open sourced questionnaire).

⁴This factor needs to be considered with caution as people can be mindful of energy consumption due to financial reason and not out of environmental consciousness.

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NALAZI O MOTIVACIJI, EKOLOŠKOJ SVIJESTI I PRAKSI BUDUĆIH INŽENJERA U ZAGREBU

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SAŽETAK

Ovaj rad nastao je kao rezultat ankete provedene na studentima prve godine fakulteta strojarstva i brodogradnje u Zagrebu. Glavne čestice u fokusu ovoga rada su intrinzična i ekstrinzična motivacija studenata te njihova ekološka svijest i praksa. U skladu s time željeli smo ispitati prevladava li kod studenata prvi odnosno drugi oblik motivacije za karijeru strojara te utvrditi stupanj ekološke svijesti i prakse navedenog uzorka. Rezultati pokazuju da su ispitanicima po pitanju buduće karijere bitniji ekstrinzični elementi motivacije za karijeru. U sferi ekološke svijesti i prakse rezultati pokazuju višu razinu ekološke svijesti i prakse kod studenata. Kao zaključak se može istaknuti da dominantna ekstrinzična motivacija za karijeru ne kompromitira interes za ekološke teme niti ekološku praksu.

KLJUČNE RIJEČI

ekstrinzična i intrinzična motivacija, ekološka svijest i praksa, studenti strojarstva