

Elements of Motivational Structure for Studying Mechanical Engineering

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Abstract

The article presents the findings on students' reasons for studying mechanical engineering. These reasons were covered in terms of extrinsic and intrinsic motivation additionally related to selected independent variables of the sample – students' secondary school Grade Point Average, their gender and the socio-economic status. The research was conducted with the first year students of the Faculty of Mechanical Engineering at the University of Zagreb, Croatia. The sample consisted of 282 students (228 males and 54 females) and comprised students of all majors. According to descriptive character of the questionnaire type survey characteristics of the sample are presented. Composite variables of extrinsic and intrinsic motivation were dichotomized to present different levels of the students' overall motivational structure. Results indicate a students' interest in the field of science and technology as the most important element of intrinsic motivation, with no significant relation to any of independent variables. By contrast, extrinsic motivation has manifested as significantly related to the variables of Grade Point Average and to parents' education as one component of the socio-economic status. However, a significant level of indecisive respondents regarding the both intrinsic and extrinsic motivation suggests that the choice of the study programme is not always a consistent and an unambiguous process.

Keywords: motivation; engineering; education; freshmen.

Introduction

Research of the most important factors affecting the choice of engineering study programmes has intensified worldwide over the past two decades triggered by reports of the declining interest of young people in studying engineering. In its report on student interest in science and technology studies, the Organisation for Economic Co-operation and Development (OECD) considered the subject of engineering along with physical sciences, mathematics, life sciences and computer science. It was found that interest in engineering in general is relatively stable in comparison to a decline regarding other fields of science and technology, but this finding was relativized by significant differences in the national trends in the numbers of engineering graduates (OECD, 2008). However, some years later, the United Nations Educational, Scientific and Cultural Organization (UNESCO, 2010) indicated enrolment problems in engineering studies in particular: “One of the most serious internal issues and challenges facing engineering is the decline of interest and enrolment of young people, especially women, in engineering in most countries around the world” (UNESCO, 2010, p. 308).

This trend had been anticipated earlier, mostly through analyses in (post)industrial countries of the major changes taking place at the societal level. It was found that engineering programmes were not part of the primary academic orientation for young people. Moreover, other corresponding analyses of dominant features of engineering education in general indicated discouraging characteristics of engineering studies, mostly combined with inertia and unattractiveness.

At the societal level in the industrialised world, it should be noted that socio-economic changes, which reflected unstable career paths for engineers, had been indicated in the 1990s. Thus, Sennett's elaboration and detailed portrayal of unsuccessful harmonization of work-life balance among engineers demonstrated a clear relationship between deindustrialisation, the precarious nature of employment, and the corresponding uncertainty in terms of the individual's professional career and biography (Sennett, 1998). Similarly, Barley & Orr (1997) pointed out that regardless of the trend of massification and diversification of academic studies, engineering could be viewed in terms of relative uncertainty in regard to social status and salaries in the respective professions. Although these warnings were presented in the 1990s, they were to be echoed in the OECD report a decade later where it explicitly stated that the traditional attractions of science careers had been eroded by changes in the economy at large: “With rising unemployment or precarious contracts, young people may be prone to operate a shift towards profession oriented studies” (OECD, 2008, p. 47). Finally, as it can be seen in the UNESCO report (2010), despite the relatively stable demand in the labour market, engineering was considered to be an area that was perhaps most affected by the decline of study interest.

The analyses of internal discouraging factors point out a problematic character of the predominantly narrow disciplinary focus of the study programmes in engineering. The main objections relate to the excessive abstraction of the studies and difficulties in understanding engineering as a social enterprise (Beder, 1999; Bucciarelli, 2008). In her analysis of the historical reasons of the overly technical focus in engineering studies, Beder stated the declining social image and status of engineers in which they were viewed mainly as socially insensitive and politically naive men who were subjected to the influence of capital. Beder indicated that such an image was, to a large extent, the outcome of the traditional approach to engineering in schools in which “selection criteria and course content is of a field of

endeavour that is overwhelmingly concerned with numbers, science, and mathematical analysis” (Beder, 1999, p. 14). Such approach, according to Beder, resulted not only in creating inappropriate assumptions about the students of engineering, but also in stereotyped images of the career in engineering itself. It is stated that, devoid of any social content, career in engineering remained appealing to the narrow circle of young people who are willing to forsake professional involvement with people, public affairs, and a wider set of social concerns (Beder, 1999).

Similar considerations can be found in other studies (Seymour & Hewitt, 1997; Shulman, 2005; Pawley, 2009; Riley & Claris, 2009; Trevelyan, 2010). More recently, Wadowski & Zaród (2015) pointed out deeply rooted lack of recognition of the social context in which engineering operates. According to the authors, this overly reductionist educational framework in engineering seems to be transformed in time by the gradual introduction of social sciences and humanities. In sum, a trend of declining interest for studies in engineering, along with other problems is covered in most of these articles. Correspondingly, in most of these studies it is supposed this trend should be reversed by a radical internal curricular and pedagogical reform.

Objectives and Relevance of the Study

If opportunities for engineering careers at the societal level are ambiguous, simultaneously unpromising and insecure, while study programs are relatively unattractive, then our primary research objective was to see what motivates young people to enrol in academic engineering study programs. More precisely, the main objective of the present research was to explore freshmen's reasoning to study mechanical engineering at the University of Zagreb in terms of intrinsic and extrinsic motivation which were considered as two conceptually different basic components of motivational structure for students when entering the first semester of engineering undergraduate study. The intention was to determine whether there were significant differences between these two basic components of motivation.

In addition, the present research examines whether it is possible to determine differences in the motivational structure of mechanical engineering students by the number of their educational, socio-demographic and socio-economic characteristics. The educational variable is considered through the Grade Point Average (GPA) since it provides a well-rounded view of a student's performance in high school and often represents the key norm for enrolment in academia worldwide (Bowles & Gintis, 1977; Ferjan, Jereb & Šušterčič, 2007; Balfanz et al., 2016). Likewise, the gendered nature of enrolment in engineering represents one of the well-studied elements in contemporary research efforts to transform the engineering sector as it is currently still male dominated area of education (Kolmos, Mejlgaard, Haase & Holgaard, 2013). Finally, the importance of the socio-economic status (SES) represents the third students' characteristic since its validity in terms of family income, parental education and parental occupation, has been verified in a number of educational studies (Bowles & Gintis, 1977; Sirin, 2005; Ma, 2009; Svoboda et al., 2016).

Extrinsic and Intrinsic Motivation in Education

Generally, a good deal of research has been conducted dealing with the issue of motivation in engineering education. It has been explored in terms of choice and persistence in studying engineering (Matusovich, Streveler, & Miller, 2010); gendered nature of academic choices (Jugović, 2010; Kolmos, Mejlgaard, Haase, & Holgaard, 2013) among others. In addition,

some studies have tried to identify the most important influencing factors in choosing to study engineering such as socialisers' influence, interest in the study and working autonomy, security, wages and social position (Reed & Case, 2003; Dias, 2011; Shumba & Naong, 2012). Overall, it turned out that results vary depending on a particular's socio-cultural context.

In this regard, extrinsic and intrinsic motivations are an integral part of numerous models in the field of education and they are examined from a variety of theoretical perspectives: for example, expectancy theory, the theory of value assignment, and motivation theory associated with cognition and volition (Eccles & Wigfield, 2009). However, as Brown, McCord, Matushovich, & Kajfez (2014) point out, these two concepts appear as more inconsistent than a nuanced construct in the research of engineering educational process. Considering this observation, in the present research we relied on the theoretical approach of Deci, Vallerand, Pelletier, & Ryan (1991).

Deci et al. (1991) took into account a more complex perspective on the relationship between extrinsic and intrinsic motivation. Elements of personal choice regarding an activity were elaborated as a part of regulatory process of behaviour. This enabled the authors to outline the extrinsic and intrinsic motivations in terms of a continuum in which each variant indicates a different level of transformation from external contingencies into agency regulated by internal processes. Ultimately, the model has resulted mostly in extrinsic motivation being elaborated through a number of variants which differ from each other in nuances, gradually approaching intrinsic motivation. Thus, the most sophisticated type of extrinsic motivation – integrated motivation – comes close to intrinsic motivation for the differences among the two although sometimes not clear at first sight (Deci et al 1991). Since the initial introduction, this approach has often been employed as a valid concept in educational research (Sansone, & Harackiewicz, 2000; Rijavec, Brdar, & Miljković, 2008) along with research in engineering education in particular (Gero & Abraham, 2016).

However, regardless of the mild differences among variants in continuum, Deci et al. (1991) specified general differences between these two kinds of activity. Intrinsically motivated individuals would engage with an activity for their sheer interest and corresponding sense of enjoyment. They do so “freely, with a full sense of volition and without the necessity of material rewards or constraints” (Deci et al., 1991, p. 328). In contrast, extrinsically motivated activity would be determined primarily by external and utilitarian goals, be it attainment, reward or success. In essence, extrinsic motivation indicates behaviour which is assumed to be “instrumental for some separable consequence”. Therefore, we consider intrinsic and extrinsic motivation as two general orientations, although the former is conceptualized almost in its ideal-type form, and the latter involves a number of variations (Dubreta & Bulian, 2017).

Literature Review

Brown et al. (2014) listed more than 70 scientific articles dealing with motivation as a research subject in engineering education. Many of these articles are concerned with possibilities to consider a particular aspect of students' engagement in the learning process be it laboratory work, project learning or mathematics. The number of articles dealing with motivation in enrolment in engineering study is relatively small. Their findings are based on qualitative or quantitative research and the issue of motivation appears to be considered in a view of the applied theoretical construct.

Thus, for example, the application of expectancy-value theory (Matusovich, Streveler, & Miller, 2010) has shown that the choice of the study programmes in engineering cannot be separated from elements of personal identity and students' sense of self but is associated with types of values and perceptions of the personal importance of engineering. The theory showed that values as well as the connection between the personal and the engineering identity are crucial not only for the choice of study programmes in engineering but also as motivational factors in terms of perseverance in the course of studying.

On the other hand, while combining qualitative and quantitative research Savage & Birch (2008) observed how extrinsically and intrinsically motivated students reflect on different pedagogical approaches. Their results imply possibility of a parallel, though differently expressed importance of both types of motivation for study programmes in engineering. Therefore, the need for more detailed consideration of appropriate pedagogical approaches is suggested which would, in practice, allow for convergence of students and teachers expectations of the study programme. Another related research study (Reed & Case, 2003) also emphasises the concurrent importance of extrinsic and intrinsic motivation in choosing the study programmes in engineering. It points out that there are a series of contextual factors that may have an intervening effect; be it the appropriate elements of socialization, the interpretation of past personal experiences, aspirations in terms of career, self-images, beliefs about their own abilities, along with other factors. Finally, Dias's research (2011) showed that in considering students' motives for choosing a study programmes in engineering, we should take into account the combined effects of motivational factors such as social status, intelligence, gender, values and interests. Since the choice of study is of highly contingent character, these factors are reflected in the shapes of extrinsic and intrinsic motivation for study programmes in engineering.

Given the relevance of the topic, there are relatively few studies of motivation regarding the study programmes in engineering in Croatia. In those studies the question of motivation for enrolling into engineering study programmes is considered in different terms and the research process varies depending on whether they are using qualitative or quantitative procedures. The first study in Croatia of this type was conducted by Kesic & Previsic (1998) and it compared the motives for enrolling into faculties of economics and electrical engineering. The study relied on elements of the two-factor motivational structures which somewhat corresponded to a simplified matrix of extrinsic and intrinsic motivation. The matrix is expressed in different but nevertheless corresponding terms of hedonistic motives as well as the motives of utility. As it turns out, hedonistic motives (complacency with the programme course) are significantly more dominant among students who study electrical engineering, while the motives of utility (job and salary) dominate among students who study economics. The results also suggest that these motives play a crucial role in students' decision-making processes in terms of what they want to become and what their future profession will be.

A decade later, Potočnik (2008) researched the motives for enrolling at the University of Zagreb. By combining qualitative and quantitative approaches she determined that the majority of students, including those studying technical sciences, had a prevailing interest in the studies and independent variables such as gender, age and years of study did not represent relevant factors. Certain differences were shown in the interpretations of the market situation in terms of finding future employment, whereby the position of the certain profession and the political context in Croatia was perceived as a considerably greater potential barrier to the

employment of students who study social sciences and humanities (SS&H) than for those who study technical sciences.

Using the model of expectations and values, Jugović (2010) investigated the factor structure of motivation in the field of physics. She specifically concentrated on gender differences in motivation and stereotypes in the interpretation of individual choice of study programmes in which physics is important. Relevant findings indicate that there are no differences between boys and girls when it comes to personal importance and the assessment of their own abilities in this area of science. However, the author herself questions the finding since other findings indicated significant educational aspirations in the selection of future study programmes with respect to the gender. As it turns out, a significantly higher number of boys intend to enrol into some of the technical faculty and this allowed the author to consider the category of gender stereotypes as an important factor in educational and occupational gender segregation in Croatia.

Finally, Miloš & Čiček (2014) presented the results of the quantitative research conducted at the Faculty of Mechanical Engineering and Naval Architecture. By aggregating claims which can be taken as indicators of extrinsic and intrinsic motivation and by testing their differences, the dominance of extrinsic motivation in the choice of study programme was determined. The article relied on studies that have already been mentioned (Reed & Case, 2003) where the focus was shifted from the set of factors (cultural, social, previous experience) to the specified reasons for enrolling into a faculty and in the aspirations for a career in engineering in the context of extrinsic and intrinsic motivation.

The Method and the Research Sample

The research was conducted with first year students of the Faculty of Mechanical Engineering at the University of Zagreb. A questionnaire type survey was conducted among 282 students in October 2013. Non probabilistic purposive sampling was used. The reasons for this kind of sampling procedure stems from the fact that the research was limited to newly enrolled students in the mechanical engineering study programme and in a corresponding attempt to relate their motivational structure for enrolment with their SES, gender and educational characteristics. In proportion with the number of students enrolled (425), the questionnaire comprised students of all majors. Figure 1 shows the socio-demographic characteristics of the sample.

We used descriptive statistical methods for describing the sample and the independent variables (Figure 1). Besides that, inferential statistical methods were used in accordance with the aims of the research. Therefore, two logistical regressions were conducted in order to determine the relevance of the model for the predicament of the level of extrinsic and intrinsic motivation for a career in engineering. That model was comprised of the variables of socio-economic status, gender and the GPA achieved in high school. Dichotomization of extrinsic and intrinsic motivation by their (low/high) level provided us with the opportunity to get a more distinct insight in SES, gender and educational effects on the motivation. Additionally, counties of students' origin were introduced as possible supplementary SES component. As regards SES, counties here refer to Croatia's highly centralized administrative character in which the city of Zagreb represents the wealthiest and most populated centre, with the biggest university and with the significant share of students from other, less developed parts of country.

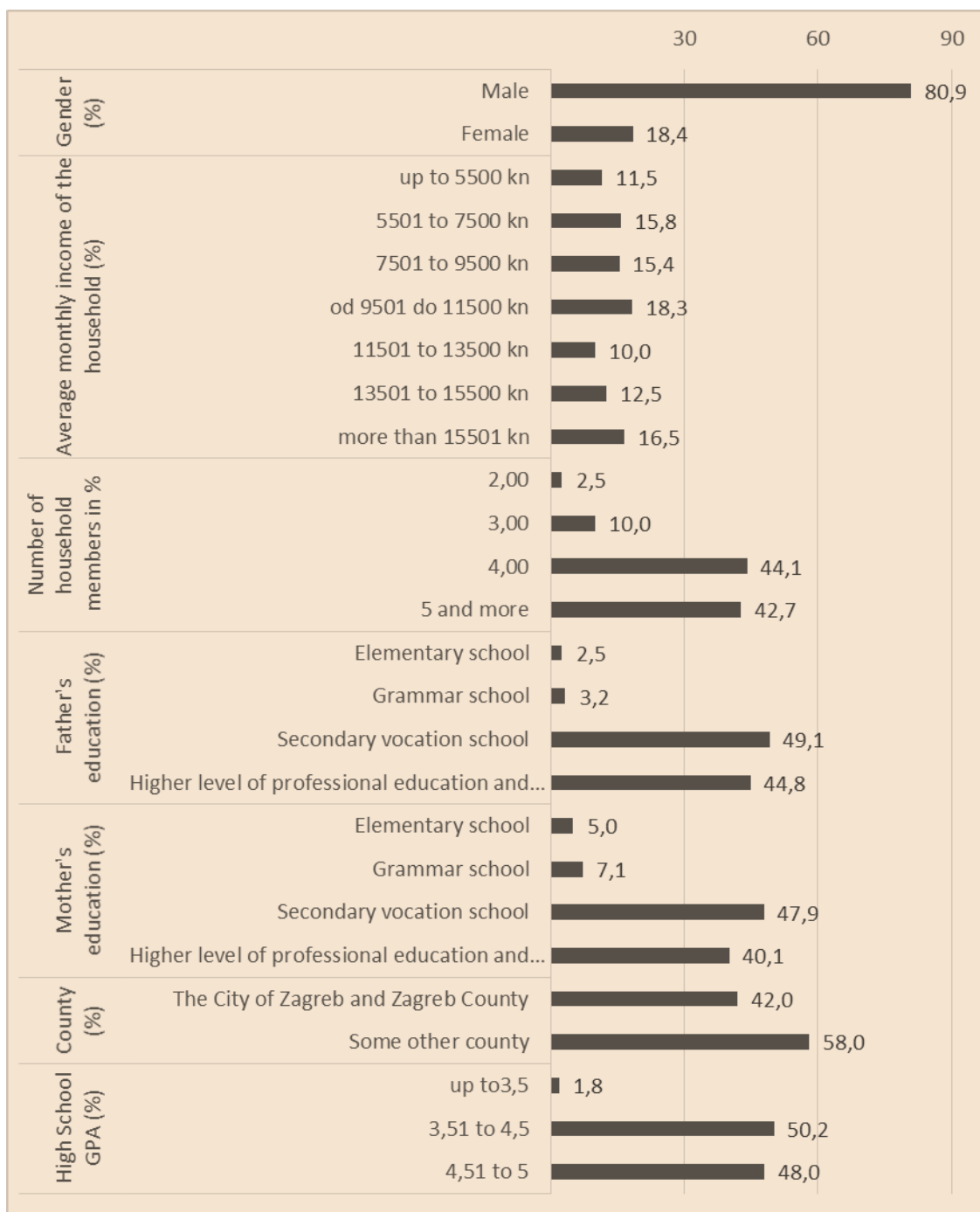


Figure 1: Socio-demographic features of the sample.

In accordance with what has been written about the intrinsic motivation as a type of "internal" motive for an activity per se, or the voluntary and conscious effort in a certain direction without expectation of extrinsic rewards, it was necessary to adjust this term to the context of intrinsic motivation for a specific professional career. The underlying theme for the development of a model is very similar to previous work in this field (Miloš & Čiček, 2014), with minor modifications. In fact, this time we used the model that had resulted by the factor analysis with slightly altered components.

Thus, the respondents had to express the degree of disagreement with a particular statement on a scale from 1 to 5 (1 – strongly disagree, 2 – disagree), indecision with respect to

compliance (3 – I'm not sure) and the degree of agreement with the statement (4 – agree, 5 – strongly agree). The components that were later added together in the composite variable of the intrinsic motivation were: "I enjoy in acquiring a new knowledge and skills", "I find the studies in engineering exciting and challenging", "I enrolled in this faculty because I am primarily interested in the field of science and technology", "I like to solve complex, but concrete problems", "This study corresponds to my personal traits". For a composite variable that later represents the extrinsic motivation in the choice of the study programme the following statements were summed up (also represented numerically 1–5 with the degrees of influence): "Good/above average salary", "Quick employment", "Quick career advancement", "The reputation (of the profession) in the society", "Possibilities of decision-making and influence on the society".

Results

Values obtained by aforementioned procedure for composite variable of intrinsic motivation are $r = 3.90$, $SD = .54$ (Cronbach $\alpha = 0.66$). On the other side, values of composite extrinsic motivation are $r = 3.57$, $SD = 0.70$ (Cronbach $\alpha = 0.83$). The resulting composite variables were dichotomised in the following way: on a scale of extrinsic/intrinsic motivation (absence of the occurrence), scale figures 1 and 2 signify low motivation, while the scale figures 4 and 5 signify high E/I motivation. The results thus indicate that the absence of the intrinsic motivation is expressed in 5.3% of all cases, and the absence of the extrinsic motivation in 17% of all cases. In contrast, high intrinsic motivation is expressed in 50.9% of all cases, and a high extrinsic in 28.6% of all cases (Table 1).

Table 1: Dichotomized variables overview.

	Dichotomized variable of the intrinsic motivation			Dichotomized variable of the extrinsic motivation		
	Frequency	Percentage	Cumulative percentage	Frequency	Percentage	Cumulative percentage
Low motivation	15	5,3	5,3	48	17	17
High motivation	144	50,9	56,2	81	28,6	45,6
Undecided	124	43,8	100	154	54,4	100,0
Total	283	100		283	100	

By this procedure (Figures 2 and 3) we obtained a high percentage of cases (43.8% for intrinsic, and 54.4% for extrinsic motivation) where the respondents expressed indecision (3 – I'm not sure) in terms of agreement or disagreement with the statement; a rather small number of cases presented in the low range of motivation and a much larger number of cases represented in the higher range of motivation. Thus, the situation is much clearer, that is, the cases of low and high motivation are consistently isolated and it is evident that in general, scale results lean towards higher E/I motivations.

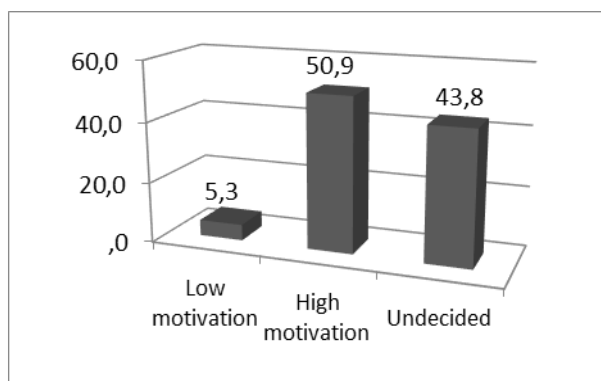


Figure 2: Dichotomized variable of the intrinsic motivation (%).

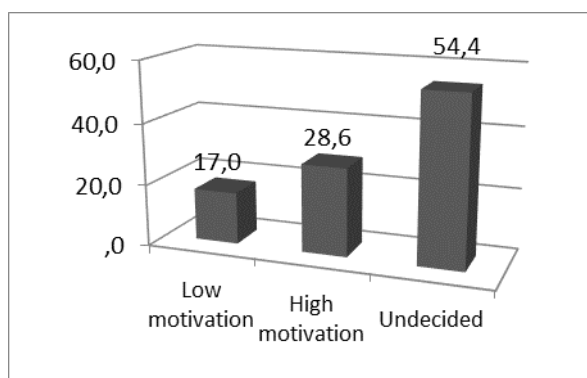


Figure 3: Dichotomized variable of the extrinsic motivation (%).

The model for the prediction of E/I motivations contains two categorical variables – gender and counties from which the students come (counties were dichotomised into two categories: the first one consisting of the respondents of both City of Zagreb and Zagreb County and the second one consisting from all other counties of Croatia). Besides these, four discontinuous variables were used in the model: monthly household income, number of family members, father's educational level and mother's educational level. Finally, high school GPA is the only continuous variable in the model.

In order to determine the impact of such factors on the likelihood of the respondents being more extrinsically or intrinsically motivated, two logistic regressions were performed. The abovementioned independent variables constitute a common model for predicting both types of motivation. A model for intrinsic motivation is not statistically significant $\chi^2(7, N = 153) = 11,79, p > 0,05$ ($p = 0,1$), which indicates that the model in general does not distinguish students who are poorly and highly intrinsically motivated for a career in engineering, that is, our independent variables do not contribute to the explanation of the dependent variable. However, Table 2 shows that only one independent variable brings a statistically significant contribution to the model, i.e. the only predictor of high intrinsic motivation is the county from which the students come ($B = 1,461; p < 0,05$), and its quotient probability is 4,31. If the model was significant this would tell us that students who do not come from the city of Zagreb and Zagreb County showed more than four times "stronger" intrinsic motivation (with all other factors in the model unchanged). But considering the fact that the model is not significant it can be noticed that we cannot relate SES to intrinsic motivation in this case.

Table 2: Predicting the probability of high intrinsic motivation.

	B	Stand. error	Wald	df	Sig.	Exp(B)	95% confidence interval for Exp(B)	
							Lower Limit	The upper limit
Gender	1,569	1,088	2,079	1	,149	4,804	,569	40,556
High school GPA	-,032	,768	,002	1	,967	,968	,215	4,362
Average household income	,121	,163	,546	1	,460	1,128	,819	1,554
Number of household members	-,721	,442	2,662	1	,103	,486	,204	1,156
County	1,461	,651	5,035	1	,025	4,312	1,203	15,455
Mother`s education	-,269	,428	,395	1	,529	,764	,330	1,769
Father`s education	-,354	,502	,497	1	,481	,702	,262	1,878
Constant	6,162	4,483	1,889	1	,169	474,325		

On the other hand, the model is statistically significant $\chi^2(7,122) = 18,82$, $p < 0,01$ in the case of extrinsic motivation, which means that the model differentiates between poorly and highly extrinsically motivated subjects, i.e. independent variables contribute to the explanation of the dependent variable. The model interprets between 14.3% and 19.5% of the variance of extrinsic motivation and accurately classifies 73% of all cases. In Table 3 we can see that the two independent variables provide statistically significant contribution to the model (average high school GPA and mother`s educational level). The strongest predictor of high extrinsic motivation is the high school GPA ($B = 1.360$; $p < 0.01$) with the quotient of probability of 3,898. This means that an increase of GPA for one unit of value (simply put, the grade) means almost four times higher probability for high extrinsic motivation, with all other factors in the model remaining the same. Furthermore, mother's education as a predictor ($B = 0,680$; $p < 0,05$) has a coefficient of probability 1,975 which points out that with each increase in level of mothers education, the probability for high extrinsic motivation doubles (with all the other factors in the model remaining the same).

Table 3: Predicting the probability of high extrinsic motivation.

	B	Stand. Error	Wald	df	Sig.	Exp(B)	95% confidence interval for Exp(B)	
							Lower limit	The upper limit
Gender	-,153	,555	,076	1	,782	,858	,289	2,547
High school GPA	1,360	,496	7,509	1	,006	3,898	1,473	10,314
Average household income	,071	,122	,337	1	,562	1,074	,845	1,364
Number of household members	,390	,270	2,089	1	,148	1,476	,870	2,504
Mother`s education	,680	,311	4,777	1	,029	1,975	1,073	3,635
Father`s education	-,420	,370	1,289	1	,256	,657	,318	1,357
County	-,587	,434	1,831	1	,176	,556	,237	1,301
Constant	-7,62	2,886	6,974	1	,008	,000		

Discussion and Conclusion

The first objective of this research was to determine students' components of intrinsic and extrinsic motivation for enrolment into the engineering study programme. On the one hand, the obtained results indicate that the interests to study engineering in half of all respondents are encouraged by motives of predominantly intrinsic character. About 50% of respondents expressed their agreement with statements that primarily refer to the interest in the subject area. The responses of one quarter of all respondents (28.6%) suggest that motives are affected by continuum of extrinsic motivation suggested by Deci et al. (1991). To some extent, the results correspond to those found in similar studies (Reed & Case, 2003; Kesić & Previšić, 1998; Potočnik, 2008). Therefore we are not surprised by the dominantly expressed importance of intrinsic motivation which suggests that students are encouraged by the very content of the study programme.

Although the county is a significant predictor in the model of intrinsic motivation which is cast aside, one should bear in mind the consequences of the way in which counties were dichotomised in our model. Variable named County (Tables 2 and 3) consisted of two parts: the first one is the City of Zagreb and Zagreb County and the second one refers to all the other counties. The latter includes the remaining 19 Croatian counties and a significant number of them are underrepresented in the sample. In this sense, one cannot say the evidence of predictability of the intrinsic motivation in terms of the county from which the student comes is particularly indicative. The important is that the model is not significant in this case and new researches are welcomed in this regard.

With regard to extrinsic motivation, it turns out that the GPA is the most important factor and can be considered as an indicator of competitiveness and conformism. The previously mentioned research (Bowles & Gintis, 1977; Ferjan, Jereb & Šušterčič, 2007; Balfanz et al., 2016) has already indicated that "GPA hunting" offers proof that the education system works as divisional as well as a stratificational factor in society. Because students cannot influence the form and the content of the educational process, their motivation is based on extrinsic factors and it is also one of the ways in which they can conform and prepare for the next step – a job. In the context of our study this would indicate "a job well-done" at the previous level of education as well as the fertile ground that was created for primarily extrinsically motivated students who will become future employees.

On the other hand, it is important to take notice of a large number of indecisive respondents both in terms of intrinsic (43.8%) and in terms of extrinsic (54.4%) motivation. They indicate that the choice of the study programme is not always a consistent and an unambiguous process. This finding is important since it allows us to pose the following question: to what extent does the choice of study programme correspond with any kind of motivation and how much does it stem from the nature of the educational system, still relatively closed to students of vocational schools and open predominantly to students coming from (mainly general) gymnasiums in which the transition to the next educational, i.e., the academic level is almost the only reasonable option. Furthermore, the results allow us to question the importance of the motivational matrix indicated in the E/I terms. In a way, it seems reasonable that at the time of the enrolment, students are not confident of their choices, that is, some of the motives that were outlined and contrasted here can be developed or challenged "along the way" in the course of the study programme (Renninger, 2000).

Such an assumption would allow sequencing of an examination of human choices and actions in the wake of the research which showed that motivation is often yet to come for the initial choice (in this case by entering a specific study programme) and is important in later sequences when it can arise as an important factor in terms of maintaining this initial choice (Renninger, 2000).

The second objective of this study aimed at reassessing the hypothesis that socio-economic status is a relevant factor in choosing a study programme and future career. Socio-economic status is often studied and interpreted differently, especially when it comes to predicting the future academic achievement in the matrix of social stratification (White, 1982). Our results showed that, in this particular case, the elements in the utilised model of socio-economic status are irrelevant for predicting intrinsic motivation. This is not the case with the extrinsic motivation because one of the elements has clearly crystallized itself in the defined components of the socio-economic status – mother's education. It is possible to assume that in traditional and patriarchal social structures, such as is Croatian (Galić, 2004), mothers are more active parents and they are more directly involved in the school activities of their children from the very beginning of their education. The correspondent results were offered by Burušić, Babarović & Marković (2010) stating that a mother's education has a greater impact on academic achievement than the father's. In the assumed continuity of aspiration of Croatian students, the results of our research are consistent because they indicate that students who have educated mothers strive towards external awards for their achievement. In this sense, one could argue that a mother's education influences the level of the obtained grades that were also proved to be a factor in the expressed levels of extrinsic motivation.

However, predominantly expressed importance of intrinsic motivation and a large number of indecisive respondents are the most important results of this study. A high percentage of reported intrinsic motivation shows that students enroll into engineering study programmes because it best suits their interests in the subject area. Thus, it is a choice that is not conditioned by widely conceptualised external reasons and it is not derived from components of their socio-economic status.

A high percentage of indecisive responses in terms of motivation implies the need for continuous efforts to shape and promote the engineering study programmes that will encourage hesitant freshmen. This corresponds with the research mentioned in the introduction, which indicated that the lack of attractiveness of engineering academic programs is one of the important "internal" factors for the decline of interest in technical studies in general.

References

- Balfanz, R., DePaoli, J. L., Ingram, E. S., Bridgeland, J. M. & Fox, J. H. (2016). *Closing the college gap a roadmap to postsecondary readiness and attainment*. Washington: Civic Enterprises.
- Barley, S., & Orr, J. E. (1997). *Between craft and science: Technical work in U.S. settings*. Cornell University Press.
- Beder, S. (1999). Beyond technicalities: Expanding engineer thinking. *Journal of Professional Issues in Engineering Education and Practice*, 125(1), 12–18. [https://doi.org/10.1061/\(ASCE\)1052-3928\(1999\)125:1\(12\)](https://doi.org/10.1061/(ASCE)1052-3928(1999)125:1(12))
- Bowles, S. & Gintis, H. (1977). *Schooling in capitalist America: Educational reform and the contradictions of economic life*. New York: Basic Books.
- Brown, P. R., McCord, R. E., Matushovich, H. M. & Kajfez, R. L. (2014). The use of motivation theory in engineering education research: A systematic review of literature. *European Journal of Engineering Education*, 40(2), 186–205. <https://doi.org/10.1080/03043797.2014.941339>
- Bucciarelli, L. (2008). Ethics and engineering education. *European Journal of Engineering Education*, 33(2), 139–147. <https://doi.org/10.1080/03043790801979856>
- Burušić, J., Babarović, T., & Marković, N. (2010). Koliko daleko padaju jabuke od stabla? Odnos obrazovnih postignuća djece i obrazovne razine njihovih roditelja [How Far Does the Apple Fall from the Tree? The Relationship between Childrens Educational Achievement and the Educational Level of their Parents]. *Društvena istraživanja [Social Research]*, 19(4–5), 709–730. [In Croatian]
- Deci, L. E., Vallerand, R. J., Pelletier, L. G. & Ryan, R. M. (1991). Motivation and Education: The Self-Determination Perspective. *Educational Psychologist*, 26(3–4), 325–346. <https://doi.org/10.1080/00461520.1991.9653137>
- Dias, D. (2011). Reasons and motivations for the option of an engineering career in Portugal. *European Journal of Engineering Education*, 36(4), 367–376. <https://doi.org/10.1080/03043797.2011.593096>
- Dubreta, N & Bulian, L. (2017). Longitudinal research of motivation for mechanical engineering study at the University of Zagreb. *World Transactions on Engineering and Technology Education*, 15(3), 217–222.
- Eccles, L. S. & Wigfield, A. (2002). Motivational beliefs, values, and goals. *Annual Review of Psychology*, 53, 109–132. <https://doi.org/10.1146/annurev.psych.53.100901.135153>
- Ferjan, M., Jereb, E & Šušteršič, O. (2008). Social Class Position as a Determinant of Educational Achievement, *Social Research*, 17(4–5), 869–886.
- Galić, B. (2004). Seksistički diskurs rodnog identiteta [Sexist Discourse of Generic Identity]. *Socijalna ekologija [Social Ecology]*, 13(3–4), 305–324. [In Croatian]
- Gero, A. & Abraham, G. (2016). Motivational factors for studying science and engineering in beginning students: the case of academic preparatory programmes. *Global Journal of Engineering Education*, 18(2), 72–76.
- Jugović, I. (2010) Uloga motivacije i rodnih stereotipa u objašnjenju namjere odabira studija u stereotipno muškom području [The role of motivation and gender stereotypes in the

- choice of study in a stereotypically male domain]. *Sociologija i prostor [Sociology and Space]*, 48(1), 77–98. [In Croatian]
- Kesić, T. & Previšić, J. (1998). Motivi upisa i zadovoljstvo nastavnim programom studenata ekonomskih i elektrotehničkih fakulteta u Hrvatskoj [Students' motives for enrollment in and satisfaction with the curricula of faculties of economics and electrical engineering in Croatia]. *Društvena istraživanja [Social Research]*, 7(4–5), 731–746. [In Croatian]
- Kolmos, A., Mejlgaard, N., Haase S. & Holgaard, J. E. (2013). Motivational factors, gender and engineering education. *European Journal of Engineering Education*, 38(3), 340–358. <https://doi.org/10.1080/03043797.2013.794198>
- Kostyszak, M., Wadowski, J. & Zaród M. (2015). Engineering education in Slavic language countries. In: S. H. Christensen, C. Didier, A. Jamison, M. Meganck, M. Mitcham, B. Newberry, (Eds). *International perspectives on engineering education. Engineering Education and Practice in Context, Volume 1*. Springer.
- Ma, Y. (2009). Family Socioeconomic Status, Parental Involvement, and College Major Choices – Gender, Race/Ethnic, and Nativity Patterns. *Sociological Perspectives*, 52(2), 211–234.
- Matusovich, H. M., Streveler, R. A., & Miller, R. L. (2010). Why do students choose engineering? A qualitative, longitudinal investigation of students' motivational values. *Journal of Engineering Education*, 99(4), 279–294. <https://doi.org/10.1002/j.2168-9830.2010.tb01064.x>
- Miloš, D. & Čiček, F. (2014). Findings on motivation and the environmental awareness and practice of future engineers in Zagreb. *Interdisciplinary Description of Complex Systems*, 12(2), 119–136. <https://doi.org/10.7906/index.12.2.2>
- OECD (2008). Encouraging student interest in science and technology studies. OECD Publishing /online/. Retrieved on 14th April 2011 from <http://www.sourceoecd.org/scienceIT/9789264040694>
- Pawley, A. L. (2009). Universalized narratives: Patterns in how faculty members define “engineering”, *Journal of Engineering Education*, 98(4), 309–319. <https://doi.org/10.1002/j.2168-9830.2009.tb01029.x>
- Potočnik, D. (2008) Izbor studija: motivacijska struktura upisa i očekivani uspjeh u pronalasku željenoga posla [Going to university: Motivation structure and expectations for finding a desired job]. *Sociologija i prostor [Sociology and Space]*, 46(3–4), 265–284. [In Croatian]
- Reed, B. & Case, J. (2003). Factors influencing learners' choice of mechanical engineering as a career. *African Journal of Research in Mathematics, Science and Technology Education*, 7(1), 73–83. <https://doi.org/10.1080/10288457.2003.10740550>
- Renninger, R. A. (2000). Individual interest and its implications for understanding intrinsic motivation. In: C. Sansone, J. M. Harackiewicz, (Eds.) *Motivation. The search for optimal motivation and performance*. London, San Diego: Academic Press.
- Rijavec, M., Brdar, I. & Miljković, D. (2008). Aspirations and well-being: Extrinsic vs. intrinsic life goals. *Social Research*, 20(3), 693–710.

- Riley D. & Claris L. (2009). From persistence to resistance: Pedagogies of liberation for inclusive science and engineering. *International Journal of Gender, Science and Technology*, 1(1), 36–60.
- Sansone, C. & Harackiewicz, J. M., (eds) (2000). *Intrinsic and extrinsic motivation: The Search for optimal motivation and performance*. San Diego: Academic Press.
- Savage, N. & Birch R. (2008). An evaluation of motivation in engineering students. Employing self-determination theory. *Proceedings of the International Conference on Innovation, Good Practice and Research in Engineering Education 2008*, pp. 1–10 /online/ Retrieved on 27th May 2011 from https://www.heacademy.ac.uk/sites/default/files/p012-savage_1.pdf
- Sennett, R. (1998). *The corrosion of character: The personal consequences of work in the new capitalism*. W. W. Norton & Company.
- Seymour, E., & Hewitt, N. M. (1997). *Talking about leaving: Why undergraduates leave the sciences*. Boulder, Colorado, Westview Press.
- Shumba, A. & Naong, M. (2012). Factors influencing students' career choice and aspirations in South Africa. *Journal for Social Sciences*, 33(2), 169–178. Retrieved on 7th June 2013 from [http://www.krepublishers.com/02-Journals/JSS/JSS-33-0-000-12-Web/JSS-33-2-000-12-Abst-PDF/JSS-33-2-169-12-1397-Shumba-A/JSS-33-2-169-178-12-1397-Shumba-A-Tx\[4\].pdf](http://www.krepublishers.com/02-Journals/JSS/JSS-33-0-000-12-Web/JSS-33-2-000-12-Abst-PDF/JSS-33-2-169-12-1397-Shumba-A/JSS-33-2-169-178-12-1397-Shumba-A-Tx[4].pdf)
- Shulman, L. S. (2005). If not now, when? The timeliness of scholarship of the education of engineers. *Journal of Engineering Education*, 94(1), 11–12.
- Sirin, S. R. (2005). Socioeconomic status and academic achievement: A meta-analytic review of research. *Review of Educational Research*, 75(3), 417–453. <https://doi.org/10.3102/00346543075003417>
- Svoboda, R. C., Rozek, C. S., Hyde, J. S., Harackiewicz J, M., Destin, M. (2016). Understanding the relationship between parental education and STEM course taking through identity-based and expectancy-value theories of motivation. *AERA Open*, 2(3), 1–13.
- Trevelyan, J. (2010). Reconstructing engineering from practice. *Engineering Studies*, 2(3), 175–195. <https://doi.org/10.1080/19378629.2010.52013>
- UNESCO Report (2010). *Engineering :Issues, challenges and opportunities for development*. UNESCO Publishing.
- White, K. (1982). The relation between socioeconomic status and academic achievement. *Psychological Bulletin*, 91, 461–481. <https://doi.org/10.1037/0033-2909.91.3.461>

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