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INITIAL CONSIDERATION OF THE ENTERPRISENESS OF THE UNDERGRADUATE STUDENTS IN CROATIA

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ABSTRACT

The article discusses the interplay between the enterpriseness and higher education. Current attitudes toward enterpriseness of the Croatian undergraduate students of mechanical engineering were collected partially with a questionnaire. The attitudes are analysed and their alignment with the general technology trends discussed.

KEY WORDS

enterpriseness, venturesomness, higher education institution, mechanical engineering, Kranzberg's laws

CLASSIFICATION

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INTRODUCTION

Enterpriseness is a general human characteristic, observable in different fields. It is related extensively to the entrepreneurship, but also to the creativity and innovativeness. Ranging from shorter-in-time chapters of one's life to life-long endeavours, it presents the unavoidable, constantly present, often ubiquitous impetus for final result, which is a change spanning forms from local improvement in life to global, historical technological changes. That makes the enterpriseness rather important for our whole civilisation.

A spontaneously arising question is in what amount can the enterpriseness be cultivated, that is learned, either as an accompanying part or as the central point of an education process? In addition, do we already have developed and reliable methods for determining the portion of the enterpriseness that is intrinsic to an individual?

There is extensive literature covering inclusion of enterpriseness-related topics into education, ranging from initial education [1] to higher education [2], along with informal approaches [3]. The topic is far from resolved, partially because of the dynamics character of the enterpriseness' approaches in the more digitised world.

This article has twofold goal. On the one hand, it discusses how enterpriseness is intertwined with the technology basis, with the later formulated in the form of Six laws of technology by M. Kranzberg [4]. On the other hand, as an initial additional contribution, we collect and analyse the preliminary data about the attitudes toward enterpriseness that some undergraduate students of mechanical engineering have.

In section two, we present theoretical framework and critically approach the role that enterpriseness has in it. Section three is devoted to questionnaire formulation and presentation of the collected results. Section four summarises and concludes the article.

RELATING ENTERPRISENESS TO TECHNOLOGY

REPRESENTATION OF THE TECHNOLOGY

On a general level, in this section we represent the technology basis, and tackle its role in society using the Kranzberg's Six laws of technology [4]. In this subsection all these laws are listed, for completness. In the second subsection we relate the enterpriseness to first four of these laws.

Kranzberg's First Law of technology read as follows: Technology is neither good nor bad; nor is it neutral [4]. In order to understand it, one must take into account that technology is applied or introduced within some society. That application influences and changes lives of a group, usually of many people. Moreover, the change itself is a process, and eventually brings about a set of consequences. The corresponding dynamics needs time to develop and conduct. Dominant and additional consequences of introduction of a particular technology change during some time span. Because of that, a consequence that was in some time period considered as a good for a group of people tackled by it, can be considered by same group as bad in a different time period, still within a time span of the technology's consequences. There are other possibilities, in that within the same time period for a part of influenced people the consequences are good and for other part of influenced people bad. However, since technology induces a change, it is constantly evaluated as a good or bad, thus not neutral.

Kranzberg's Second Law of technology read as follows: Invention is the mother of necessity. In order to understand it, one must take into account in more details the typical S-curve pattern of innovation [5, 6], as a specific manifestation of the dynamics of innovations [7]. After the initial period of introduction of a technology, a majority of population starts to use it. Gradually, from habit, through being something useful technology adoption becomes a necessity in order that someone is aligned with the majority of the population.

The Third Law of technology states that technology comes in packages, big and small. Kranzberg himself states that the notion of package other people denote as a system. The meaning of that law is that one cannot separately introduce a single change in the society. There is as a rule a myriad of connected changes, a sequence of related innovations and inventions, that in the end result in new technology. In that sense, introduction of a technology is like making of a chain – one needs a lot of links connected, each link must function properly and each link is necessary.

The Kranzerg's Fourth Law of the technology is "Although technology might be a prime element in many public issues, nontechnical factors take precedence in technology-policy decision". The role of humans in directing the technology is thereby implicitly considered as a crucial. It does not simply mean that humans conduct all the research, development and other types of work underlying the introduction of a technology. Instead, it emphasises the facts that technologies which are considered relevant and understandable by a given population, eventually develop in encouraging social environment, have more possibilities to assure funding, to utilise existing skills and tools, etc. Overall, they have the larger probability for development and introduction in comparison with the technologies that are not considered relevant, or that are not understandable to a majority of people.

The remaining two laws ask for a much broader context and discussion in order to be sufficiently covered and understood as the previous four. Kranzberg's Fifth Law: All history is relevant, but the history of technology is the most relevant. Finally, the Sixth Law of the technology states that technology is a very human activity – and so is the history of technology.

ENTERPRISENESS WITHIN THE LAWS OF THE TECHNOLOGY

Regarding the First Law of technology, it is in fact impossible to predict precisely possible consequences of introduction of a technology. But one may expect that thorough thinking about possible consequences, during research and development of a technology as well as during other phases of its introduction, contributes to lessening the outcome of bad consequences and to maximising the outcome of good consequences. That can be augmented by introducing relevant classes into regular, formal or informal education since that includes also the enterprisers. Examples of relevant classes include classes about ethics in technology related disciplines, as well as classes about systems theory. With that approach one may argue that short- and middle-term consequences of a technology can be in a larger portion good. Regarding long-term consequences one may argue that they will be partially influenced with middle-term societal dynamics that considerably lessen the possibility to predict them in a reliable amount nowadays. Yet, that considered time span also provides significant period for timely observation of possible bad consequences and for timely development and application of measures that will lessen these.

Second Law of technology point to one fact that is in the basis of human society, a constantly conducted pattern: change in the technological level causes changes in society, which brings about possibility for further changes in the technological level. In itself, that pattern is neither good nor bad, but also not neutral (before proceeding let us emphasise that the very formulation of the First Law of technology has been here applied in a meta-theoretic way onto the Second Law of technology). If that is generally constant, repeatable pattern, then one can discuss and (also on the general level) prescribe parts of that pattern which can have important consequence onto some person's enterpriseness and corresponding initiatives.

Aforementioned relating the enterpriseness with the First and Second Laws of technology relied on the emphasising the possible consequences, that implies somewhat more analytic approach. Yet, the synthesis of the consequences and its causes in the dynamics of technologically modified society, must be constantly taken into account. The way that incorporates partially analytic and partially synthetic point of view is the systems point of view, as developed within the systems theory and systems thinking. Its importance for the proper evaluation of the technology was identified in the aforementioned of the alignment of the enterpriseness and the First Law of technology. Here one encounters additional aspect – a package (or a system) gradually emerges out of the large number of inventions and innovations, which has diffused through society. Innovators, one type of the enterprise people, the people who creates them are naturally important for existence of the inventions and innovations. Yet, another type of enterprise people, the organisers, is also important. The organisers are people who combine existing innovations and inventions with other characteristics of the society and thereby form that very self-contained, robust and sustainable package (the system) that underlies the notion of the technology introduction.

In the context of this article, the Fourth Law of technology stresses previously stated need for proper inclusion of ethical concepts into regular education, so that it maximally influences the enterprisers.

DATA COLLECTING AND ANALYSIS

DATA COLLECTING

Data collecting was taking place using the questionnaire, during summer and autumn od 2022, among the students of the technical profile of the University of Zagreb, in particular of the undergraduate and graduate studies Faculty of Mechanical Engineering and Naval Architecture. The purpose of the data collecting was to gain some insight about the students' experiences of non-technical aspects and problems related to their technical work. The questionnaire formulated was of preliminary character and the results presented here are on the one hand also the basis for further, more detailed and thorough collecting of data.

The questionnaire was given during the seven university classes belonging to different study areas. Classes were chosen following the several criteria. First criterion is that the students know their study in some extent, both in the organisation of the study and in the content of the classes. That was fulfilled by giving the questionnaire to graduate students. The second criterion is that classes are connected to professional areas that are considered rather novel and innovative, to be contrasted with the classes belonging to well established professional areas, that are considered as requiring presumably application of previously gathered knowledge. Overall, such a criterion should be fulfilled at the individual level, by students that (answering the part of questions) profile themselves as enterpriseners. One may argue that it is partially included along by choice of the classes. Naturally, there are many other classes that fulfils both stated criteria.

The students were asked to fill the questionnaire during the regular classes, in agreement with the faculty and corresponding professors. Time span of the questionnaire was initially determined by pandemic measures, that restricted the access to the classes and communication among the students and the faculty personnel and eventually disabled filling the questionnaires until the second half of the 2022. The questionnaires were printed on paper and filled during July and October of 2022, during regular face-to-face classes. One of the authors was always present during the questionnaire filling, but altogether there was no additional question asked by the students. We considered the questionnaire to be filled if all closed-type questions were answered. There were 56 completely filled questionnaires, all used in subsequent analysis. Among these, there were altogether three questionnaires containing writen answers to the open type question and its sub-question. Collected answers were transcribed into Google-form for questionnaire analysis.

The questionnaire consists of nine questions; eight of the closed type with given answers and the last one of the combined type. Seven of the closed-type questions asks for precisely one answer, while the eight closed-type question allows the multiple answers. Some of the questions of the closed type are listed in the figures. The question of combined type has one closed and one open sub-question. Its closed sub-question asked the students to address the main reason for not doing sufficient number of simulations and/or models (including not doing them at all). The accompanied open sub-question asked the students to describe why they chose a particular reason. In addition, since among the list of given answers included the money, in case that the students marked it as a reason they were additionally asked to describe what would they use any additional money for. In order for the questionnaire to be concise, we did not include into it many other questions, rather relevant for the topic.

The questionnaire is stated as follows:

1) How old are you?
2) What is your study year?
3) Where did you finish your middle school?
4) Do you make privately objects from out of different materials (metal, paper, cardboard, wood, stone, plastic, textile, …)?
5) Do other people (parents, cousins, neighbours, friends, …) help you in making the objects?
6) Do you make computer simulations of the objects that do not exist yet?
7) Do you plan or wish to make objects and computer simulations that do not exist yet?
8) If you do not make such objects or computer simulations, or make them in too small a number, what do you consider to be main reason for such a case (multiple answers possible)?

DATA ANALYSIS

Basic statistic was conducted on the received answers, having in mind that their total number is rather small for reliable extraction of eventually possible, additional characteristics.

Most of the students, and their average age is 23 years. Since classes during which the questionnaires were filled belong prevalently to graduate study, this is to be expected. There are few rather young students, which is probably a consequence of their starting the elementary schooling in earlier age than average children, along with few older students. Some of the previous statements are along with the answers to the second question, since 46 (82 %) of the students are the graduate students.

Prior to entering the university, students were in 28 different middle schools, mainly in Croatia, but some also in neighbouring countries. There were no additional questions to find out whether these schools are vocational schools or gimnasia.

Regarding three further questions (numbers 4-6) students prevalently do not make any of asked products. In particular, 68 % do not make any objects, while 82 % do not make computer simulations. Thus, out of the 32 % of students who make some objects, the 56 % of them conduct computer modelling. For the present moment we cannot relate that percentage to other data, thus to contextualise it. Before proceeding let us note that in general there are students who make objects without conducting computer simulations as well as students who conduct computer simulations without making the objects, along with the students who do both these actions. Moreover, out of the 32 % of student who make some objects, the 78 % of them use some sort of help from other people (family members, relatives, friends, ...). We do not have additional data to check what percentage of the help provided belongs to advices and additional knowledge, and what to mere physical help in case that making of some object requires simultaneous work of two or more people.

Regarding the seventh question, 60 % of students wish to make objects or their computer models.

Regarding the eighth question, majority of students (60 %) list lack of time as the main reason preventing them from making objects or conducting computer modelling. Having in mind that generally the corresponding undergraduate and graduate studies are considered as demanding ones, that seems consistent. Other listed obstacles for individual student making of objects or conducting computer simulations are: lack of knowledge (49 %); lack of will (36 %); lack of appropriate tools (30 %); lack of raw materials (19 %) or something else. In additional subquestion it was clarified in three questionnaires that something else was money (2 answers) and tiredness (1 answer). If provided with additional money, both students would buy additional tools, and one of them also the licensed software. The answer about tiredness belong to the student who privately work, so if eventually too tired to make some objects in the small available free-time.

Overall, most of the students are concentrated on the regular studies, and that leaves them too small time for additional professional endeavours like is making objects and/or conducting computer simulations. If a change of that is wanted than the most prospective way seems to be modification of regular classes. Individual work of students is rather rare, yet additionally demanding and in fact more than fulfils their desire for making objects and conducting computer simulations. It is to be noted that the questionnaire was conducted among the students that regularly enrolled the classes, so one may expect that among other groups of students there is a larger number of the students who spend more time on making objects or conducting computer simulations, for their individual purpose or as employees or contractors.

SUMMARY

Enterpriseness is a general, rather fundamental human characteristic, manifested in diverse fields. It is insufficiently researched, not sufficiently resolved, thus many times it is interpreted as the enterpreneurship, but also as the creativity, ingenuity and related human characteristics.

In this article we related two fundamental notions: enterpriseness as an individual characteristic with technology as a collective characteristic. The emphasis is put onto the education for enterpriseness in order for it to contribute optimally to further technology progress. Data initially collected for grounding our approach are analysed.

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