sustainability

MDPI

Article

Engineering Students' Human Values as Rhizomatic Lines of Sustainability

Gabriel-Mugurel Dragomir [1], Mariana Cernicova-Buca [2,*], Vasile Gherheș [2,*] and Liliana Cismariu [2]

[1] Department of Teaching Training, Politehnica University Timisoara, 300006 Timisoara, Romania; mugur.dragomir@upt.ro

[2] Department of Communication and Foreign Languages, Politehnica University Timisoara, 300006 Timisoara, Romania; liliana.cismariu@upt.ro

* Correspondence: mariana.cernicova@upt.ro (M.C.-B.); vasile.gherhes@upt.ro (V.G.)

Received: 28 July 2020; Accepted: 7 September 2020; Published: 9 September 2020

Abstract: The study reports on research carried out at the five major technical higher institutions in Romania. It views the human values students bring with them to the educational setting as rhizomatic lines, in the Deleuzian sense, and aims at identifying the intensity of each value, respectively, at grasping the correlations between the students' values and their projection concerning postgraduation life, including nomadic (i.e., migration) intentions. Such an approach is novel in educational research. The 1782 valid responses collected after applying an online questionnaire were subjected to multivariate statistical analyses. The results unfold the research stages, from intensity-identification concerning the 18 values included in the questionnaire to the factor extraction and correlation findings that highlight strata beneath the upper layer of responses. The values boil down to three nodes of the rhizome, anchoring the Romanian engineers-to-be in the present setting and allowing them to grow in a sustainable manner, i.e., to become professionals, socially accepted, and belonging to a group. The findings are useful to professors, who need to constantly check their assumptions about the profile of the young generation, to better ground their partnership relation with students in moral realities that are relevant and help learners face disruption, crisis, incertitude.

Keywords: higher education; engineering students; rhizome; social sustainability; values; multivariate statistics; factors mining

1. Introduction

The scientific literature, popular press, and polity reports on higher education vocally and energetically warn that the millennium-old university structure needs profound and radical rethinking. Since in the early 1970s, harsh voices called for "deschooling society" [1], due to the fact that the democratization of the educational system led to an industrial mode of mass production of skilled, but uniformized labor force. "Hey, teachers, leave the kids alone"—sang Pink Floyd, a rock band popular at the time, blaming the levelling effect of the education that transforms each and every human being into "another brick in the Wall" (1979). However, education is here to stay. Even Ivan Illich, the very author who called for a deschooling society, acknowledges that "the history of homo educandus deals with the emergence of a social reality within which «education» [planned learning] is perceived as a basic human need" [2] (p. 113). Increasingly higher levels of schooling are required to ensure access to the labor market. University diplomas, though not guaranteeing employment, make a huge difference in favor of the candidate capable of presenting them as part of the recruitment process [3]. Employability, the level of financial security, and self-realization directly depend on

education, evidence being produced that "higher education pays, both financially and socially, for the individual as well as society" [4].

1.1. A Global View on Higher Education

For the society at large, education is viewed as an indispensable element for sustainable development [5]. To be an agent of sustainable development, education needs itself to consider the local environmental, economic, and societal conditions. As UNESCO emphasizes, such an educational model has to meet the needs of present and future generations, to accommodate the evolving nature of the concept of sustainability and, among other features, to build capacity for community-based decision making, social tolerance, environmental stewardship, adaptable workforce, and quality of life [5]. The dramatic changes in society have triggered changes in the way education is seen, organized, and provided for the learners. New and increasingly more sophisticated tools are developed to ensure a global pace for educational systems and convergent evolutions, as one can see from the World Bank's strategy for education [6]. This institution took upon itself the task to provide "system assessment and benchmarking tools, along with data, to assess the capacity of an education system to improve learning outcomes; assessments of student learning and achievement that cover the basic competencies of reading and numeracy, as well as other skills, including critical thinking, problem solving, and team skills; and impact evaluations and other analytical work that can inform policies and interventions, together with knowledge exchange and debate that facilitate learning across partner countries and organizations" [6] (p. 8). In a more nuanced manner, UNESCO calls for supplementing the standardized tests that assess the quality of education with evaluations of life skills, perceptions, behaviors, and values [5].

1.2. Sustainability and Higher Education

In the reconstruction towards responsibility for the world, engineering education holds a special place. It is framed as a key factor for the sustainable development of a region or country [7], a sign of modernity and, at the same time, a precondition to ensure the human capital needed in a sustainable, sound, social and economic environment. Unlike the popular assumption that "organizational and market incentives will adequately guide engineering towards outcomes that serve the public good" [8] (p. 151), the research team carrying out this study considers that educational institutions play a role in shaping the future engineers as an agent of sustainable development for the society where they intend to build a career path. Education for sustainability starts with designing faculty–student relations as partnerships for the transformational journey that helps learners to become professionals. Only in such a manner, students' "feelings of inclusion and belonging while nurturing others' growth and experiencing one's own growth are what constitute (in the present) and contribute to (future) human sustainability" [9]. Studies on the topic show that "though many engineering schools are trying to develop their sustainability related curriculum, most are still struggling" and tend to produce "technically competent barbarians," instead of integrated citizens capable of emotional and professional interaction with the social environment where they exercise their profession [10].

In a compelling effort to decipher the subtle meaning of social sustainability, Amartya Sen suggests "that human development coincide with the expansion of capabilities (« … [a] development that promotes the capabilities of present people … » Sen, 2000: 5). If this enlargement of the space of choices is expected to hold in the future (« … without compromising capabilities of future generations», ibid: 5) it is possible to refer to it as sustainable (human) development" [11].

Sustainability is often treated in scientific literature as "a function of values" [12–14]. Such values need a careful and respectful handling, organizations being often criticized for their somewhat brutal intervention in the "beliefs and ways of behaving so as to bring them more in line with the organization's pre-existing methods and beliefs" [15]. The educational system is a transformative one, proposing to incoming students to adhere to the organizational (university) values and to embrace the professional values of their future employment. Studies on the human values of students are

scarce and predominantly measure these in association with psychological traits and/or with ethical considerations [16,17].

1.3. The Call for New Paradigms and Metaphors

The educational system is constantly measured, weighed, checked against society's needs, expectations, and demands, and analyzed in terms of input and deliverables. In the postmodern society, the way in which knowledge and skills are produced, developed, and transmitted has changed, and universities cease to be the sole beacon of science and wisdom. As Le Grange inspirationally states [18], "the foundations of the modern era (including modern educational institutions) are under sharp scrutiny; the fragmentation of nature, society and self is evidence of the cracks in the foundations. In times of crises old questions often come to the fore." In such times, institutions, values, and key concepts need to be revisited. Influential authors like Ken Robinson [19], Anthony Seldon [20], Aharon Aviram [21], or Ronald Barnett [22] call for new metaphors and fresh visions in relationship with the educational system as a whole and with universities as particular institutions.

Robinson warns that "our school systems are now a matrix of organizational rituals and intellectual habits that do not adequately reflect the great variety of talents of the students who attend them" [19]. He makes a warm and compelling plea for a richer personalization of education, for a revolution in education, "based on different principles from those of the standards movement" that would allow for organic education and the manifestation of natural creativity and talent of the learner.

Coming from a different background, Seldon focuses on the social and technological environment which directly impacts education, and concludes that: "There is a profound mismatch between the way we are educating our young and the world we're educating them for, and what should, and could, be happening" [20]. For him, the industrial model of organizing education is outdated for other reasons than for Robinson, namely that technological advances remove the barriers for personalized, affordable education, tailored to the individual, instead of forcing homogeneous and standardized patterns, specific for what he calls "the third education revolution stage" [20]. The provocative manner in which Seldon discusses the administrative-bureaucratic burden on teachers and the critical view on the current state of education reflects common concerns regarding education, even if the technological panacea he proposes is not necessarily the response many educators would accept for dealing with the necessity of transformative action. Seldon is by far not alone in the analysis of the impact digitization brings to the educational arena and to sustainable development due to stewardship in education. An extensive bibliometric analysis of the topic showed that the number of articles connecting higher education and sustainability is growing, bringing nuances and clarifications with respect to the rainbow of elements pertaining to these two terms. The authors draw attention to the fact that "one of the most important challenges of sustainable development is the demand for innovative alternatives and new ways of thinking in HEIs [higher education institutions]" [23].

In his turn, Aviram makes an ardent argument for "reinventing education for postmodern democracies," highlighting the fact that the scientific, technologic, social, and medical changes in society—all part of the postmodern cultural crisis—could not and did not exclude education. In his words, there is an urgent need to bridge the gap between the structures and conceptions shaping the way in which education operates in Western societies and the chaotic and divergent reality of post-modernity. This gap renders the educational system "non-functional from both social and organizational perspective" [21] (p. XVI). Social—because current education systems fail in serving current economic and cultural needs; organizational—because in many aspects the educational systems described lost the capacity to operate meaningfully and coherently. In discussing the possible scenarios for steering education on the unchartered waters for postmodernity, Aviram offers ample food for thought both for educators and for education policy makers so that they embrace courageous decisions in allowing for the endless reinventing of educational institutions and processes. Also, he draws attention to the fact that "while the former, modern conception regarded the learner's minds as basically passive vessels for archiving a given quantity of content," the postmodern paradigm sees

students as "active agents occupied with solving problems that are of relevance and interest to them, by reconstructing their cognitive structure." Learning is no longer seen as a process during which "the teacher pours into an empty vessel, but as a proactive process of constructing new cognitive structures produced by the learner" [21] (p. 132). Despite the critical view on the situation, Aviram's conclusion is optimistic, pointing out that "a society that successfully deciphered the human genome and is building and manning space stations is certainly able to support productive processes of rethinking its education and future" [21] (p. 334).

All the cited authors, despite the variety of paradigms brought into discussion, still maintain the focus on the human factor, compensating the (apparent) disproportion in the interest towards the physical aspects of sustainability by comparison to the social environment in which the skilled workers-to-be are rooted [13].

1.4. The Rhizomatic Proposal

In this gallery of critical reflections on the status of (higher) education, Barnett holds a special place. He invites the audience to focus on what a university is or should be, beyond the various propositions found in the educational and/or political discourse regarding the entrepreneurial, bureaucratic, scientific university and the like [21]. "Being a university is always a matter of becoming a university"—thus a university enters the world—and a university "is active in the world" [22] (p. 62). The university "is seeking to become itself," conducts "inquiries into itself," takes "its own self-understanding forward" so necessary "to edge seriously towards its full possibilities" [22] (p. 62). Barnett's view on the becoming process relies on Deleuze and Guattari's concept of becoming, be it related to people, or to the planet as a whole [24]. If the discussion on the university and its relation to society needs to be reconceptualized, we can draw inspiration from the wisdom of plants, who, according to Deleuze and Guattari "connect to multiple organisms and entities: Even when they have roots, there is always an outside where they form a rhizome with something else—with the wind, an animal, human beings (and there is also an aspect under which animals themselves form rhizomes, as do people, etc.)" [25] (p. 11).

A rhizomatic view on education provides fresh paths to understand and, possibly, explain the multiple facets of the process that prepares people-yet-to-come for life on a planet-yet-to-come [26]. At the same time, Deleuze and Guattari's philosophy on education breaks free from the Procrustean bed type of approach, imposed on the educational systems by international organizations (be they concerned with educational matters or with political and economic implications of education) that regulate, rank, and herd all educational institutions and processes into rigid, hierarchical, and arborescent patterns. A rhizomatic approach "creates or maps new possibilities for growth—new possibilities for knowing and being" [18]. It may also account for explanations concerning the resilience of universities in disruptive times, because "a rhizome might become broken, shattered at a given place, but it will again grow on one of its old lines, or on new lines" [18].

The rhizomatic view of the world "considers the whole inextricable combination of interrelated assemblages of individuals and groups and includes: Humans, non-humans, material resources, non-material resources. In this regard, the rhizome offers a novel way of perceiving our world and, in doing so, enables us to consider the interconnection of knowledge construction, society, culture, attitudes and/or values" [25] (p. 6). Moreover, we need to create space for the deconstruction of old narratives and worldviews, while engaging in "reconstructing them with an awareness of how we share responsibility for the state of the world" [27] (p. 109).

The research team involved in the present study draws inspiration from the existing body of literature and looks into Romanian engineering education, focusing on the values and beliefs of students, i.e., future engineers, portrayed by various reports not only as professionals-to-be, but also as people-on-the-go, animated by nomadic predispositions, and relying more on individualistic goals than on an interest in the public good [28,29]. Offering an alternative view to the mainstream opinion, namely that the stability of a highly skilled workforce in a region is a prerequisite for sustainable development, Deleuze and Guattari associate nomadism with free spaces for thinking as "nomads

think without limits or boundaries and, in the process, generate creative and imaginative frames of thinking" [25] (p. 9). This freedom in projecting the future makes the 21st century students and graduates difficult to pin to the pre-determined patterns dominant in the 19th and 20th centuries.

This study focuses on students as vital partners in education. They come to the university with expectations and hopes to successfully engage in their transformation into specialists, with a bright and fulfilling future awaiting upon graduation. While students are in school, society changes at an almost astronomical speed. Various studies and prognoses anticipate that "65% of children entering primary school today will ultimately end up working in completely new job types that don't yet exist" [30], or that by 2030 "up to 85 percent of the jobs that today's college students will have haven't been invented yet" [31]. Deleuze and Guattari encouragingly propose the orchid-wasp metaphor, allowing for imagining a future where the graduates can find their way of fulfilling their potential, despite disruptive processes or unchartered waters in which they navigate [18]. Viewed in an arborescent manner, or in a rhizomatic setting, education is called upon to embrace "approaches to learning processes that lead to enhancement of individuals' full potential and capabilities and that ensure that learners' differing needs, abilities, learning expectations and styles are respected" [32] (p. 11).

The present study aims at analyzing the nodes that help students build and rebuild their roots and lines connecting them to their self, to their traditions, and to their futures. Such nodes are the human values that accompany them throughout university, and subsequently, throughout their lives. They are embedded in the way students perceive ties with their families, friends, (future) employers, and society at large. The research team aims to:

- Map the human value system of the Romanian students;
- Mine the factors underlying the values of the student population and understand the correlations between the students' values and their projection concerning postgraduation life.

The interest in the students' values and intentions is an intrinsic element in considering students as educational partners whose voices, needs, and aspirations should always be central for organizing the educational process. Schooled locally, in the major university centers of Romania, the 21st century students perceive the world globally and imagine themselves in a variety of settings, shaped by their choices and beliefs.

Along these lines, the present study also investigates the nomadic predisposition (or, in other words, intentions to migrate) of Romanian engineers-to-be, in terms of their desire to seek fulfillment of their professional life domestically or abroad.

The objectives set forth by the research team are:

- Research objective 1 (RO_1): To measure the intensity of the human values shared by Romanian engineering students.
- Research objective 2 (RO_2): To map the value system of the polled student population.
- Research objective 3 (RO_3): To identify the factors accounting for the career-related projections of students upon graduation (domestically or abroad).

2. Materials and Methods

The data collection was carried out in a relatively homogenous type of institution, the main providers of education in hard sciences (science, engineering, technology, and mathematics, known as STEM) in Romania. Eurostat data show that one out of five Romanian university graduates are engineers, but studies on engineering education are scarce and deal mainly with the provided programs, contributions to the innovation system, or employability of the graduates [33]. While at the continental and global levels big datasets are built for drafting policies and/or orienting societal efforts towards convergent goals, this study works with what is called "small data," collected and processed to offer a generous perspective on the analyzed case, but close enough to the investigated topic, allowing for actionable data and discerning in-depth context for the alignment between students' objectives and institutional settings [34].

The three-stage approach allows for highlighting the embedded motivators of students for action and interaction, offering possible predictions concerning the assemblage they are likely to form after graduation, mainly in a social sense. While the number of engineering graduates in Romania is higher than the European Union average [29], a heavily significant proportion of students ponder migration in search of higher payment and better career opportunities than the ones offered in their home country [35]. The participants in the study, conducted from November 2019 to February 2020, were students enrolled in the five major technical universities of Romania, namely Politehnica University of Bucharest (UPB), the Technical University of Civil Engineering of Bucharest (UTCB), the Technical University of Cluj-Napoca (UTCN), Gheorghe Asachi Technical University of Iași (TUIASI), and Politehnica University Timișoara (UPT), higher institutions that educate over 80,000 students at the levels of Bachelor, Master, Doctorate [36]. The official acronyms for these universities are hereunder used in the tables and figures.

The team of researchers visited each university and obtained the approval of the academic leadership to carry out the polling of the student population. Participation required filling in an online self-administered questionnaire, posted on Isondaje.ro, a free online Romanian survey platform. To ensure the candor in offering responses, no personal identification data were collected. The participation was voluntary, and no incentives were used to elicit responses. 1783 valid questionnaires were obtained, as presented in Figure 1 below:

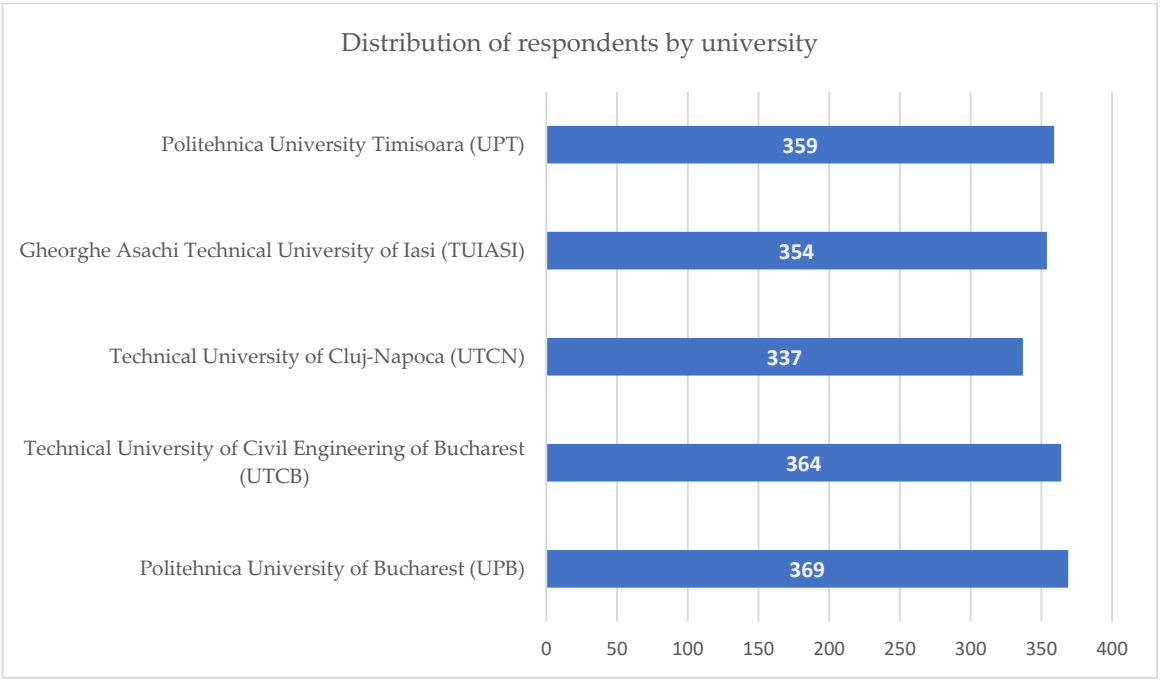

Figure 1. Distribution of respondents by university.

The data analysis was performed in Statistical Package for the Social Sciences (SPSS) Statistic Standard program and SPSS Analysis of Moment Structures (AMOS) programs versions 20. A multivariate statistical analysis was carried out to interpret the results [37]. The factors mining was selected to deepen the understanding of the layers of beliefs shared by the polled students and multiple tests were applied to validate the model. The questionnaire asked students to identify the values that underpin their lives (in an 18-items menu, see Appendix A) and to point to their career plans for the future, in terms of seeking employment domestically or abroad (intention to migrate).

3. Results

This section presents the results of the study in correlation with the research objectives, allowing to follow the obtained information by university, in comparison between universities and in the whole sample, represented by the five polled technical higher education institutions. The combination of methods brings forward numerous aspects that can prove useful in the quest for grasping the correlations and mutual interconnectedness of the values shared by the young generation.

3.1. The Intensity of the Human Values Shared by Romanian Engineering Students

The statistical averages of the responses concerning the human values included in the survey carried out in the Romanian technical universities show that the first top places in students' preferences are: *Personal dignity* (4.65), *protection of the family* (4.64), and *freedom of thinking and action* (4.60). The last three places in this ranking are occupied by: *Prestige or social status* (3.88), *feeling of belonging* (3.74), and *spirit of competition* (3.72) (Appendix B). Figure 2 below presents a comprehensive image of the obtained results.

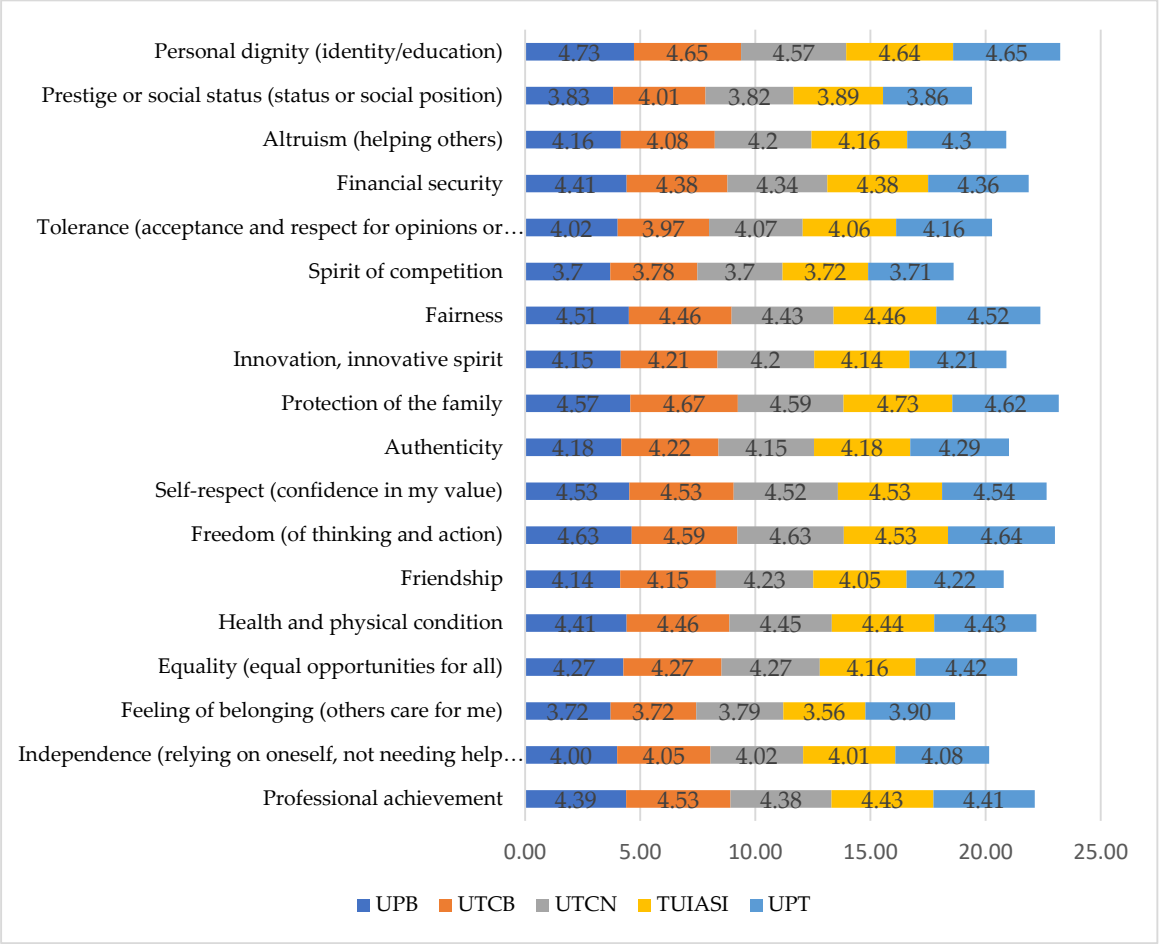

Figure 2. Values averages obtained in the sample.

The differences in the sample are interesting to note. Below are the highest rates obtained by comparison to the average values, by items in the survey: *Personal dignity* (identity/education): 4.73 at UPB (sample average is 4.65); *prestige or social status* (status or social position): 4.01 at UTCB (sample average is 3.88); *altruism* (helping others): 4.30 at UPT (sample average is 4.18); *financial security*: 4.41 at UPB (sample average is 4.37); *tolerance* (acceptance and respect for opinions or groups other than one's own): 4.16 at UPT (sample average is 4.05); *spirit of competition*: 3.78 at UTCB (sample average is 3.72); *fairness*: 4.52 at UPT (sample average is 4.48); *innovation, innovative spirit*: 4.21 at UTCB and UPT

(sample average is 4.18); *protection of the family*: 4.73 at TUIASI (sample average is 4.64); *authenticity*: 4.29 at UPT (sample average is 4.20); *self-respect* (confidence in my value): 4.54 at UPT (sample average is 4.53); *freedom* (of thinking and action): 4.64 at UPT (sample average is 4.60); *friendship*: 4.23 at UTCN (sample average is 4.16); *health and physical condition*: 4.46 at UTCB (sample average is 4.44); *equality* (equal opportunities for all): 4.42 at UPT (sample average is 4.27); *feeling of belonging* (others care for me): 3.90 at UPT (sample average is 3.74); *independence* (relying on oneself, not needing help from the others): 4.08 at UPT (sample average is 4.03); *professional achievement*: 4.53 at UTCB (sample average is 4.43).

Although such measurements may suggest ranking or hierarchies, in reality they do not place one value above another or one university ahead of (or behind) the rest. Unlike ranking, this analysis, based on standardized factors aimed at finding a place of the assessed university in a top of alike institutions, aims to signal to the academic body of each university what are the most intensive perceptions of the young generation concerning each of the human values included in the survey.

3.2. Mapping the Value System of the Polled Student Population

The comparison of the averages of more than two independent samples requires a careful selection of methods. The t-test for all combinations of two possible averages is not recommended because the risk of error is high. For the purpose of this research, covering samples from five universities, the ANOVA test is appropriate. The variance analysis (ANOVA) calculates the ratio between the variation caused between groups and the variation caused by intra-group differences and determines whether this ratio is large enough to distinguish between groups. This report is known as the variance report or the F report, from the name of the British statistician Ronald Fisher who developed it (the F report also appears in our calculations in Appendix C).

The one-dimensional variance analysis for independent scores showed a significant difference between students belonging to the five polled universities. It was found only for six of the analyzed 18 values. The Bonferroni method for analyzing the interval nuanced the conclusion and revealed that the difference does not expand over all the five universities in the sample, but highlights pairs or groups of universities (Appendix D).

In synthesis, Figure 3 below presents the map of averages obtained for each of the six significant values, by university.

To interpret the results, the following data are useful:

a. For the value *personal dignity*, the difference between groups is given by $F_{4.1777} = 2.953$, ($p = 0.019$).

The research highlighted that students at UPB differ from those at UTCN ($p = 0.007$) in the sense that UPB students value more personal dignity by comparison to those at UTCN ($Mean_{UPB} = 4.73$ vs. $Mean_{UTCN} = 4.57$; mean difference = 0.157 *). (* Correlation is significant at the 0.05 level, 1-tailed).

b. For the value *altruism* ($F_{4, 1777} = 3.333$, $p = 0.010$) is responsible for the differences encountered between polled groups.

Analysis shows that UPT students differ from those studying at UTCB ($p = 0.004$) in the sense that the first group values *altruism* more than the latter group ($Mean_{UPT} = 4.30$ compared to $Mean_{UTCB} = 4.08$; mean difference = 0.224 *).

c. The value *tolerance* also registered differences between the analyzed groups ($F_{4, 1777} = 2.549$, $p = 0.038$). The results reveal that there are differences between students at UTCB vs. those at UPT ($p = 0.023$) in the sense that UTCB students value less *tolerance* than UPT students ($Mean_{UTCB} = 3.97$ compared to $Mean_{UPT} = 4.16$; mean difference = −0.195 *).
d. The difference between the polled groups for the value *protection of the family* occurs due to ($F_{4, 1777} = 3.241$, $p = 0.012$). The results reveal that students at UPB differ from those at TUIASI ($p = 0.019$) in the sense that UPB students appreciate less the value of protection of the *family* than those of TUIASI ($Mean_{UPB} = 4.57$ vs. $Mean_{TUIASI} = 4.73$; mean difference = −0.154 *).

e. The value *equality (equal opportunities for all)* also presents different importance for the polled groups of students ($F_{4, 1777} = 3.869$, $p = 0.004$). This difference exists between students from UPT and those from TUIASI ($p = 0.001$) in the sense that UPT students value more *equality (equal opportunities for all)* than those at TUIASI ($Mean_{UPT} = 4.42$ vs. $Mean_{TUIASI} = 4.16$; mean difference = −0.260 *).

f. The difference between groups of polled students with respect to the value *feeling of belonging (others care for me)* is given by ($F_{4, 1777} = 5.016$, $p = 0.001$). The analysis shows that students at UTCN differ from those at TUIASI ($p = 0.043$) in the sense that the former ones manifest a higher intensity of attachment for the value *feeling of belonging (others care for me)* than the latter ones ($Mean_{UTCN} = 3.79$ vs. $Mean_{TUIASI} = 3.56$; mean difference = −0.224 *). Also, results show that TUIASI students differ from those at UPT ($p = 0.000$) in the sense that they have a lower attachment for the value *feeling of belonging (others care for me)* than the UPT students ($Mean_{TUIASI} = 3.56$ vs. $Mean_{UPT} = 3.90$; mean difference = −0.335).

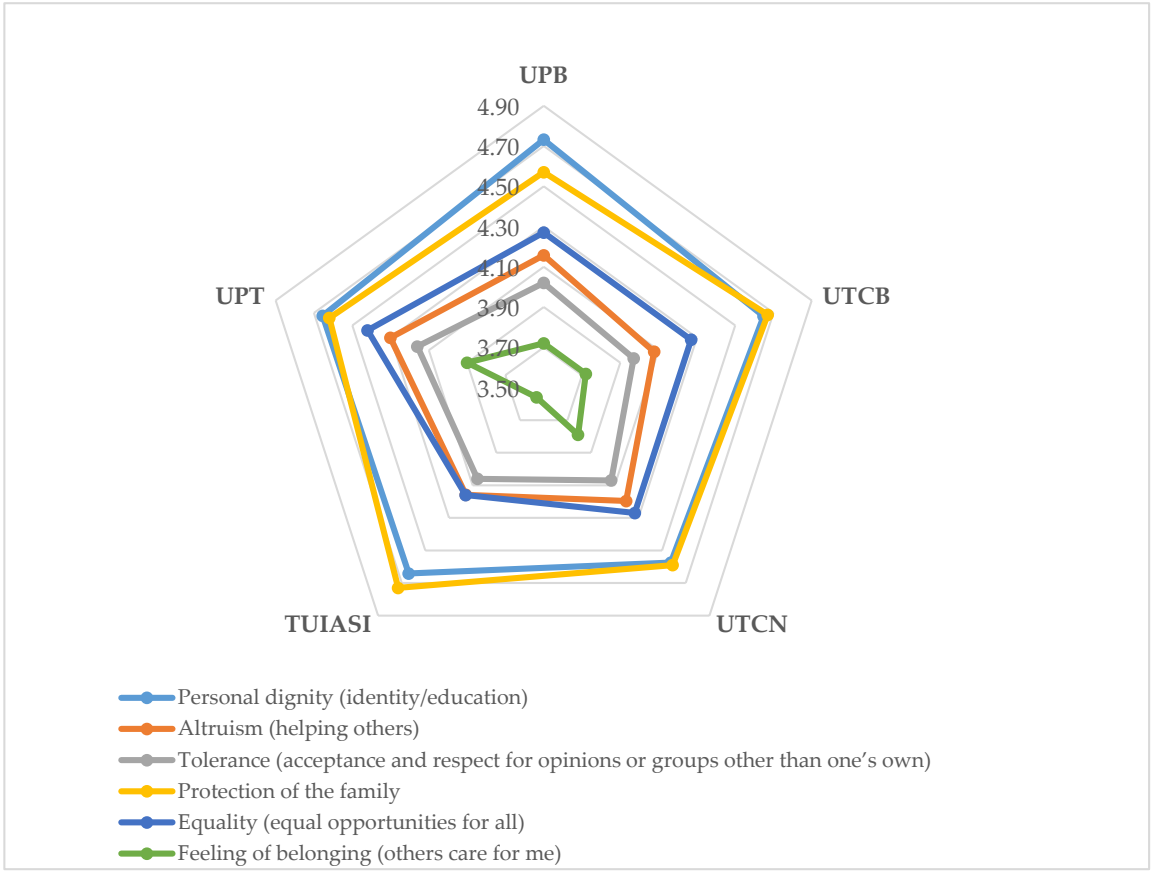

Figure 3. Intensity of the values in the sample.

3.3. Identification of the Factors Accounting for the Career-Related Life Choices of Students upon Graduation

Working with 18 items (values), although tempting and rewarding as a first step in the research, proves tiresome in the quest for identifying the bottom-line motivators of students' beliefs and actions. To refine our data and discover the pattern behind this variety of information we resorted to factor analysis. The advantage of this method is the reduction of the number of variables, by combining two or more variables into a single factor or more factors [34,37–39]. For something to be labeled as a factor, it should have at least three variables. The analysis investigates, thus, the possibility to identify such correlations in the constructed database. The method accounts for finding the common properties among a set of objects in the database and classifies a set of data based on their attributes or features. The generated factors consist of variables that are highly correlated among them and help knowing

what features affect the system to a significant degree. The methodological approach for this stage in our study is presented in Figure 4.

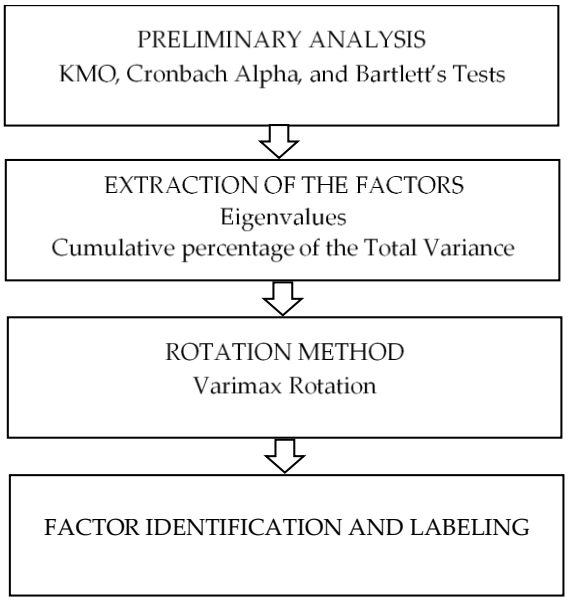

Figure 4. Design of the factor analysis.

The factor analysis is a multivariant mathematical technique traditionally used to give structure to the analyzed variables and reveal the latent forces behind the visibly noticeable information. For a consolidated view on the model, a two-step process is recommended, namely first, an exploratory factor analysis (EFA) on a sample of respondents, followed by the second step, a confirmatory factor analysis (CFA) on a different sample. [38].

To perform this type of analysis, we randomly split the sample of respondents in two subgroups, using SPSS program. Sample I, made of 922 respondents, was used for the exploratory factor analysis (EFA), and sample II, comprising 860 respondents, was used for the confirmatory factor analysis (CFA) [40].

To verify to what extent these samples may be subject to factor analysis, we have resorted to testing them through three specific tests, i.e., Cronbach's alpha, Kaiser-Meyer-Olkin (KMO) and Bartlett's tests.

The Cronbach's alpha test is used to assess the internal consistency of a questionnaire. The Cronbach's Alpha coefficients can take values between 0 and 1 [41]. In social sciences, a coefficient of 0.7 or higher is considered acceptable [37,41]. For sample I, the Cronbach's alpha test has a value of more than 0.8 for the items included in the study (Table 1), i.e., we have an internal consistency of the questionnaire items. For sample II, the Cronbach's alpha test has a value of more than 0.8, values included in Table 1.

The results of the Cronbach's alpha test show that the questionnaire items display a high level of internal consistency and are suitable for factor analysis.

The Kaiser-Meyer-Olkin test (KMO) measures how suited the sample is for factor analysis [39]. The recommended KMO values range between 1 and 0.5, with a percentage below 0.5 indicating that the sampling is not adequate and that remedial actions should be taken. The KMO value obtained for sample I is 0.856, and for sample II, 0.919, showing an adequacy of the samples chosen for the intended factor analysis (Table 1).

Finally, we used Bartlett's test of sphericity to confirm that our samples have patterned relationships. The Bartlett's test of sphericity returned a chi-square value for sample I of (2866.310), having several degrees of freedom (df = 78), and a $p < 0.01$. These values indicate that the dataset is adequate for factor analysis (Table 1). Sample II was also subject to the test. It returned a chi-square value of (4142.487), with several degrees of freedom (df = 153), and $p < 0.01$.

Table 1. Results of the Kaiser-Meyer-Olkin (KMO), Cronbach's alpha, and Bartlett tests on the two samples.

Type of Factor Analysis	**EFA—Exploratory Factor Analysis**	**CFA—Confirmatory Factor Analysis**
Sample	Sample I (922 respondents)	Sample II (860 respondents)
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	KMO = 0.856	KMO = 0.919
Bartlett's Test of Sphericity	χ^2 = 2866.310	χ^2 = 4142.487
	df = 78 sig. = 0.000 (<0.01)	df = 153 sig. = 0.000 (<0.01)
Value	Cronbach's alpha if Item Deleted (>0.8)	Cronbach's alpha if Item Deleted (>0.8)
1. Personal dignity (identity/education)	0.854	0.859
2. Protection of the family	0.860	0.862
3. Freedom (of thinking and action)	0.857	0.858
4. Self-respect (confidence in my value)	0.855	0.859
5. Fairness	0.858	0.860
6. Health and physical condition	0.861	0.864
7. Professional achievement	0.855	0.858
8. Financial security	0.853	0.855
9. Equality (equal opportunities for all)	0.857	0.861
10.Authenticity	0.853	0.855
11. Innovation, innovative spirit	0.852	0.856
12. Altruism (helping others)	0.853	0.857
13. Friendship	0.857	0.861
14. Tolerance (acceptance and respect for opinions or groups other than one's own)	0.854	0.862
15. Independence (relying on oneself, not needing help from the others)	0.856	0.861
16. Prestige or social status (status or social position)	0.860	0.866
17. Feeling of belonging (others care for me)	0.864	0.865
18. Spirit of competition	0.855	0.858

The results of these tests summed up in the table below (Table 1) verified that a factor analysis is adequate for this study and may offer additional information on the analyzed topic. Hereunder, we present the results of the tests for both samples, but the discussion of each sample is unfolded separately.

3.3.1. Exploratory Factor Analysis (EFA)

The EFA analysis was carried out on Sample I (922 respondents) by running the data SPSS program. The results show that only 13 out of the 18 items from the questionnaire allow for the factor analysis, namely those that present saturations higher than 0.5 in the extracted factors. The results indicate that for each item included in the survey different averages have been obtained, showing that respondents resonate in a nuanced manner to every value they were invited to assess.

A complete description of the results includes the obtained averages and the standard deviations from the highest value obtained for *self-respect* (mean = 4.53; σ = 0.742) to the lowest value, obtained for *feeling of belonging* (mean = 3.74, σ = 1.03) (Appendix E).

The EFA calculations show that only three factors register a value higher than 1, i.e., they account for more than a single variable. The rest of the factors, which were not extracted, present a variation of the error that cannot be accounted for (Appendix F).

The factor rotation shows that the first factor explains 19.639% of the variance, the second factor explains 19.316% of the variance, and the third factor explains 13.536% of the variance. Summed up, the three factors explain 52.491% of the variance, a result we consider satisfactory for our study.

The curve of the 13 variables (Figure 5) and the results in Table 2 (below) clearly detach the first three factors which have a value greater than 1, i.e., they are super unitary, from the remaining 10 factors. This is the reason to take into account the first three and search for the way in which they correlate between them, on one hand, and between them and the rest, on the other.

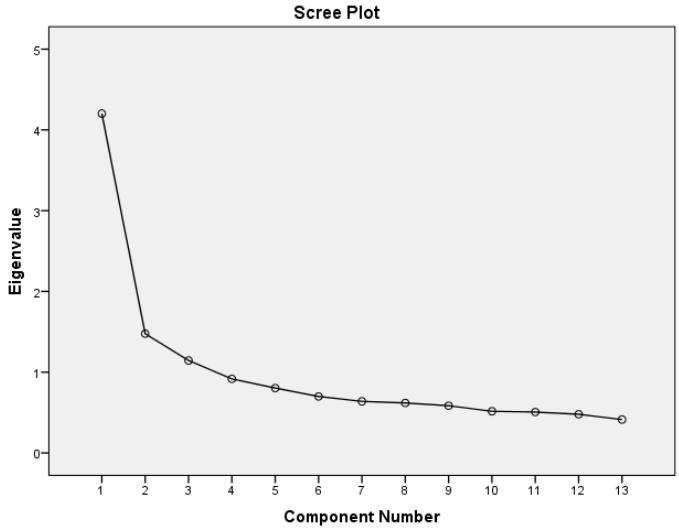

Figure 5. Chart of the 13 significant variables.

In Table 2, the selected variables are ordered according to the saturation they have in the extracted factors. Based on the obtained results, three explanatory factors were outlined:

Factor 1 (labeled *profession*) loads the variables included in the questionnaire with the following saturations: *Professional achievement* with 0.693; *independence* with 0.692; *financial security* with 0.674; *authenticity* with 0.572; *self-respect* with 0.553.
Factor 2 (labeled *acceptance*) loads the variables in the questionnaire with the following saturations: *Tolerance* with 0.689; *altruism* with 0.674; *equality* with 0.646; *fairness* with 0.635; *innovation* with 0.564.
Factor 3 (labeled *belonging to a group*) loads the variables in the questionnaire with the following saturations: *Feeling of belonging* with 0.786; *friendship* with 0.622; *prestige or social status* with 0.611.

The three factors extracted as a result of the factor analysis indicate that the engineers-to-be from the polled universities guide their lives by:

- Profession;

- Acceptance;
- Belonging to groups.

Table 2. Saturations of variables in each extracted factor, obtained after rotation.

Rotated Component Matrix			
Values	**Component**		
	1	**2**	**3**
Professional achievement	* 0.693	0.072	0.269
Independence	0.692	−0.006	−0.062
Financial security	0.674	0.159	0.172
Authenticity	0.572	0.419	0.013
Self-respect	0.553	0.293	0.244
Tolerance	0.127	0.689	0.066
Altruism	−0.039	0.674	0.350
Equality	0.036	0.646	0.300
Fairness	0.293	0.635	0.022
Innovation	0.458	0.564	−0.010
Feeling of belonging	0.079	0.171	0.786
Friendship	0.062	0.343	0.622
Prestige/social status	0.425	−0.067	0.611
Extraction method: Principal component analysis. Rotation method: Varimax with Kaiser normalization.			
a. Rotation converged in eight iterations.			

* The shadow highlights the grouping of variables into extracted factors.

These three factors can be interpreted as nodes in the rhizomatic strata of values shared by the students in the sample.

The next step in the research was to identify the correlations between the extracted factors. Table 3 below presents these results.

Table 3. Correlations between the extracted factors.

Component Transformation Matrix			
Component	1	2	3
1	0.629	0.642	0.439
2		−0.564	−0.285
3			0.852
Extraction method: Principal component analysis. Rotation method: Varimax with Kaiser normalization.			

The following correlations can be highlighted:

- Between factor 1 and factor 2 of 0.622;
- Between factor 1 and factor 3 of 0.439;
- Between factor 2 and actor 3 of –0.285.

The values of the correlation coefficients between factors are quite high. These results allow moving to the next stage, which is the confirmatory factor analysis (CFA). CFA enables a refinement of the analysis, the calculation of more pure factors, with a greater explanatory power.

3.3.2. Confirmatory Factor Analysis (CFA)

The confirmatory factor analysis (CFA) was carried out on sample II, with 860 respondents. Figure 6 below presents a synopsis of the confirmatory factor analysis. The measured variables, i.e., the values are represented by the 13 rectangles. Latent variables, i.e., the extracted factors are represented by the three ovals. The correlations between factors are represented by the curved lines with arrows at both ends and have values listed on them and detailed in Table 3. Each variable (rectangle) has two arrows pointed at it, on the one hand from the extracted factor whose feature it measures, and on the other hand a measurement error denoted by e1 … e13, depending on the variable. These errors can be designed as dispersions (variances) due to the unique extracted factors and are detailed in Table 4.

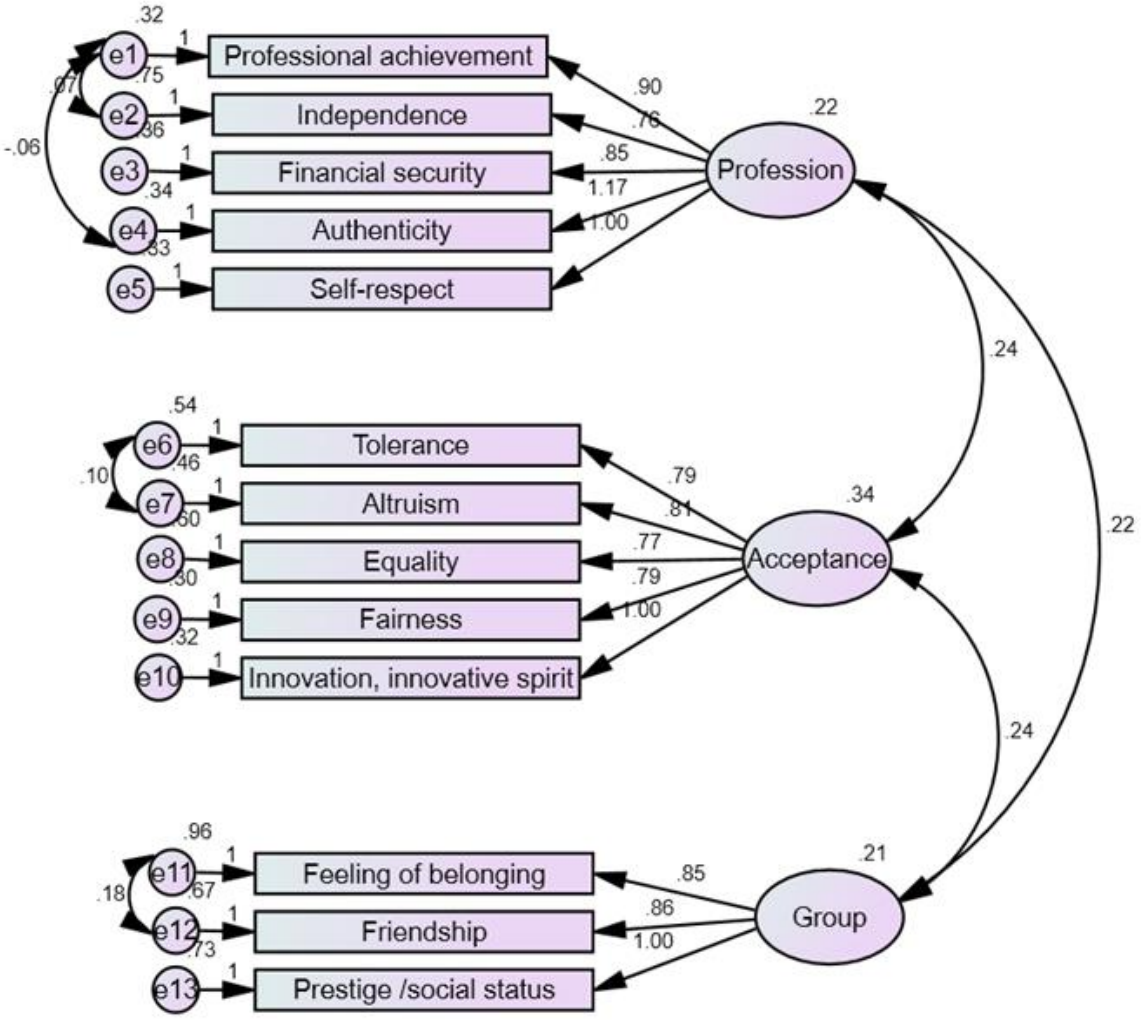

Figure 6. Confirmatory factor analysis.

The values of the extracted regression, presented in Figure 5, with the coefficients β to predict the variables in the latent factors, are as follows: *Self-respect* (β = 1); *authenticity* (β = 1.173; σ = 0.076; $p < 0.01$); *financial security* (β = 0.846; σ = 0.63; $p < 0.01$); *independence* (β = 0.756; σ = 0.079; $p < 0.01$); *professional achievement* (β = 0.902; σ = 0.065; $p < 0.01$); *innovation* (β = 1); *fairness* (β = 0.790; σ = 0.049; $p < 0.01$); *equality* (β = 0.766; σ = 0.06; $p < 0.01$); *altruism* (β = 0.814; σ = 0.056; $p < 0.01$); *tolerance* (β = 0.785; σ = 0.059; $p < 0.01$); *prestige/social status* (β = 1); *friendship* (β = 0.859; σ = 0.088; $p < 0.01$); *feeling of belonging* (β = 0.853; σ = 0.09; $p < 0.01$). For all β values, we have $p < 0.01$, which means that the model is appropriate (Appendix G).

Table 4. Standard deviations (variances) for variables entered in the analyzed model.

Variables Introduced in CFA	Estimate	S.E.	P
Profession	0.222	0.024	0.000
Acceptance	0.342	0.031	0.000
Group	0.214	0.038	0.000
e5	0.335	0.019	0.000
e4	0.339	0.022	0.000
e3	0.359	0.019	0.000
e2	0.747	0.038	0.000
e1	0.323	0.019	0.000
e10	0.323	0.021	0.000
e9	0.299	0.017	0.000
e8	0.598	0.031	0.000
e7	0.464	0.026	0.000
e6	0.538	0.029	0.000
e13	0.733	0.043	0.000
e12	0.667	0.037	0.000
e11	0.961	0.050	0.000

To make the model more stable, we have also identified a number of co-variations (links that influence the causal relationship between variables). They do not in themselves alter causal relationships, but they can partially alter these results as values. To obtain the optimized model presented in Figure 6 we made three iterations and related co-variations (Appendix H). The results of the intermediate iterations are presented in Appendix I Appendices J and K.

The covariations are expressed in the extracted factors, i.e., between the errors obtained from the stabilization of the model. The following covariations can be observed: *Profession*↔*acceptance* (0.237; σ = 0.02; $p < 0.01$); *acceptance*↔*group* (0.237; σ = 0.024; $p < 0.01$); *profession*↔*group* (0.225; σ = 0.022; $p < 0.01$); e7 ↔ e6 (0.102; σ = 0.02; $p < 0.01$); e12 ↔ e11 (0.184; σ = 0.033; $p < 0.01$); e4 ↔ e1 (−0.059; σ = 0.014; $p < 0.01$); e2 ↔ e1 (0.069; σ = 0.019; $p < 0.01$). All made co-variations have a $p < 0.01$ significance threshold, which means that they are the right ones, and they help to optimize our model.

Table 4 highlights the following standard deviations (variances) that fall within acceptable limits, by the fact that the significance threshold is $p < 0.01$.

The high values for the modification indices (MI) in Appendices J and K indicate that there is a need for covariation between the extracted factors in order to optimize the model [37].

Table 5 shows that all the comparison indices resulting from the confirmatory factor analysis are within optimal limits, the model being acceptable. The following indices were calculated: χ2, RMR (root mean squared residuals), RMSEA (root mean square error of approximation), CMIN/DF (chi-square mean/degree of freedom), CFI (comparative fit index), GFI (goodness-of-fit), AGFI (adjusted goodness-of-fit), TLI (Tucker–Lewis index), NNFI (non-normed fit index), RFI (relative fit index), PNFI (parsimony-adjusted normed fit index), PCFI (parsimony-adjusted comparative fit index), AIC (Akaike information criterion). The factor mining showed that out of the 18 values included in the questionnaire, only 13 can be the basis for a factor analysis. These 13 factors are aligned along three axes: Profession, social acceptance, and belonging to a group. The first factor, *profession*, represents the achievement of the goals that animated the young people to choose a higher program. *Acceptance*, the second extracted factor, represents the connection of the young person with the societal environment (present or future), in the home country or abroad. Finally, the third factor—*belonging to a group*—gives the measure of the young person's integration into the immediate circle (family, friends,

colleagues). The two group factors, which came out of the factor analysis (*acceptance* and *belonging to a group*), indicate a good social integration of the young generation and a solid argument of social sociability and sustainability that they can demonstrate. *Profession*, as the main factor identified and the existence of the two social pillars (acceptance and group) may be the basis of any direction of development of society, depending on the dominance of the period during which these young people will exercise their competences.

Table 5. The main model verification indicators (optimal variant).

	Correction Indices			**Comparison Indices**			
	χ^2	RMR	RMSEA	CMIN/DF	CFI	GFI	AGFI
	High number of respondents $p < 0.05$	<0.05—a very good model	≤0.08	<5 for an acceptable model	>0.8 Has values between 0 and 1.1 indicating a good match	over 0.9 or close	over 0.9 or close
Optimized variant (covariate errors)	267.333 (58) at $p < 0.01$	0.037	0.065	4.609	0.922	0.953	0.926
	Comparison Indices						
	TLI	NNFI	RFI	PNFI	PCFI	AIC	
	Has values between 0 and 1, 1 indicating a good match	Has values between 0 and 1, 1 indicating a good match	Has values between 0 and 1, 1 indicating a good match	Has values between 0 and 1, 1 indicating a good match	Has values between 0 and 1, 1 indicating a good match	A model with a lower AIC is preferred	
Optimized variant (covariate errors)	0.895	0.903	0.869	0.671	0.685	333.333	

3.3.3. Correlation between Factors and the Students' Intention to Migrate (Career-Related Choices for the Future, Domestically or Abroad)

Many of the existing reports on the availability of highly skilled human capital that include Romania alarmingly draw attention to the migration disposition of youth. Responses obtained in this research showed that 23.8% of the polled students are determined to leave the country upon graduation. Forty-five percent are undecided, while 31.1% envisage a career in their home country [29]. Building on these data, we wanted to examine whether there is a correlation between the students' decision to emigrate and the values highlighted in the study. The analysis shows that only six of the values correlate with the decision to emigrate, as presented in the table below (Table 6).

The decision to emigrate correlates negatively with three of the values, i.e., *personal dignity* ($r = -0.054$, $p = 0.023$), *fairness* ($r = -0.052$, $p = 0.028$), *protection of the family* ($r = -0.049$, $p = 0.040$) (Table 6). These results can be read as offering explanations for the decision against migration, those who ponder such a decision most probably looking at such values as *protection of the family*, some sort of *personal dignity*, and *fairness*. *Fairness*, in such a context, would be related to a moral obligation, felt by the young people. They are offered free access to education and most probably think that they need to pay forward, to reward the efforts previous generations took to ensure free and quality schooling. It may also point towards the traditional understanding of social solidarity and even social sustainability.

The decision to emigrate correlates positively with three other values included in the research, i.e., *financial security* ($r = 0.082$, $p = 0.001$), *innovation, innovative spirit* ($r = 0.067$, $p = 0.004$), *independence* (relying on oneself, not needing help from the others) ($r = 0.083$, $p = 0.000$) (Table 6). In other words, young people who are determined to emigrate think above all about the *financial security* and the

independence that can be ensured by innovation and by the qualities embedded in the *innovative spirit*. This segment of the student population hopes to enhance the possibility of success by projecting the future in the context of already accomplished, well developed, and stable economies, abroad.

Table 6. Correlations between the determination to emigrate and various values (Spearman test).

To What Extent Do You Consider the Following Values as Being Important for You?		To what Extent Do You Intend to Emigrate after Graduation?
1. Personal dignity (identity/education)	Correlation Coefficient	−0.054 *
	Sig. (2-tailed)	0.023
	Number of respondents	1782
2. Fairness	Correlation Coefficient	−0.052 *
	Sig. (2-tailed)	0.028
	Number of respondents	1782
3. Protection of the family	Correlation Coefficient	−0.049 *
	Sig. (2-tailed)	0.040
	Number of respondents	1782
4. Financial security	Correlation Coefficient	0.082 **
	Sig. (2-tailed)	0.001
	Number of respondents	1782
5. Innovation, innovative spirit	Correlation Coefficient	0.067 **
	Sig. (2-tailed)	0.004
	Number of respondents	1782
6. Independence (relying on oneself, not needing help from the others)	Correlation Coefficient	0.083 **
	Sig. (2-tailed)	0.000
	Number of respondents	1782

* Correlation is significant at the 0.05 level (1-tailed). ** Correlation is significant at the 0.01 level (2-tailed).

Balancing the two categories of values, i.e., those that correlate positively and negatively with emigration, we think of a duality that appears in the souls of those who have a choice between their individual self-realization, whether they would emigrate, and the comfort of the family, its protection and an assumption, in dignity, of the values of the society in which they grew up and formed as specialists. It is hard to predict which element(s) will weigh more heavily in the final decision. The decision will certainly depend on other sets of contextual factors such as the availability of a job, job satisfaction, and even some form of personal fulfillment [28]. However, we do not venture to speculate further, since we have not measured such elements in our research.

4. Discussion and Conclusions

The investigation of the human values shared by the engineers-to-be, schooled in Romanian technical universities, viewed through rhizomatic lenses showed that all 18 values are important to the respondents, but with various intensities. At the present moment in time, on an average scale from 1 to 5 (1 being the lowest and 5 being the highest), the lowest scores were encountered for the value *spirit of competition* (3.72), while the highest intensity in students' perceptions is held by *personal dignity* (4.65). It is possible that, in time, due to different contextual factors, the order of these values will be rearranged, but they will accompany these professionals-to-be along their lives and help them re-territorialize and re-invent themselves, despite the disruptive processes that mark their projections of the future [5,30,42]. In the next step of our research, we set as an objective the mapping of the value

system of the polled student population, following the suggestion formulated by Kinchin and Gravett to view these maps "as gateways into future" rather than representations of the past [43] (p.10).

Significant differences between universities are recorded only for the following items: *Personal dignity*, *altruism*, *tolerance*, *protection of the family*, *equality*, *feeling of belonging*. The results show that there is no hierarchy of universities from this point of view. Also, there are no significant differences between the geographical areas of Romania, or between the capital of the country (Bucharest) and the provinces. Rather, we record a relatively uniform distribution of responses, with emphasis on certain values in various universities subject to study. As poles of economic growth and social development, universities can be viewed as a social rhizome [22]. The relatively low differences between the polled student samples may lead to the interpretation that the peaks in results' potential "development poles" against the egalitarian level of values displayed by the 2020 generation of the engineers-to-be. This rhizomatic view on universities allows for "vectors of escape" from the homogenizing and normalizing documents that force higher education institutions into strict rubrics and standards and help re-think students as active partners in education, with aspirations, values, beliefs, behaviors that are precious assets to be considered when choosing educational strategies and approaches [18].

Last but not least, the study aimed at identifying the factors accounting for the career-related projections of students upon graduation. A slice into the intricate system of values, displayed by the polled students showed that there are three underlying factors that function as nodes for the shoots and lines that are the observable values.

The main takeaway from the factor analysis (CFA) is that engineers-to-be in Romania value above all the chosen profession, at the same time considering that they draw roots from social values such as acceptance and belonging to a group (a value labeled in this study concisely as 'group'). These three factors represent the node trinomen of values for the generational development of students seeking tools and paths towards their becoming as professionals. Further research can deepen the way in which these nodes impact learning, acceptance, development, and pedagogy in technical universities.

Profession is an important aspect in a young person's life; it is linked to individual sustainability on the one hand, and to social sustainability on the other, ensuring that in the future it will serve as a viable line, enabling the young person to reinvent himself/herself in the continuously changing social, economic, and political environment [21,30,31]. Here the wasp-orchid metaphor proposed by Deleuze and Guattari comes to the mind [44]. The nowadays student will leave the university, the current territory with all its determining features, and will re-territorialize in a new setting. The student-university nexus will be replaced by the engineer-workplace one. But, as the two philosophers so adequately suggested, something else entirely is likely to occur: "(. . .) not imitation at all but a capture of code, surplus value of code, an increase in valence, a veritable becoming, a becoming-wasp of the orchid and a becoming-orchid of the wasp. Each of these becomings brings about the deterritorialization of one term and the reterritorialization of the other; the two becomings interlink and form relays in a circulation of intensities pushing the deterritorialization ever further. There is neither imitation nor resemblance, only an exploding of two heterogeneous series on the line of flight composed by a common rhizome that can no longer be attributed to or subjugated by anything signifying" [44] (p. 10).

Optimism concerning the capacity of the engineers-to-be to reinvent themselves and anchor in new territories (both in a geographic and in a professional sense) is fueled by the two subsequent relevant factors. The factor we labeled "acceptance" allows the young person to connect with society and search for strategies to positively interact with the societal environment. It reflects even for secular societies the biblical commandment "thou shalt love thy neighbor as thyself." Based on the desire of people to seek harmony and acceptance in the larger group society can secure its sustainability and resilience even in times of crisis [8].

The third factor we labeled "belonging to a group" creates the microcosmos for the wellbeing of each person. Groups can be family ties, college colleagues, circles of friends, NGOs where the students choose to enroll, etc. In these familiar, relatively small settings, the students, professionals-to-be,

exercise their roles, test their talents, safely unfold their plans, and express their aspirations. These groups ensure the psychological balance and resilience net in turbulent times. Ultimately, society at large is the sum of the numerous groups people belong to [43,45].

All in all, the triumvirate of factors profession–acceptance–group (in the primordial sense of belonging) ensures that the nowadays students are the future pillars of social sustainability.

The entire effort to investigate and analyze human traits and values, shared by students, serves to better anchor the professor–student relationship in a partnership philosophy. Professors need to constantly check their assumptions about the expectations and needs of the generations of students they teach. Students' voices must be heard beyond the feedback collected in relation to the various aspects of their academic experience. Adaption to the psychosocial needs of students, understanding the heritage they bring into the educational environment, can represent those benchmarks that elude standardized tests and mission statements formulated in industrial terms for universities as stakeholders. This study focused only on the human values with which students come to academia, not on those that the university deliberately forms, as part of the professional development of young people [43]. Professional values are described and transmitted through academic documents, i.e., they are verified by the different forms of assessment [46]. Also, this study brings a new dimension discussed in scientific literature, by connecting personal values of the students with their intentions to work abroad after graduation. Most studies focus either on young people's values, or on intentions concerning migration [29]. This research connects the two and presents the possible career choice of engineers-to-be in other social-economic environments than the one they were born and educated in terms of de-territorializing and re-territorializing of the self [26], while preserving all the pre-requisites for a successful and fulfilling life. The intentions of students to reinvent themselves in a variety of settings and their intellectual nomadism helps them overcome the discomforting effects of disruptive forces that pile up for the 2020 generation of future highly skilled workers [27]. Such an approach is new to the body of research and lowers the tone of criticism associated with the way in which universities "deliver" students as outputs to labor markets, as if people can be viewed in terms of marketable goods [22].

The human values that we discussed in this study represent the constellation by which these young people are oriented throughout their lives, regardless of whether the territory they are in is familiar or completely unknown [12]. Or, to return to the Deleuzian paradigm, these values are the nodes and lines that allow the young person to survive disruption, crisis, incertitude, in a rhizome-like manner.

Further research should place individual values shared by students in correlation with the university values and with the professional (engineering values) embedded in the curricula, thus completing the map of values in which students evolve and engage in their becoming. Also, we resonate with the recommendation formulated by Cook-Sather, Becker, and Giron that "placing human sustainability at the center of education and educational development" is paramount for universities [9]. New realities in society (and of course in education) require new narratives and new approaches to support the rhizomatic growth of the people-to-come. This study offers food for thought in evaluating who these people-to-come are, while they are in the assemblage with professors and educational institutions.

As this research was based on data from Romanian technical universities only, the findings are clearly not generalizable to the whole generation of students. It was an exploratory study, aiming to explore the values viewed as lines of sustainability, adding to that body of knowledge. We supplemented the measurement of intensities in the students' beliefs with factor identification, thus helping map the future assemblages these engineers-to-be are likely to form after graduation. The aim of the research was not to generalize the findings, rather it was to generate theory that can be further tested and explored in subsequent research with larger samples, more case studies. A dramatic change in society, such as the global crisis created by the SARS-COV-2 pandemic makes predictions concerning the migration of students upon graduation debatable. The data collection took place in a relatively stable economic and social environment when questions related to possible crises did not

seem relevant. A new direction for research would be to check the findings presented in this study with new data, collected when the SARS-COV-2 pandemic will come to its resolution.

Author Contributions: Conceptualization, G.-M.D., M.C.-B., V.G., and L.C.; methodology, V.G. and G.-M.D.; formal analysis, G.-M.D. and V.G.; investigation, G.-M.D., V.G., and L.C.; writing—original draft preparation, G.-M.D., M.C.-B., and V.G.; writing—review and editing, M.C.-B., and V.G.; visualization, G.-M.D., M.C.-B., and V.G. All authors have read and agreed to the published version of the manuscript.

Funding: The data collection for is research was funded by The Romanian Alliance of Technical Universities (ARUT), GNaC2018—ARUT, no. 1354/01.02.2019 VALTECH—Cultural and professional values of students in Romanian technical universities.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

Appendix A Questionnaire

(1) Select your university:

Table A1. Select your university.

Politehnica University of Bucharest (UPB)
Technical University of Civil Engineering of Bucharest (UTCB)
Technical University of Cluj-Napoca (UTCN)
Gheorghe Asachi Technical University of Iasi (TUIASI)
Politehnica University Timisoara (UPT)

(2) To what extent do you consider the following values as being important for you? (18 items)

Table A2. To what extent do you consider the following values as being important for you? (18 items).

Values	To a Very Little Extent/ Not at All	To a Little Extent	To Some Extent	To a Great Extent	To a Very Great Extent
1. Personal dignity (identity/education)					
2. Protection of the family					
3. Freedom (of thinking and action)					
4. Self-respect (confidence in my value)					
5. Fairness					
6. Health and physical condition					
7. Professional achievement					
8. Financial security					
9. Equality (equal opportunities for all)					
10. Authenticity					
11. Innovation, innovative spirit					
12. Altruism (helping others)					
13. Friendship					
14. Tolerance (acceptance and respect for opinions or groups other than one's own)					
15. Independence (relying on oneself, not needing help from the others)					
16. Prestige or social status (status or social position)					
17. Feeling of belonging (others care for me)					
18. Spirit of competition					

Intention to seek work domestically or abroad

Do you intend to work abroad after graduation?
1 Yes 2 No 3 I am undecided

Duration of intended living and working abroad

How long do you intend to live and work abroad after graduation?
1 Permanently 2 More than 5 years 3 For 4–5 years 4 1–3 years 5 less than 1 year 6 I do not intend to leave

Appendix B

Table A3. Average values per total sample and each university under investigation.

VALUE	Total Sample	UPB	UTCB	UTCN	TUIASI	UPT
Personal dignity	4.65	4.73 *	4.65	4.57	4.64	4.65
Prestige/social status	3.88	3.83	4.01	3.82	3.89	3.86
Altruism	4.18	4.16	4.08	4.2	4.16	4.3
Financial security	4.37	4.41	4.38	4.34	4.38	4.36
Tolerance	4.05	4.02	3.97	4.07	4.06	4.16
Spirit of competition	3.72	3.7	3.78	3.7	3.72	3.71
Fairness	4.48	4.51	4.46	4.43	4.46	4.52
Innovation	4.18	4.15	4.21	4.2	4.14	4.21
Protection of the family	4.64	4.57	4.67	4.59	4.73	4.62
Authenticity	4.2	4.18	4.22	4.15	4.18	4.29
Self-respect	4.53	4.53	4.53	4.52	4.53	4.54
Freedom	4.6	4.63	4.59	4.63	4.53	4.64
Friendship	4.16	4.14	4.15	4.23	4.05	4.22
Health	4.44	4.41	4.46	4.45	4.44	4.43
Equality	4.27	4.27	4.27	4.27	4.16	4.42
Feeling of belonging	3.74	3.72	3.72	3.79	3.56	3.9
Independence	4.03	4	4.05	4.02	4.01	4.08
Professional achievement	4.43	4.39	4.53	4.38	4.43	4.41

* The grey cells indicate the maximum obtained for each value.

Appendix C

Table A4. ANOVA test results for the significant variance among values.

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Personal dignity (identity/education)	Between Groups	4.415	4	1.104	2.953	0.019
	Within Groups	664.176	1777	0.374		
	Total	668.591	1781			
Altruism (helping others)	Between Groups	9.548	4	2.387	3.333	0.010
	Within Groups	1272.416	1777	0.716		
	Total	1281.964	1781			

Table A4. *Cont.*

ANOVA						
		Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Tolerance (acceptance and respect for opinions or groups other than one's own)	Between Groups	7.499	4	1.875	2.549	0.038
	Within Groups	1307.111	1777	0.736		
	Total	1314.611	1781			
Protection of the family	Between Groups	5.756	4	1.439	3.241	0.012
	Within Groups	788.880	1777	0.444		
	Total	794.636	1781			
Equality (equal opportunities for all)	Between Groups	12.167	4	3.042	3.869	0.004
	Within Groups	1397.097	1777	0.786		
	Total	1409.264	1781			
Feeling of belonging (others care for me)	Between Groups	21.114	4	5.278	5.016	0.001
	Within Groups	1869.867	1777	1.052		
	Total	1890.981	1781			

Appendix D

Table A5. Results interpreted through the lenses of Bonferoni test.

Multiple Comparisons							
Bonferroni							
Dependent Variable	**(I) Q1 University**	**(J) Q1 University**	**Mean Difference (I-J)**	**Std. Error**	**Sig.**	**95% Confidence Interval**	
						Lower Bound	**Upper Bound**
Personal dignity (identity/education)	UPB	UTCN	0.157 *	0.046	0.007	0.03	0.29
Altruism (helping others)	UPT	UTCB	0.224 *	0.063	0.004	0.05	0.40
Tolerance (acceptance and respect for opinions or groups other than one's own)	UTCB	UPT	−0.195 *	0.064	0.023	−0.37	−0.02
Protection of the family	UPB	TUIASI	−0.154 *	0.050	0.019	−0.29	−0.01
Equality (equal opportunities for all)	UPT	TUIASI	0.260 *	0.066	0.001	0.07	0.45
Feeling of belonging (others care for me)	UTCN	TUIASI	0.224 *	0.078	0.043	0.00	0.44
	TUIASI	UPT	−0.335 *	0.077	0.000	−0.55	−0.12

* Correlation is significant at the 0.05 level (1-tailed).

Appendix E

Table A6. Description of the variables subjected to factor analysis.

	Values	Mean	Std. Deviation	N
1	Self-respect	4.53	0.742	1782
2	Fairness	4.48	0.72	1782
3	Professional achievement	4.43	0.734	1782
4	Financial security	4.37	0.724	1782
5	Equality	4.27	0.89	1782
6	Authenticity	4.2	0.82	1782
7	Altruism	4.18	0.848	1782
8	Innovation, innovative spirit	4.18	0.819	1782
9	Friendship	4.16	0.902	1782
10	Tolerance	4.05	0.859	1782
11	Independence	4.03	0.95	1782
12	Prestige/social status	3.88	0.965	1782
13	Feeling of belonging	3.74	1.03	1782

Appendix F

Table A7. Table with the three extracted factors.

Total Variance Explained									
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.202	32.323	32.323	4.202	32.323	32.323	2.553	19.639	19.639
2	1.477	11.361	43.684	1.477	11.361	43.684	2.511	19.316	38.955
3	1.145	8.807	52.491	1.145	8.807	52.491	1.760	13.536	52.491
4	0.917	7.053	59.544						
5	0.803	6.178	65.722						
6	0.699	5.380	71.102						
7	0.639	4.914	76.016						
8	0.619	4.759	80.775						
9	0.585	4.500	85.275						
10	0.516	3.966	89.242						
11	0.507	3.897	93.138						
12	0.479	3.682	96.821						
13	0.413	3.179	100.000						

Extraction method: Principal component analysis.

Appendix G

Table A8. The link between measured values and extracted factors.

Variables in the Model		Extracted Factors	Estimate (β)	SE (σ)	P
Self-respect	<—	Profession	1.000		
Authenticity	<—	Profession	1.173	0.076	0.000
Financial security	<—	Profession	0.846	0.063	0.000
Independence	<—	Profession	0.756	0.079	0.000
Professional achievement	<—	Profession	0.902	0.065	0.000
Innovation	<—	Acceptance	1.000		
Fairness	<—	Acceptance	0.790	0.049	0.000
Equality	<—	Acceptance	0.766	0.060	0.000
Altruism	<—	Acceptance	0.814	0.056	0.000
Tolerance	<—	Acceptance	0.785	0.059	0.000
Prestige/Social status	<—	Group	1.000		
Friendship	<—	Group	0.859	0.088	0.000
Feeling of belonging	<—	Group	0.853	0.098	0.000

Appendix H

Table A9. Covariances analyzed in the confirmatory factorial analysis model.

Covariations in the Model	Variables in the Model		Variables in the Model	Estimate	S.E. (σ)	P
1	Profession	<–>	Acceptance	0.237	0.020	0.000
2	Acceptance	<–>	Group	0.237	0.024	0.000
3	Profession	<–>	Group	0.225	0.022	0.000
4	e7	<–>	e6	0.102	0.020	0.000
5	e12	<–>	e11	0.184	0.033	0.000
6	e4	<–>	e1	−0.059	0.014	0.000
7	e2	<–>	e1	0.069	0.019	0.000

Appendix I

Table A10. The main verification indicators of the model (with successive iterations).

	Correction Indices		**Comparison Indices**				
	χ^2	**RMR**	**RMSEA**	**CMIN/DF**	**CFI**	**GFI**	**AGFI**
	High number of respondents $p < 0.05$	<0.10—a good model <0.05—a very good model	≤0.06 or ≤0.08	<3 for a precise model <5 for an acceptable model	>0.8 Has values between 0 and 1, 1 indicating a good match	over 0.9 or close	over 0.9 or close
Variant 1 (without covariation between the extracted factors)	1077.902 (65) at $p < 0.01$	0.151	0.135	16.583	0.620	0.843	0.780
Variant 2 (covariation between extracted factors)	363.863 (62) at $p < 0.01$	0.04	0.075	5.869	0.887	0.933	0.902
Optimized variant (covariate errors)	267.333 (58) at $p < 0.01$	0.037	0.065	4.609	0.922	0.953	0.926
	Comparison Indices						
	TLI	**N(NFI)**	**RFI**	**PNFI**	**PCFI**	**AIC**	
	Has values between 0 and 1, 1 indicating a good match	Has values between 0 and 1, 1 indicating a good match	Has values between 0 and 1, 1 indicating a good match	Has values between 0 and 1, 1 indicating a good match	Has values between 0 and 1, 1 indicating a good match	The model with a lower AIC is preferable	
Variant 1 (without covariation between the extracted factors)	0.545	0.608	0.529	0.506	0.517	1129.902	
Variant 2 (covariation between extracted factors)	0.858	0.868	0.833	0.690	0.705	421.863	
Optimized variant (covariate errors)	0.895	0.903	0.869	0.671	0.685	333.333	

Appendix J

Table A11. Modification Indices-Covariances—Variant 1.

Variable		**Variable**	**MI**	**Par Change**
Tolerance	<–>	Group	191.536	0.122
Profession	<–>	Group	191.935	0.119
Profession	<–>	Tolerance	305.654	0.210

Appendix K

Table A12. Modification Indices-Covariances—Variant 2.

Variable		**Variable**	**MI**	**Par Change**
e3	<–>	e5	23.464	0.085
e13	<–>	e16	23.263	0.13
e10	<–>	e18	18.044	−0.057
e17	<–>	e18	17.524	0.075

References

1. Illich, I. *Deschooling Society*; Harper & Row: New York, NY, USA, 1971.
2. Illich, I. The history of homo educandus. In *The Mirror of the Past: Lectures and Addresses, 1978–1990*; Marion Boyars Publishers: London, UK, 1992; pp. 113–117.
3. Millet, M.; Moreau, G. *La Société des Diplômes*; La Dispute: Paris, France, 2011.
4. OECD State of Higher Education 2015–2016. Available online: http://www.oecd.org/education/imhe/ (accessed on 20 July 2020).
5. UNESCO. Contributing to a More Sustainable Future: Quality Education, Life Skills and Education for Sustainable Development. Available online: https://unesdoc.unesco.org/ark:/48223/pf0000141019 (accessed on 20 May 2020).
6. World Bank. Learning for All: Investing in People's Knowledge and Skills to Promote Development. Available online: https://openknowledge.worldbank.org/handle/10986/27790 (accessed on 20 July 2020).
7. Sustainable Development Goals—Overview. Available online: https://ec.europa.eu/eurostat/web/sdi/overview (accessed on 3 May 2020).
8. Mathebula, M. *Engineering Education for Sustainable Education. A Capabilities Approach*; Routledge: Abingdon, UK, 2018.
9. Cook-Sather, A.; Becker, J.W.; Giron, A. While we are here: Resisting hegemony and fostering inclusion through rhizomatic growth via student—Faculty pedagogical partnership. *Sustainability* **2020**, *12*, 6782. [CrossRef]
10. Lagun, M.P.; Missimer, M. Supporting engineering students in analysing social sustainability of a product: Lessons learned. *Proc. Des. Soc. Des. Conf.* **2020**, *1*, 1755–1764. [CrossRef]
11. Grasso, M.; Di Giulio, E. Mapping Sustainable Development in a Capability Perspective. Available online: https://www.researchgate.net/publication/23745209_Mapping_sustainable_development_in_a_capability_perspective (accessed on 31 May 2020).
12. Rickaby, M.A.; Glass, J.; Fernie, S. Conceptualizing the relationship between personal values and sustainability—A TMO case study. *Adm. Sci.* **2020**, *10*, 15. [CrossRef]
13. Pfeffer, J. Building Sustainable Organizations: The Human Factor. In *Academy of Management Perspectives*; American Management Association: Briarcliff Manor, NY, USA, 2010; Volume 24, Available online: https://ssrn.com/abstract=2233972 (accessed on 31 August 2020). [CrossRef]
14. Alexa, L.; Maier, V.; Șerban, A.; Craciunescu, R. Engineers changing the world: Education for sustainability in romanian technical universities—An empirical web-based content analysis. *Sustainability* **2020**, *12*, 1983. [CrossRef]
15. Graves, C.V. Human nature prepares for a momentous leap. *Futurist* **1974**, *8*, 72–85.
16. Parks-Leduc, L.; Feldman, G.; Bardi, A. Personality traits and personal values: A meta-analysis. *Pers. Soc. Psychol. Rev.* **2015**, *19*, 3–29. [CrossRef] [PubMed]
17. Koscielniak, M.; Bojanowska, A. The role of personal values and student achievement in academic dishonesty. *Front. Psychol.* **2019**, *10*, 1887. [CrossRef] [PubMed]
18. Le Grange, L.L.L. Sustainability and higher education: From arborescent to rhizomatic thinking. *Educ. Philos. Theory* **2011**, *43*, 742–754. [CrossRef]
19. Robinson, K.; Aronica, L. *Creative Schools: The Grassroots Revolution That's Transforming Education*; Viking: New York, NY, USA, 2015.
20. Seldon, A.; Abidoye, O. *The Fourth Education Revolution. Will Artificial Intelligence Liberate or Infantilise Humanity*; The University of Buckingham Press: Buckingham, UK, 2018.
21. Aviram, A. *Navigating Through the Storm: Reinventing Education for Postmodern Democracies (Educational Futures: Rethinking Theory and Practice)*; Sense Publishers: Rotterdam, The Netherlands, 2010.
22. Barnett, R. *Being a University*; Routledge: Abingdon, UK, 2011.
23. Abad-Segura, E.; González-Zamar, M.-D.; Infante-Moro, J.C.; Ruipérez, G.G. Sustainable management of digital transformation in higher education: Global research trends. *Sustainability* **2020**, *12*, 2107. [CrossRef]
24. Young, E.B.; Genosko, G.; Watson, J. *The Deleuze and Guattari Dictionary*; Bloomsbury: London, UK, 2013.
25. Tillmanns, T.; Holland, C.; Lorenzi, F.; McDonagh, P. Interplay of rhizome and education for sustainable development. *J. Teach. Educ. Sustain.* **2014**, *16*, 5–17. [CrossRef]

26. Hroch, P. Deleuze, Guattari, and Environmental Pedagogy and Politics: Ritournelles for a planet-yet-to-come. In *Deleuze & Guattari, Politics and Education*; Carlin, M., Wallin, J., Eds.; Bloomsbury: London, UK, 2014; pp. 49–75.
27. Winks, L. Discomfort, challenge and brave spaces in higher education. In *Implementing Sustainability in the Curriculum of Universities*; Leal, F.W., Ed.; Springer: Cham, Switzerland, 2018; pp. 99–111.
28. De Grip, A.; Fouarge, D.; Sauermann, J. What affects international migration of European science and engineering graduates? *Econ. Innov. New Technol.* **2010**, *19*, 407–421. [CrossRef]
29. Gherheș, V.; Dragomir, G.-M.; Cernicova-Buca, M. Migration intentions of Romanian engineering students. *Sustainability* **2020**, *12*, 4846. [CrossRef]
30. World Economic Forum. The Future of Jobs. Available online: https://reports.weforum.org/future-of-jobs-2016/ (accessed on 23 June 2020).
31. Mekouar, D. Most of 2030's Jobs Haven't Been Invented Yet. Available online: https://www.voanews.com/usa/all-about-america/most-2030s-jobs-havent-been-invented-yet (accessed on 23 June 2020).
32. UNESCO Digital Library. UNESCO Education Strategy 2014–2021. Available online: http://unesdoc.unesco.org/images/0023/002312/231288e.pdf (accessed on 20 July 2020).
33. Over One in Five Romanian University Graduates Are Engineers, the Highest Share in EU. Available online: https://www.romania-insider.com/romanian-university-graduates-engineers (accessed on 20 May 2020).
34. Fang, B.; Shewmaker, J. The case for small data in higher education. *Intell. Environ.* **2016**, 159–168. [CrossRef]
35. European Commission. Education and Training Monitor 2018, Romania. Available online: https://ec.europa.eu/education/sites/education/files/document-library-docs/et-monitor-report-2018-romania-2_en.pdf (accessed on 23 June 2020).
36. The Romanian Alliance of Technical Universities. ARUT Students. Available online: https://www.aruteh.ro/en/education/arut-students (accessed on 21 April 2020).
37. Tabachnick, B.G.; Fidell, L. *Using Multivariate Statistics*, 6th ed.; Pearson Education, Inc.: Boston, MA, USA, 2013.
38. Coman, C. *Statistică Aplicată În Ştiinţele Sociale*; Institutul European: Iaşi, România, 2011.
39. Howitt, D.; Cramer, D. *Introduction to Statistics in Psychology*, 6th ed.; Harlow Pearson Education Ltd.: Essex, UK, 2014.
40. Kim, J.O.; Mueler, C.W. *Introduction to Factor Analysis. What It Is and How to Do It*; Sage Publication: Thousand Oaks, CA, USA, 1985.
41. Cronbach, L.J. *Essentials of Psychological Testing*, 5th ed.; Harper & Row: New York, NY, USA, 1990.
42. Posner, B. Another look at the impact of personal and organizational values congruency. *J. Bus. Ethics* **2010**, *97*, 535–541. [CrossRef]
43. Deleuze, G.; Guattari, F. *A Thousand Plateaus: Capitalism and Schizophrenia*; University of Minnesota Press: Minneapolis, MN, USA, 2005.
44. Kinchin, I.M.; Gravett, K. Concept mapping in the age of deleuze: Fresh perspectives and new challenges. *Educ. Sci.* **2020**, *10*, 82. [CrossRef]
45. Kelly, R.; McGarr, O.; Leahy, K.; Goos, M. An investigation of university students and professionals' professional STEM identity status. *J. Sci. Educ. Technol.* **2020**, *29*, 536–546. [CrossRef]
46. Nahar, Y.; Baillie, C.; Catalano, G.; Feinblatt, E. *Engineering Values: An Approach to Explore Values in Education and Practice*; Research in Engineering Education Symposium: Queensland, Australia, 2009; Available online: http://rees2009.pbworks.com/f/rees2009_submission_3.pdf (accessed on 5 July 2020).

© 2020 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (http://creativecommons.org/licenses/by/4.0/).