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Article in *Acta Metallurgica Slovaca* · March 2022

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TECHNICAL PAPER

ENGINEERING PEDAGOGY COURSE MAPPING

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Received: 06.02.2022

Accepted: 24.02.2022

ABSTRACT

Graduate students of technical universities have practical difficulties with learning and successful instructional implementation of the fundamentals of engineering didactics. The paper is focused on the formulation of a thought-provoking curriculum with computational assignments for the course of "Technical University Pedagogic and Methodological Foundations of Engineering Education" (TUPMFEE) for graduate and Ph.D. students. The paper uses computational modelling of behavioral processes in socio-educational systems. The TUPMFEE-curriculum teaches future engineers to apply computational techniques to modeling of socio-technical phenomena. The author-formulated and a computer modeling-supported metaphor for the psycho-educational effects of high social pressure impact on student learning dynamics was allegorically visualized using mechanical rolling stress distribution for the nonlinear social process of student knowledge acquisition during instructor-enhanced education with description of some successive forgetting of the previously acquired instructional material upon the studied course completion. The author-proposed TUPMFEE-course successfully triggers graduate students' interest in both social, mechanical and computer sciences.

Keywords: engineering; rolling, modelling

INTRODUCTION

The ongoing engineering-and-pedagogic efforts [1 – 130] of the contemporary STEM-(science, technology, engineering, and mathematics) community of engineers and instructors resulted in the appearance of the following numerous

- comprehensive international guides & textbooks [24, 34, 45-46, 53, 72, 99],
- socio-engineering studies [1-3, 5, 7, 12-13, 14, 16-17, 24, 27, 31-32, 34, 37-38, 45, 47, 49-51, 53-54, 56, 59-60, 63-65, 68, 71-74, 77-78, 80, 82-83, 85, 87-91, 99, 103, 111, 117-118, 121, 124],
- technical studies [3, 5, 7, 9, 14, 16, 18, 37, 42-43, 47, 50-51, 60, 74-75, 77-79, 83, 85-91, 98, 111, 115],

- socio-educational studies [2-4, 6, 8, 10-11, 15, 17, 21-22, 26, 28, 30, 33, 35, 39-40, 44, 52, 55, 57, 61-62, 65-66, 73, 76, 82, 84-86, 93, 96-97, 101, 105-110, 112, 120, 122-123, 125, 127-130],
- socio-behavioral studies [2, 19-20, 23, 25, 29, 36, 38, 41, 46-47, 51, 58, 64, 67, 69, 71, 75-76, 79, 81, 89-90, 92, 94-96, 100, 102, 104, 107, 109-110, 113-115, 116, 119, 124, 126, 129-130],
- medical studies [20, 25, 46, 76, 105, 108, 124],
- socio-political studies [6, 51],
- socio-ethical studies [34, 51, 69, 71, 81, 100],
- socio-legal studies [6],
- socio-economic studies [58, 62, 77, 101, 123],
- socio-religious studies [39-40, 117], and
- studies in arts & humanities [54, 56, 70, 80, 103, 130],

focused on technical curriculum development for better education of scientific and technical disciplines.

Analysis of the state of the art [1 – 130] reveals that the ongoing processes of agreement, development and harmonization for competency building, capability building and skills formation approaches become very important for national and international systems of engineering-and-pedagogical education in the last few decades.

Analysis of literature [1 – 130] also shows us a significant shift of activity-oriented emphasis of engineering education from classical acquisition of subject-stipulated specific ways of particular proceeding and operating to modern acquisition of educational fundamentals of future professional activity of the technical instructor.

References [1 – 130] outline that professional growth of the prospective technical instructor should include not only technical and methodological components of “hard skills” but also multi-disciplinary pedagogical tools of “soft skills”. Soft skills-enhanced instructor’s activity should stimulate student educational motivation, and provide positive and optimistic attitude with respect to learning success achievement, and also encourage regular students’ participation in compulsory and recommended educational and academic activities of formal and informal higher education.

However, the engineering and computational topics, directly associated with teaching methodology for instruction of technical disciplines for control and computer engineering curriculum, are much better developed than for social-scientific and socio-technical issues.

Moreover, social science related questions of prospective technical instructor training have not been properly addressed in numerous available engineering references [1 – 130].

The overwhelming majority of existing papers on curriculum development for the spheres of general engineering and engineering education are mainly focused on educational reflection of numerous instructional viewpoints on the process of engineering curriculum mapping without detailed specification of computer subject-specific engineering pedagogic content.

Additionally, Covid-, post-Covid-, climate-, ecology-, war-, and cybercrime-induced burdens and sources of social instabilities have achieved global outreach and must be addressed in engineering and engineering educational curricula.

Disturbing effects on academic wellbeing, induced by sources of external social pressure, require adequate and constructive educational reflection in social and socio-technical courses, mapped within the control- and computer engineering curriculum.

TUPMFEE COURSE DESIGN

Concerning the TUPMFEE course title definition

The graduate course of “Technical University Pedagogic and Methodological Foundations of Engineering Education” (TUPMFEE) for students, majoring in computer networks and automation, is the educational discipline, which is focused on a detailed description of the interdisciplinary questions of theory and practice of student-centered training of future technical instructors who are satisfactorily qualified for specialized teaching in high school (Figures 1 – 37).

The forthcoming instructor should be well acquainted with the following modern social-and-engineering methods, approaches and techniques of such pedagogical, psychological, technical, philosophical and medical sciences as:

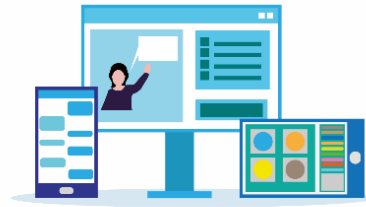
(I) Engineering didactic for teaching of information-and-communication technologies, computer integrated technologies, ed-

ucational approaches to teaching of computer engineering, computer networking and network science, automation, control-and-systems engineering, fundamentals of instrument-making engineering, and engineering instrumentation (Figures 5 – 14, 20 – 28, 31);

(II) International standards for engineering education quality; compliance verification and control of education quality maintenance; as well as acquaintance with interdisciplinary problems of academic, educational and research integrity (Figures 5 – 9, 31 – 37);

(III) Educational psychology of “hard skills” and “soft skills” formation, and creative development of the art of teaching (Figures 1 – 4, 31, 34 – 37);

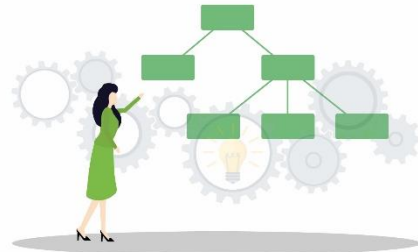
(IV) Students acquaintance with computer-assisted nonlinear {mathematical, cyber-physical and socio-physical} modeling of didactic, socio-educational and psychological processes in teaching complex socio-dynamic control systems and guided socio-technical networks (Figures 15 – 19, 29 – 30, 32 – 33).



Paperless Education Today

Fig. 1 Network communication-enhanced paperless education today. The Internet is multifunctional: a person can communicate, get an education and be entertained, abandoning stereotypical ideas such as “the educational process should only take place in person”, “information carriers should only be paper” etc. Source: Drawing by co-author Mykyta O. Zhuravlov.

The aims and scopes of the TUPMFEE course



Student-Friendly Education

Fig. 2 Education technology freedom in the process of new knowledge and skills acquisition using modern media. It all depends on the person: only he (she) has the opportunity and freedom to choose useful information for himself (herself). Students can try themselves in various fields of activity in the learning process of obtaining an education. Source: Drawing by co-author Mykyta O. Zhuravlov.

The author-proposed TUPMFEE course is conceptually focused on the formation of cognitive, affective and motorial competences, as well as “soft” and “hard” skills of future instructors, majoring in computer engineering, network (Internet) engineer-

ing and automatic control in the multidisciplinary and interdisciplinary socio-technical spheres of engineering pedagogy; domain of didactic-enhanced engineering instructional description of scientific disciplines, and educational psychology. The author-proposed TUPMFEE course should acquaint prospective instructors with fundamental concepts, socio-technical approaches and international standards for teaching and quality assurance of engineering education, STEM/STEAM-education, cybernetic pedagogic, applied educational psychology, subjective wellbeing, sociology, conflictology and social psychiatry fundamentals.

Author-proposed themes of the TUPMFEE classes

I.1. Lecture Topic 1. The structure, organization, general trends, social-and-philosophical dimension, politics, ethics and non-linear social dynamics of the functioning and development of modern systems of higher education in EU, USA, China, Far East, Latin America and Africa Countries.

I.2. Practical Training 1. Zoom-based face-to-face discussion and collaboration with group students upon completion of the first large comparative table “PrTable1” for multi-level comparison of structure and principles of operation for higher education systems in a student-selected list of prosperous, developing and poor countries. The first training session is based on preliminary individual home preparation of a detailed and comprehensive student-narrated written contribution concerning distinctive characteristics of a particular higher education system in one of the student-selected world countries. The compulsory home preparation is required for every course-enrolled group student.

II.1. Lecture Topic 2. Methods (ways) of emergence and development of the following professional characteristics, “hard” skills and “soft” skills of the future technical instructor (Figures 1 – 4, 12 – 13, 20 – 30, 34-37): {•professional competence; •sustainable lifelong learning and self-education; •speech-craft (oratory, flights of eloquence); •communicability (sociability); •empathy; •tolerance; •charisma (personality-charism); •charm (fascination); •teaching skills (art of teaching); •acting technique (dramatic arts)}. The complex of above mentioned teacher strengths jointly determine the socially-professional communicational-and-instructional effectiveness of prospective university (college) educators.

II.2. Practical Training 2. Joint instructor/student fulfillment of the second comparative table “PrTable2” for the multi-level collation of different alternative classifications of “hard skills” and “soft skills” for the following socio-technical professions and occupations: •technical instructor – university teacher; •engineer – technical specialist – R&D-developer; •manager – administrator – team leader, and •businessman – employer. Student preliminary preparation for the second practical lesson assumes home completion of an individually-written report concerning one of the possible, textbook-available or paper-retrieved, current versions of the classification of “hard skills” and “soft skills”, required by all range of employers for better graduate employability (Figures 1 – 4, 12 – 13, 20 – 30, 34-37).

III.1. Lecture Topic 3. Modern principles of higher education quality. Approaches, concepts, strategies and politics of G20 (The Group of Twenty) countries concerning the determination of effective socio-educational integral criteria for the complex and objective assessment and estimation of higher education quality (Figures 5 – 11). National implementation of international educational monitoring experience in the context of creation, launching and functioning of National Agencies for Higher Education Quality Assurance NAQA (NAHEQA).

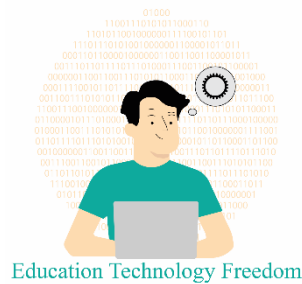


Fig. 3 Student-friendly education with a free choice of decision-making in the educational process by the teacher. Lecturers can move away from the standard template framework and choose the path of individual instructional development and associated effective learning way for students. The teacher is responsible for choosing the right instructional path for individual students in some aspects of getting an education.

III.2. Practical Training 3. Student-collaborative fulfillment of the third comparative table “PrTable3” for a multi-criteria comparison of existing alternative approaches and modern concepts for assessment and estimation of higher education quality within the framework of countrywide community experience of different G20 countries. As usually students are encouraged to prepare for the third practical training and to complete a detailed home-written report concerning specific features, individual peculiarities and country-dependent criteria of local socio-educational approaches to nationally-standardized and/or regionally-unified estimations of higher education quality for a specific student-selected country of analysis (Figures 5 – 11).

IV.1. Lecture Topic 4. Explanation of the elements of applied ethical questions of {•educational, •academic, •institutional, •research} integrity and consistency, as well as the importance of having no conflicts of interest for all members of the scientific and educational process: •students, •Ph.D.-students, •Post-doctoral researchers, •instructors, •engineers and •university management at all educationally-organizational, institutional and management levels, positions and occupations (Figures 5 – 11, 31 – 37).

IV.2. Practical Training 4. It is highly recommended for all students to prepare a detailed home-written report to the 4th practical class on one of the possible (internationally recognizable) ways to classify the existing characteristics of educational integrity and consistency using legal (regulatory-normative), educational and engineering references available in textbooks and periodic literature (Figures 5 – 11, 31 – 37). It is assumed that after home preparation all students take part in the completion of the 4th comparative table “PrTable4” for a maximally-comprehensive comparison of existing alternative approaches and modern concepts for assessment of applied ethical questions of integrity and consistency for an integral assessment of educational activity for all active and passive members of the university community.

V.1. Lecture Topic 5. Scientific and social-scientific approaches to a socio-technical description of (distinctive characteristics of) “normal” dynamics and sustainable development of the educational process in (the case of) the absence of any serious disturbances, irregularities, and interruptions in the educationally-psychological processes of learning and instruction (Figures 1 – 3, 12 – 13, 15, 17, 19 – 20, 23, 24, 26, 29 – 30, 34 – 35).

•An explanation of the stable social dynamics of a satisfactorily-controlled educational process (Figures 1 – 3, 12 – 13, 15, 17,

19 – 20, 23, 24, 26, 29 – 30, 34 – 35) resulting in (successful and mutually respecting) triggering a student’s learning motivation and the instructor’s teaching interest, achieving communicational interaction, constructive interpersonal dialog, and a fundamental mutual understanding of all principle decisions (in student-friendly communication between instructor and his/her students).



Fig. 4 Comfortable learning or Internet addiction. The Internet and Network-based modern learning technologies were created not only for entertainment, but also for education. The World Wide Web promotes the development of digitalized education, but also increasingly & enormously “absorbs” a student, and only the individual actions of the student determine how exactly the received communicational resources will be used.

•Educationally-psychological definitions and technical analogies for a student-friendly illustration of the concepts for sustainability of educational development and wellbeing of the university community (Figures 1 – 3, 12 – 13, 15, 17, 19 – 20, 23, 24, 26, 29 – 30, 34 – 35).

•Practical formation of a favorable educational and psychological conditions for successful (and sustainable) formation of empathy, “hard skills” (associated with individual progress in engineering and professional development) and “soft skills” (associated with individual progress in the formation of social and communicational skills) in university students (Figures 1 – 3, 12 – 13, 15, 17, 19 – 20, 23, 24, 26, 29 – 30, 34 – 35).

V.2. Practical Training 5. The instructor encourages (his/her) students to prepare (their) individual home-written assignments concerning one possible way to develop an internationally-acceptable structural classification for existing characteristics of sustainability and wellbeing from (actual) legal, instructional and periodic literature references. {Virtual} practical session 5 assumes completion of the “PrTable5” for comparison of existing {and retrievable} approaches and concepts for socio-educational estimation of existing international metrics and characteristics for socio-engineering description of the “sustainability” and “wellbeing” concepts (Figures 1 – 3, 12 – 13, 15, 17, 19 – 20, 23, 24, 26, 29 – 30, 34 – 35).

VI.1. Lecture Topic 6. Basic concepts of classical didactic methods of engineering teaching: {•educational constructivism; •didactic transposition, and •educational reconstruction}.

Fundamentals of modern non-classical educational concepts, approaches, methods and technologies: {•blended learning; •flipped classroom; •project-based learning (PBL); •STEM (Science, Technology, Engineering, and Mathematics) multidisciplinary education; •STEAM (Science, Technology, Engineering, Arts, and Mathematics) multidisciplinary education; •CELLL (Continuing Engineering Education and Life Long Learning); •Education 4.0}.

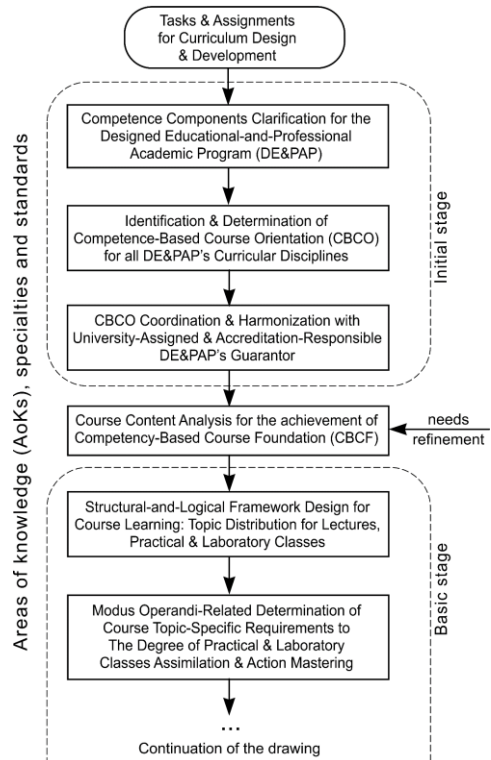


Fig. 5 The initial curriculum-mapping step of an iterative design process of educational-and-professional academic program development by accreditation-responsible guarantor.

Didactics for teaching of scientific and technical disciplines in the fields of automation, control engineering, guided system dynamics, computer engineering, networks, and information-and-communicational technologies (Figures 29 – 30, 32 – 33).

VI.2. Practical Training 6. Every enrolled student is encouraged to prepare a detailed individual home-written report concerning educational possibilities of a student-chosen instructional method of classical or modern engineering didactics. The following classroom activity assumes joint student-instructor completion of the sixth comprehensive table “PrTable6” with a multi-level comparison of learning/instructional advantages and disadvantages for different educational methods of engineering pedagogic.

VII.1. Lecture Topic 7.

Didactic principles, main assumptions, educational peculiarities, practical restrictions and economic charges, associated with the adaptation, use and practical instructional implementation of the following International, USA and European standards for engineering education and certification:

- YCADIO (Conceiving – Designing – Implementing – Operating);
- EUR-ACE (EUropean-ACcredited Engineer) Framework Standards EAFSG;
- ECQA (European Certification and Qualification Association) Certification Programs {⊕ ECQA Certified Control Systems Engineer (CSE)};

- NCEES (National Council of Examiners for Engineering and Surveying) { Ⓢ NCEES PE Control Systems Engineer (CSE) Exam};
- ISA (International Society of Automation) Certification Programs { Ⓢ Certified Automation Professional (CAP); Ⓢ ISA Certified Control Systems Technician (CCST)};
- IEC (International Electrotechnical Commission) Certification Programs { Ⓢ ISA/IEC 62443 Cybersecurity Certificate Programs};
- Cisco Certification (CC) Programs { Ⓢ Entry (E) [CCE Network Technician (CCENT)]; Ⓢ Associate (A) [CC Network A (CCNA) / CC Design A (CCDA)]; - Professional (P) [CC Network P (CCNP) / CC Design P (CCDP)]; etc.}

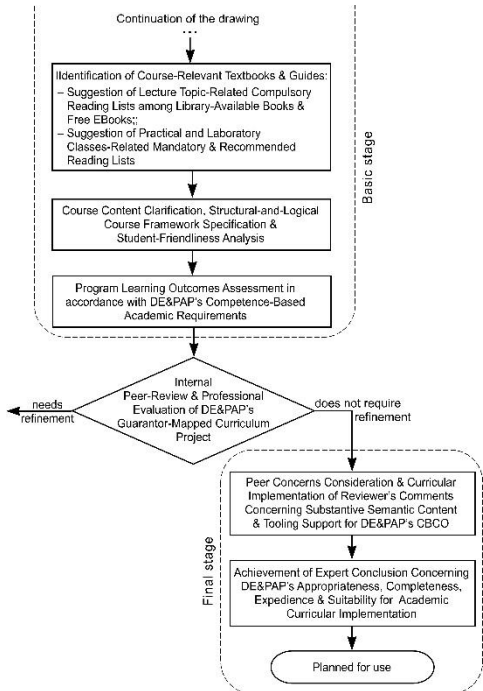


Fig. 6 The final curriculum-mapping step of an iterative design process of educational-and-professional academic program development by accreditation-responsible guarantor

- Approaches to practical development of original undergraduate/graduate syllabuses for automation, control engineering, computer engineering and computer networks curricula with wide use of the above-mentioned engineering educational standards and practices, i.e. the fundamentals of “lower level” curriculum development (Figures 5 – 11).
- Approaches to practical design of original master’s and bachelor’s degree-level educational programs with wide use of Bloom’s Taxonomy and Dublin Descriptors for description of program-determined learning outcomes, i.e. the fundamentals of “upper level” curriculum development.
- Approaches to practical development of { Ⓢ a competency matrix; and Ⓢ a compliance (correspondence) matrix for consistency of learning outcomes with components of the educational program; and Ⓢ a matrix for supplying of learning outcomes with correspondent components of the educational program}.

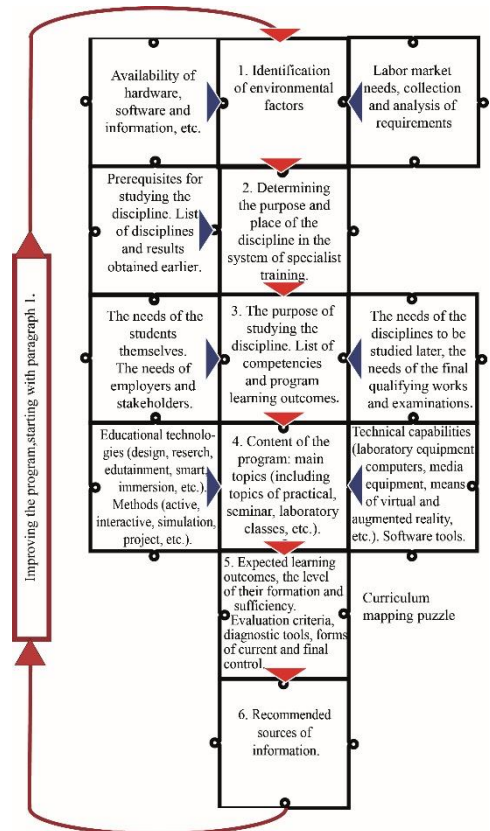


Fig. 7 Curriculum mapping loop schematic as a complex instructional puzzle with seven successive stages of iterative educational-program development. Source: Drawing by co-author Sergey V. Podlesny.

VII.2. Practical Training 7.

Preliminary student preparation of home-written individual lecture notes (leaflets) for step-by-step planning and further running of the student’s trainee-narrated his/her own lesson on one of the student-selected topics of control engineering and/or computer networks with mandatory practical use of the international concepts of current engineering educational standards. The seventh practical class assumes a detailed Zoom-based discussion of all home-prepared individual approaches to effective teaching of a specific student-chosen course topic from the engineering domains of automation or network sciences with wide use of the concepts and standards of the CDIO-based approach to engineering education.

VIII.1. Lecture Topic 8. •Elements of extremal pedagogic, psychology, conflictology (conflict resolution techniques), clinical psychology, psychotherapy (mental therapeutic counseling), psychological rehabilitation (rehabilitology, recreation therapy for mental healing) and social psychiatry for healthy lifestyle promotion (Figures 4, 12 – 13, 15 – 16, 18, 21, 22, 25, 27 – 28, 29 – 30, 31, 32 – 33, 36 – 37).

•Scientific and social scientific approaches to pedagogical, psychological and socio-engineering levels of phenomenological,

socio-physical, and narrative-reflective descriptions of specific “learning”-and-“instructional” characteristics of “problematic” educational processes (Figures 4, 12 – 13, 15 – 16, 18, 21, 22, 25, 27 – 28, 29 – 30, 31, 32 – 33, 36 – 37).

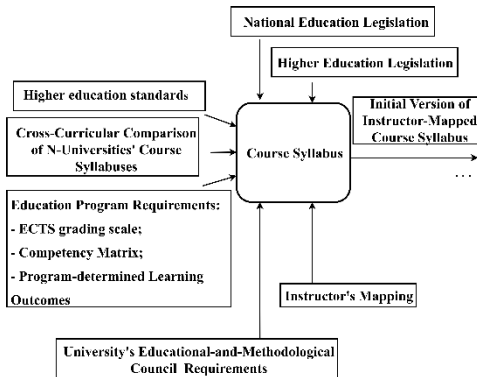


Fig. 8 The first curricular step of an iterative course-design process for syllabus development and modernization: initial stage of curriculum mapping.

•Disturbed (perturbative) social dynamics of “problematic” and unsatisfactorily-controlled low-quality educational processes with joint negative impact of the following disturbing factors, resulting in badly-guided learning progress and unpredictable learning outcomes (Figures 4, 12 – 13, 15 – 16, 18, 21, 22, 25, 27 – 28, 29 – 30, 31, 32 – 33, 36 – 37):

- absence of learning interest;
- disruptions and breakdowns in communication (communicational interaction);
- absence of mutually-respective interpersonal communications and dialogs;
- communication gaps and lack of understanding between instructor and students;
- negative external environmental impact of large-scale well-being disturbing sources of severe social pressure, repressively and overwhelmingly acting on the academic community;
- war (military conflict) of local, regional or global level with death, people killing and infrastructure destruction in a war zone;
- foreign military occupation with a full scale robbery, looting, pillaging, racketeering, shakedown and extortion in the occupied territories;
- bad ecology, induced by uncontrolled environmental contamination and pollution of the surrounding land, water and air;
- epidemic or pandemic distribution of infectious diseases;
- illness-induced bad health of instructors and/or students;
- regular individual conflicts at personal, family and/or work-place levels;
- permanent overloading of hard-working student during intensive school or university education;
- high level of educational ambitions of younger undergraduate students, desperately competing for a strictly-limited number of available academic scholarships.

Student psychotherapy-focused, corrective and remedial functions of university instructors, which are mandatorily required to practically realize educational attempts at successful establishment of “awakening” communications with persistent triggering of individual learning interest among some of course-enrolled

“problematic” students (Figures 4, 12 – 13, 15 – 16, 18, 21, 22, 25, 27 – 28, 29 – 30, 31, 32 – 33, 36 – 37).

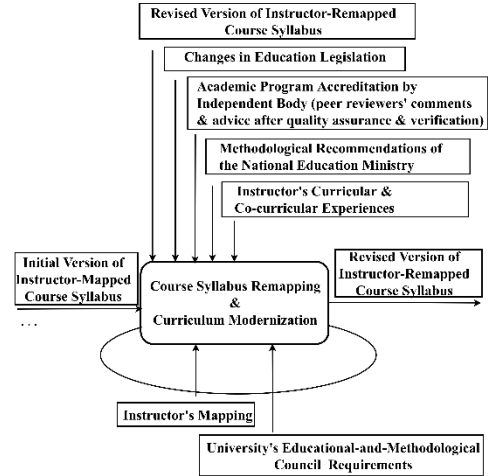


Fig. 9 The second curricular step of an iterative course-design process for syllabus development and modernization: revised stage of curriculum mapping.

VIII.2. Practical Training 8.

Students are preliminary encouraged to prepare for the eighth practical session and complete a detailed home-written report concerning one possible and practically-acceptable educationally-psychotherapeutic approach to the construction of effective, student-centered and wellbeing-focused dialogs between instructors, excellent and “problematic” students, employers, and other stakeholders of the educational process. It is assumed that students will ground their home-written practical recommendations on effective “problematic” communication with wide use of existing social theories and approaches, available in contemporary educational, psychological, technical, legal and medical papers and international textbooks (Figures 4, 12 – 13, 15 – 16, 18, 21, 22, 25, 27 – 28, 29 – 30, 31, 32 – 33, 36 – 37). Eighth practical Zoom-session is focused on joint instructor/student fulfillment of the corresponding comprehensive table “PrTable8” for a multi-criterial comparison of existing cross-disciplinary approaches to a socio-technical description and the educational-and-psychological implications of practically alarming learning and instruction situations, severely disturbed with “problematic” student-induced violations of educational and academic integrity (Figures 4, 12 – 13, 15 – 16, 18, 21, 22, 25, 27 – 28, 29 – 30, 31, 32 – 33, 36 – 37).

Eighth Discussion participating students are encouraged to argue (argument) their statements with wide use of well-established definitions, concepts, methods and techniques of technical pedagogy, engineering didactics, psychology, psychotherapy, social and statistical physics, computer network sciences, control and systems engineering, dynamics and automation (Figures 29 – 30, 32 – 33).

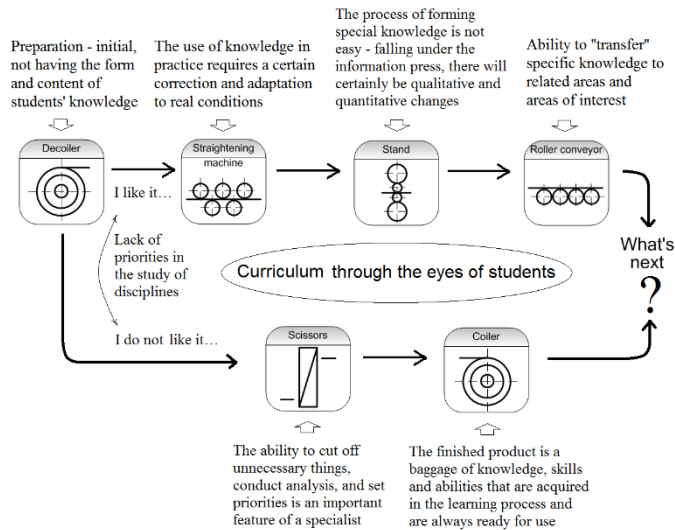


Fig. 10 The figure with the elements of the rolling mill equipment shows the socio-technical analogy of the process of forming a curriculum from its separate independent components that do not give the desired result (through the eyes of a student).

IX.1. Lecture Topic 9.

Acquaintance of prospective technical instructors with existing approaches to engineering curriculum enhancement with wide use of computational possibilities of available desktop and cloud freeware as information/communication technologies and learning tools (Figures 15 – 19, 29 – 30, 32 – 33).

Description of actual computational approaches, mathematical techniques and socio-educational implications of system, network and control engineering as well as application of interdisciplinary transport phenomena, statistical mechanics and network dynamics to computer-based modeling of guided didactical learning and instruction processes (Figures 15 – 19, 29 – 30, 32 – 33).

Student acquaintance with cybernetic, cyber-physical, networks-based, socio-physical, multi-agent and holistic approaches to contemporary learning theories and socio-educational sciences (Figures 15 – 19, 29 – 30, 32 – 33).

Explanation of modern socio-engineering and socio-physical approaches, associated with joint use of learning theory, information theory, methods of control and systems engineering as well as the concepts of irreversible thermodynamics to a thought-provoking description of normal and disturbed modes of educational dynamics (Figures 15 – 19, 29 – 30, 32 – 33).

IX.2. Practical Training 9.

All course-enrolled students are encouraged to prepare for the ninth practical classroom session with preliminary completion of a detailed home-written report concerning educational implementation of computational possibilities of one student-selected and freeware-implemented computer modeling method for a socio-computational description of practically acceptable modes of engineering education with successful achievement of curriculum-expected learning outcomes (Figures 15 – 19, 29 – 30, 32 – 33).

The student-chosen specific computer simulation approach should provide socio-engineering interpretation and computational visualization of the socio-educational effects, associated with the proper establishment of constructive, effective, collaborative and creative communications between university students, classmates, instructors, prospective employers and other

stakeholders in a sustainable higher educational process (Figures 15 – 19, 29 – 30, 32 – 33).

The technical instructor notes that possible student-proposed and computer visualization-supported additional illustration of “problematic” learning dynamics is highly welcomed as well (Figures 15 – 19, 29 – 30, 32 – 33).

Zoom-based classroom session assumes joint instructor/class students fulfillment of the large comparative table “PrTable9” for multi-level comparison of existing socio-technical and socio-physical computational approaches to computer-enhanced socio-engineering description and educational-psychological implications of “normally”-sustainable and “problematic”-disturbed learning dynamics with wide use of student-prepared preliminary home assignments (Figures 15 – 19, 29 – 30, 32 – 33).

SOCIO-TECHNICAL ANALOGIES FOR TUPMFEED COURSE

Consider that the control system of a coffee machine has malfunctioned and has missed one of the control parameters - a glass (or a cup) for a finished drink. If the process of preparing the drink has been launched, time and resources are spent on heating, dosing and mixing the ingredients. There is no way to stop the process, as control of the presence of a glass (or a cup) in the coffee machine is not provided. As a result, there is no finished product, and resources, time and money are wasted (Figures 4, 12 – 13, 15 – 16, 18, 21, 22, 25, 27 – 28, 29 – 30, 31, 32 – 33, 36 – 37). That is why constant monitoring of the progress of the technological process at every stage of product preparation is very important (Figures 11, 14, 20 – 30). This prevents failure in obtaining the desired quality result. A similar effect will be observed when considering the process of preparing students. Only systematic training in all components of the curriculum will give the desired quality of a ready-made specialist (Figures 1 – 3, 12 – 13, 15, 17, 19 – 20, 23, 24, 26, 29 – 30, 34 – 35). Otherwise, all work, even when done flawlessly, may end up meaningless.

As a rule, large control objects (functions) are divided into smaller ones (decomposition) in order to simplify the process

(Figures 5 – 14, 26 – 33) and allocate local subsystems (subfunctions). In general, any subsystem can work autonomously, but as a result, a “semi-finished product” will be obtained, which will be a blank for the next local process (see Figures 5 – 11). Only the joint work of all subsystems within the framework of one

main goal will be effective (Figures 10 – 14). The control system for the entire object (objective) plays an important role in controlling the process logic (Figures 11, 14, 29 – 30). It transforms a set of individual ingredients into a sustainable combination that gives the desired result (Figures 11, 14, 29 – 30).

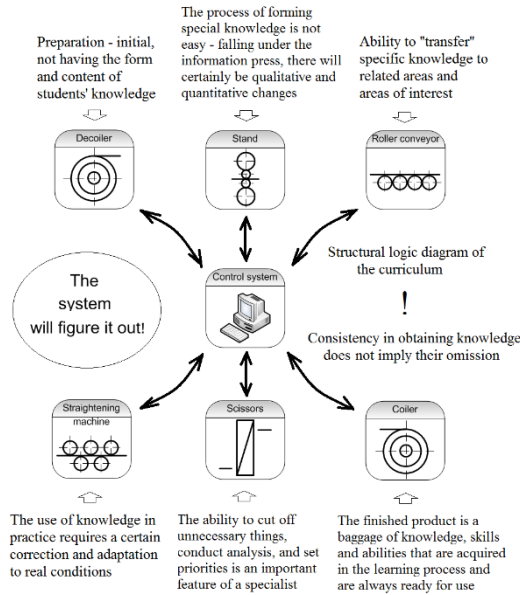


Fig. 11 The figure with the elements of the rolling mill equipment shows the socio-technical analogy of the process of forming a curriculum in the form of a stable logical combination of its components to ensure a high-quality product (systematic approach).

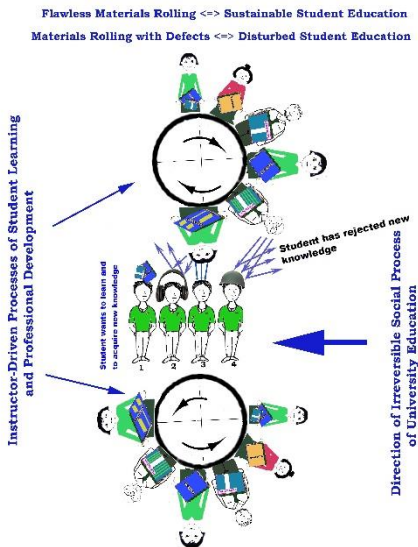


Fig. 12 Pressure forming-inspired socio-technical analogy between continuing roll-driven technical process of materials rolling and continuing instructor-guided social process of higher education, where hardworking learners 1 and 3 are successful university students but lazy pupils 2 and 4 have no desire to acquire new mandatory knowledge.

It is not difficult to assume that the systematic training of students of a specific specialty is important in the sense of forming a stable idea of the cause-and-effect relationship of individual components of the curriculum and the need for their logical coordination (Figures 5 – 14). Otherwise, it will not be possible to get a high-level specialist.

The Author-Proposed Computational Assignment for the TUPMFE Course on the Rolling Stress-Inspired Computational Analogy of Undergraduate University Education

The instructor explains to university students that, allegorically speaking, it is possible to represent the process of higher education through an analogy with the materials rolling process (Figures 10 – 28). Materials rolling is an irreversible process of plastic deformation (form change) of a metal (material) sheet between the two rotating mill rollers (Figures 12 – 14, 15 – 19, 22 – 28). The instructor notes that the degree of material-accumulated plastic deformation can be regulated by the distance between the two mill rollers, i.e. by a change of roll gap (Figures 12 – 14, 15 – 19, 22 – 23). Plate thickness (gage) decreases, plate length increases but plate width does not change in the process of material rolling (Figures 12 – 14, 15 – 19, 22).

The instructor proposes the following techno-social analogy between the social process of student university education and the metallurgical process of materials rolling (Figures 12 – 14, 15 – 19, 22):

- The mechanical process of mill drive-induced forming rolls rotation is analogous to the social process of instructor-driven student learning;

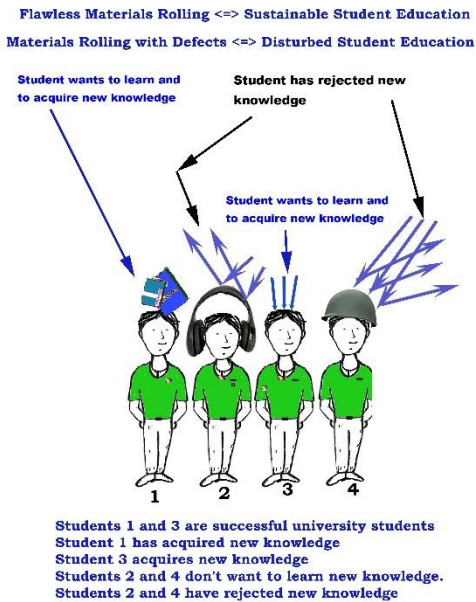


Fig. 13 Additional illustration of previously outlined rolling-inspired techno-educational analogy with detailed visualization of positive (schemes 1 & 3) and negative (schemes 2 & 4) students' attitude towards compulsory acquisition of course-required knowledge.

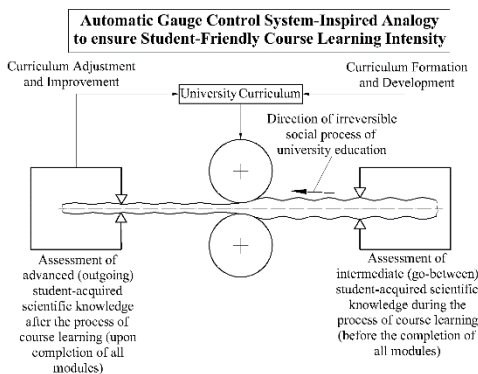


Fig. 14 An allegorical sketch, schematically illustrating the socio-technical analogy between the instructional process of student-friendly determination of the optimal level of course teaching intensity and the technical operation of an automatic gauge control system.

- The rolling force-induced (roll-feed depth-associated) mechanical pressure on a rolled metal plate is analogous to the university curriculum-induced (teaching load-associated) socio-educational pressure on an undergraduate student immersed in an academy environment;
- The geometric direction of the irreversible metallurgical process of rolling is analogous to the generalized direction of the irreversible social process of university education;

- The rolled metal plate (sheet) is analogous to the domain-specific substantive knowledge in the undergraduate-studied specialized subject-matter area for a group of students;
 - The cell of the plate (sheet mesh element) is analogous to the student's personal knowledge in the specialized subject area;
 - The stressed state along the volume of the ingoing plate thickness (gage) is analogous to the preliminary (ingoing) student-acquired knowledge level before beginning the course learning;
 - The stressed state along the volume of the intermediate (go-between) plate thickness (gage) is analogous to the intermediate (go-between) student-acquired knowledge level during the process of course learning (before the completion of all modules);
 - The stressed state along the volume of the outgoing plate thickness (gage) is analogous to the advanced (outgoing) student-acquired knowledge level after the process of course learning (upon completion of all modules).
- It is possible to derive the following social implications through the use of nonlinear finite element modeling-enhanced rolling stress-based techno-social metaphor in Figures 16 – 19.

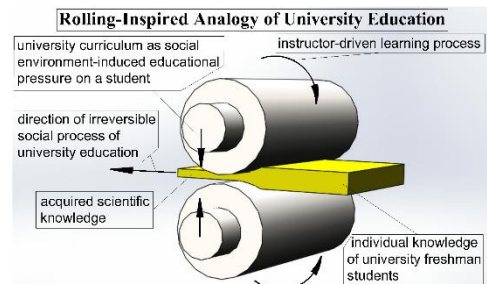


Fig. 15 An allegorical sketch, schematically illustrating the socio-technical analogy between the process of a student's university education and the process of plate rolling. The ingoing gage is similar to the individual knowledge of university freshman students. The outgoing gage is similar to a student's acquired scientific knowledge. The rolling direction relates to the direction of the irreversible social process of university education. The mill roller rotation is similar to the instructor-driven learning process. The rolling force (roll feed depth) represents the university curriculum as a social environment-induced educational pressure on a university student.

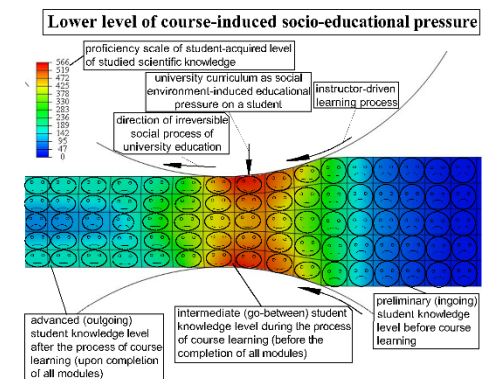


Fig. 16 Nonlinear numerical modeling-enhanced analogy between rolling-induced accumulated stress distributions within a rolled material sheet in the case of an insufficient (lower) rolling force (roll feed depth) and education-induced student-acquired scientific knowledge distributions within a student group in the

case of an insufficient (lower) level of course-induced socio-educational pressure on a university student. The computational case of uniform (even) distribution of preliminary (ingoing) student knowledge level before course learning.

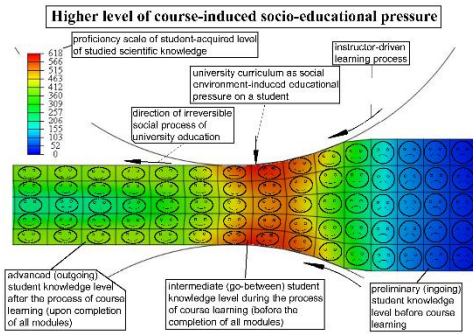


Fig. 17 Nonlinear numerical modeling-enhanced analogy between rolling-induced accumulated stress distributions within a rolled material sheet in the case of a sufficient (higher) level of rolling force (roll feed depth) and education-induced student-acquired scientific knowledge distributions within a student group with a sufficient (higher) level of course-induced socio-educational pressure on a university student. The computational case of uniform (even) distribution of preliminary (ingoing) student knowledge level before course learning.

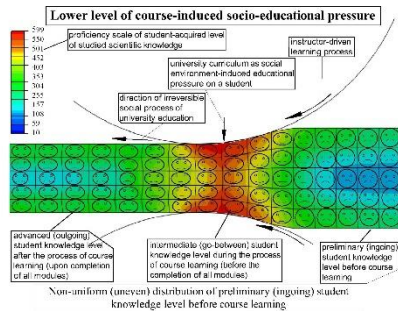


Fig. 18 Nonlinear numerical modeling-enhanced analogy between rolling-induced accumulated stress distributions within a rolled material sheet in the case of an insufficient (lower) rolling force (roll feed depth) and education-induced student-acquired scientific knowledge distributions within a student group in the case of an insufficient (lower) level of course-induced socio-educational pressure on a university student. The computational case of non-uniform (uneven) distribution of preliminary (ingoing) student knowledge level before course learning.

Normally, all university students have different learning abilities and skills. It is possible to determine the skills and training levels of students enrolled in a class using entry control for preliminary knowledge quality. Preliminary education attainment is different for all students. Student preliminary training level can be conditionally classified as “weak” or “strong”. If a lecturer tries his best to run his course with pre-advanced or advanced instructional level, addressing complex problems sufficiently, then he creates a sufficient (higher) level of course-induced socio-educational pressure on a university student in his academic group (Figures 17, 19).

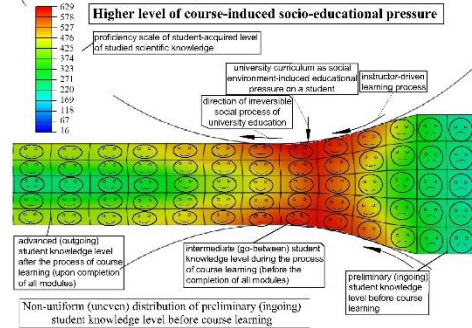


Fig. 19 Nonlinear numerical modeling-enhanced analogy between rolling-induced accumulated stress distributions within a rolled material sheet in the case of a sufficient (higher) level of rolling force (roll feed depth) and education-induced student-acquired scientific knowledge distributions within a student group with a sufficient (higher) level of course-induced socio-educational pressure on a university student. The computational case of uniform (even) distribution of preliminary (ingoing) student knowledge level before course learning.

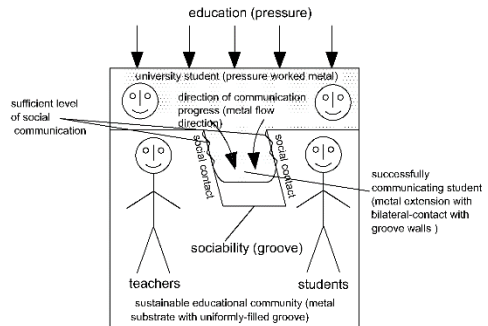


Fig. 20 Author-proposed social-and-technical analogy between an effective pressure-forming process of material rolling-induced gap-free cold metal deep-filling into the die groove with tightly coupled high-quality bimetallic composition formation and a sustainable higher education process of academic program-induced uncertainty-free university student intensive-socialization into the academy community with tightly coupled high-quality collaborative communication achievement.

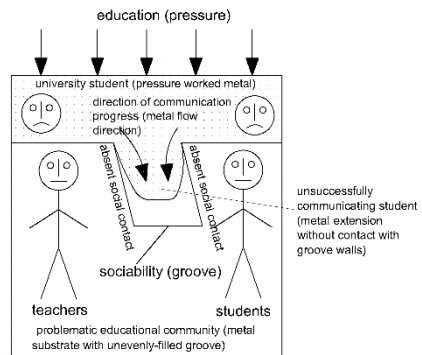


Fig. 21 Author-proposed social-and-technical analogy between defective pressure-forming process of material rolling-induced gap-containing cold metal partial-filling into the die groove with

slightly coupled low-quality bimetallic composition formation and disturbed higher education process of academic program-induced uncertainty-rich and insufficient university student socialization into the academy community with slightly coupled low-quality collaborative communication achievement.

The rolling stress-inspired metaphor in Figures 17, 19 shows that a high level of curriculum-induced socio-instructional pressure results in the achievement of a sufficient level of acquired knowledge for academically weak students and in attainment of a high level of acquired knowledge for academically strong students. "Highly-stressed" Figures 17, 19 metaphorically show the optimum educational scheme when "weak" students have managed to improve their acquired knowledge to a sufficient level and "strong" students have an opportunity to acquire some initial skills and basic ideas for the approximate solution of advanced problems in the course learning process.

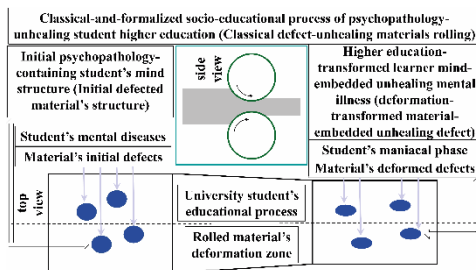


Fig. 22 An author-proposed standard metal rolling inspired social-and-technical analogy between the standard technical process of classical defect-sustaining (defect-unhealing) materials rolling and the classical-and-formalized socio-educational process of psychopathology-unhealing effects on student higher education: Materials rolling-inspired technical sketch, schematically illustrating intensive plastic deformation-induced irreversible transformation of the initial defected material's structure in the metallurgical process of classical metal-rolling, resulting in the final post-processing preservation of deformation-transformed material-embedded unhealing defect within deformation-acquired metal sheet after the standard rolling process; Materials rolling-inspired social sketch, schematically illustrating intensive university education-induced irreversible transformation of the initial psychopathology, existing in a student's mind structure in the emotional-and-cognitive process of classical university education, resulting in the final post-educational preservation of higher education-transformed learner mind-embedded unhealing mental illness within a knowledge-acquired student's mind constitution after the standard university education.

If a lecturer makes the decision to run his course with a low intermediate or intermediate instructional level, addressing less advanced assignments and simpler tasks, then he creates an insufficient (lower) level of course-induced socio-educational pressure on university student in his academic group (Figures 16, 18). The rolling stress-inspired metaphor in Figures 16, 18 shows that an average level of curriculum-induced socio-instructional pressure results in achievement of sufficient level of acquired knowledge only for academically strong students and in attainment of insufficient (and unacceptably-low) level of acquired knowledge for academically weak students. "Moderately-stressed" Figures 16, 18 metaphorically show the non-optimum educational scheme when "weak" students are lagging behind with improvement of their course-acquired knowledge to

a sufficient level and, therefore, "weak" students many times drop out of a "moderately-stressed" educational process. At the same time, the "strong" students have not kept pace with individual development of the good professional skills for the solution of advanced course-associated problems.

It is important to note that further reduction of course-induced social pressure is associated with the instructor's attempt to provide only pre-intermediate or elementary course level for his students (Figures 16, 18). This elementary explanation-focused and weak student-centered teaching approach results in the successful triggering and full scale involvement of the targeted community with the achievement of a high level of elementary course-acquired residual knowledge in the majority of instruction-involved weak undergraduates (Figures 16, 18). However, the elementary course-running approach may result in a low level of course-acquired knowledge for the strong students, who are completely dropped from the classes due to the loss of their individual interest in elementary studies (Figures 16, 18).

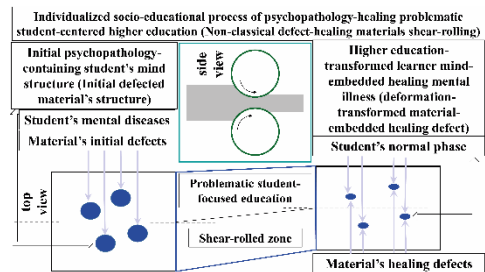


Fig. 23 An author-proposed metal rolling inspired social-and-technical analogy between the modified technical process of non-classical defect-healing materials shear-rolling and the individualized socio-educational process of psychopathology-healing problematic student-centered higher education: Technologically-modified materials shear-rolling-inspired technical sketch, schematically illustrating severe plastic deformation-induced irreversible reduction-and-healing of the initial defected material's structure in the shear strain-intensified novel metallurgical process of non-classical metal-shear-rolling, resulting in the final post-processing elimination of deformation-transformed material-embedded healing defect within deformation-acquired metal sheet after the modified shear-rolling process; Technologically-modified materials shear-rolling-inspired social sketch, schematically illustrating intensive university education-induced irreversible reduction-and-healing of the initial psychopathology, existing in a student's mind structure in the additional instructor attention-intensified novel emotional-and-cognitive process of problematic student-centered university education, resulting in the final post-educational elimination of higher education-transformed learner mind-embedded healing mental illness within a knowledge-acquired student's mind constitution after the modified university education.

How can an instructor know how many applied computational problems should be solved with his engineering students? What is better for an instructor: to introduce the course with a detailed study of relatively simple topics (Figures 16, 18) or, alternatively, to address more complicated topics (Figures 17, 19) without going into in-depth details of computational routine? It is important, for teaching purposes, to establish a student-friendly criterion for effective instructional intensity. How do we know what the optimum teaching intensity for a specific student group should be? It is possible to identify an effective education criterion through the derivation of a techno-social analogy with the operation mode of an automatic gauge control system for a rolling mill (Figure 14).



Fig. 24 Collage of an original allegorical socio-technical analogy between a student-friendly mode of sustainable collaborative engineering education when a student successfully acquires new knowledge without substantial difficulties (on the right) and high-quality metal-roll production with materials forming of flat rolled sheet without surface defects (on the left).

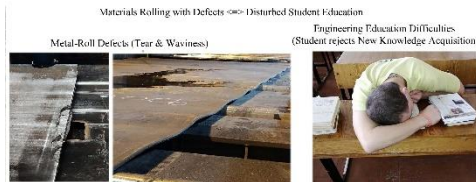


Fig. 25 Collage of an original allegorical socio-technical analogy between significantly troubled mode of student learning behavior with engineering education difficulties when a student rejects new knowledge acquisition (on the right) and scrapped metal-roll production with materials forming of rejected rolled sheet with tear & waviness defects (on the left).

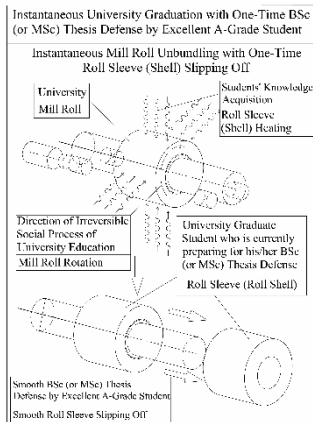


Fig. 26 A thought-provoking remanufacturing engineering-inspired social-and-technical analogy between the single-stage socio-educational process of instantaneous university graduation with one-time BSc (or MSc) thesis defense by excellent A-grade student and a similar single-step metallurgical process of instantaneous mill roll unbundling with one-time roll sleeve (shell) slipping off. The mill roll technical function is assumed to be similar to a university social function, where the direction of mill roll rotation is similar to the direction of the irreversible social process of university education. Heated and rotated roll sleeve (roll shell) of a remanufactured mill roll is similar to a university graduate student who is currently preparing for his/her BSc (or MSc) thesis defense, where roll sleeve (shell) heating is similar to students' knowledge acquisition. The time moment of a smooth roll sleeve slipping off is similar to the time moment of

a smooth BSc (or MSc) thesis defense by excellent A-grade student.

This automatic control system (Figure 14) includes the gage determination for a metal plate thickness before and after rolling as well as in-gap gaging (gauging) system for timely changing of the roll-gap geometry. A metal plate normally has gage (thickness) deviation, i.e. variation in gage (thickness) across the length of a plate. It is possible to reduce the gage deviation (thickness interference) through the rolling of heavy gage with stronger rolling force and lower gage (plate thickness) with lesser rolling force (Figure 14).

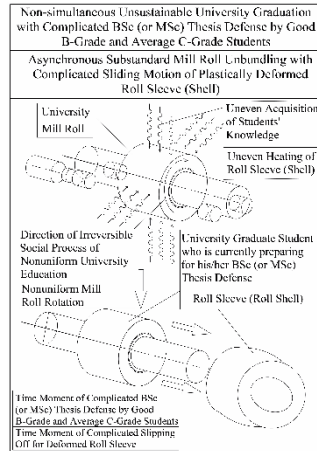


Fig. 27 A thought-provoking remanufacturing engineering-inspired social-and-technical analogy between the non-simultaneous unsustainable university graduation with complicated BSc (or MSc) thesis defense by good B-grade and average C-grade students and a similar asynchronous substandard mill roll unbundling with complicated sliding motion of plastically deformed roll sleeve (shell). The mill roll technical function is assumed to be similar to a university social function, where the direction of a non-uniform mill roll rotation is similar to the direction of the irreversible social process of non-uniform university education. Unevenly heated and non-uniformly rotated roll sleeve (roll shell) of a remanufactured mill roll is similar to a university graduate student who is currently preparing for his/her BSc (or MSc) thesis defense, where uneven heating of roll sleeve (shell) is similar to uneven acquisition of students' knowledge. The time moment of a complicated slipping off for deformed roll sleeve is similar to the time moment of a complicated BSc (or MSc) thesis defense by good B-grade and average C-grade students.

It is very promising to organize an effective social process for the practical achievement of a rigorous but student-friendly level of instructional intensity for successful teaching of course material by using an analogy with the operation of an automatic gauge control system for a rolling mill (Figure 14). The entry level of students' preliminary knowledge is determined with entrance tests or using final grades of previously studied supporting courses. It is possible to identify a student-friendly level of the course and to develop the relevant course curriculum using the results of the entrance knowledge assessment. Upon course completion, an instructor makes an evaluation of residual student knowledge to analyze curriculum efficiency and to consider student-recommended curriculum modifications (Figures 5 – 9, 14).

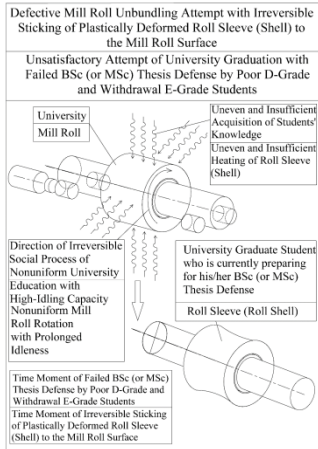


Fig. 28 A thought-provoking remanufacturing engineering-inspired social-and-technical analogy between the unsatisfactory attempt of university graduation with failed BSc (or MSc) thesis defense by poor D-grade and withdrawal E-grade students and a similar defective mill roll unbundling attempt with irreversible sticking of plastically deformed roll sleeve (shell) to the mill roll surface. The mill roll technical function is assumed to be similar to a university social function, where the direction of a non-uniform mill roll rotation with prolonged idleness is similar to the direction of the irreversible social process of non-uniform university education with high-idling capacity. Unevenly heated and non-uniformly rotated roll sleeve (roll shell) of a remanufactured mill roll is similar to a university graduate student who is currently preparing for his/her BSc (or MSc) thesis defense, where uneven and insufficient heating of roll sleeve (shell) is similar to uneven and insufficient students' acquisition of knowledge. The time moment of irreversible sticking of a plastically deformed roll sleeve (shell) to the mill roll surface is similar to the time moment of failed BSc (or MSc) thesis defense by poor D-grade and withdrawal E-grade students.

SOCIAL IMPLICATIONS

It was assumed that the author-mapped TUPMFEE course will ensure the practical achievement of the following range of curriculum-designed learning outcomes.

C. Instructor-estimated learning outcomes for the TUPMFEE course in the cognitive domain:

C.1. Detailed and profound understanding, common awareness and qualified practical use of applied methods of engineering didactics in contemporary STEM/STEAM education for the original lecturer's development of student-friendly and student-centered courses for training of prospective technical instructors, qualified for individual teaching of scientific and technical disciplines from the fields of control and computer engineering (Figures 5 – 14, 20 – 28, 31).

C.2. Achievement of a confident level of skills formation, required for adequate, relevant, consistent, creative and successful practical application of contemporary educational methods and approaches like didactic transposition, educational reconstruction, mathematical constructivism, blended learning, flipped classroom and project-based learning together with instructional implementation of International and European standards of higher engineering education.

C.3. Formation of persistent individual ability for student-centered pedagogical and psychological thinking, constructive vision of educationally-didactic conceptions, understanding of an

instructionally-admissible level of methodological generalization, comprehension of and successful multi-iterative rethinking of student-acquired new social knowledge in direct and indirect forms. Graduate students are expected to demonstrate sustainable abilities for critical but constructive and benevolent analysis of objective advantages and known shortcomings of existing didactic approaches as well as educational and psychologic models/concepts of national and international levels. Engineering students should also be able to creatively assess and rethink their existing instructional experience, individually synthesize and construct new student-proposed socio-technical ideas, analogies and educational techniques, and develop reasonable socio-educational proposals and models.

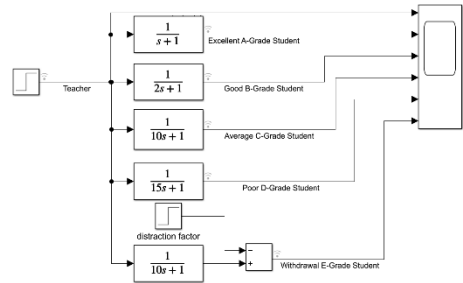


Fig. 29 SciLab-enhanced computational model with first-order aperiodic links for a description of an author-proposed social-and-technical analogy between a sustainable educational process with progressive knowledge acquisition by university students and the functioning of an automatic control system of higher education with instructor-provided linear control action of new knowledge transmission and a student-determined aperiodic transient process of new knowledge acquisition by university students as first-order lag blocks.

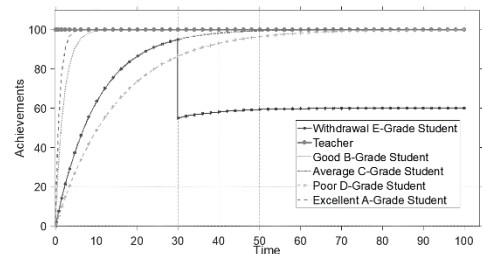


Fig. 30 Computational modeling-enhanced author-derived illustration of aperiodic transient processes for learning time delays in course-required mandatory knowledge acquisition between {excellent A-grade; good B-grade; average C-grade; poor D-grade & withdrawal E-grade} students, where the minimum and maximum time delays take place for A- & E-graded technical students. SciLab-computed aperiodic transient processes provide a thought-provoking interdisciplinary visualization of an author-formulated control engineering-inspired social-and-technical analogy between different learning delays of {A...E}-graded university students in sustainable higher education and different response delays of first-order aperiodic links in an automatic control system under instructor-provided linear control action.

C.4. The prospective technical instructors should develop qualified abilities to successfully ensure student-centered compliance with the operation principles of educational, academic, institutional, and research integrity (Figures 5 – 9, 31 – 37). Multilevel

organizational-and-pedagogical peculiarities of integrity-related socio-educational processes determine both “normal” and “disturbed” modes of learning-and-instructional dynamics in the practical implementation of continuous and long-term educational processes of lifelong learning with the purpose of simultaneous achievement of sustainability and wellbeing criteria within the student/instructor community (Figures 1 – 3, 12 – 13, 15, 17, 19 – 20, 23, 24, 26, 29 – 30, 34 – 35).

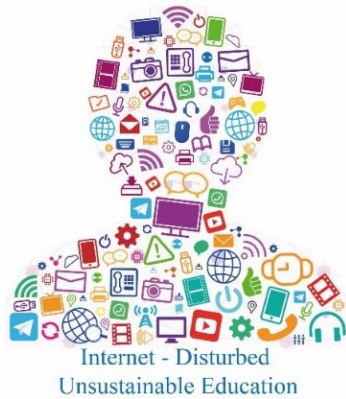


Fig. 31 The inability of a modern student to use his (her) resources efficiently affects personal use of the World Wide Web and can result in Internet-disturbed unsustainable education when “incorrect” use of Internet possibilities leads to personal chaos. Because of personal naivety and sometimes lack of education, a student is very vulnerable on the Internet, because young people are unable or unwilling to identify and discard inferior and harmful Internet resources.

Contemporary educational practice (Figures 1 – 37) raises numerous and never-ending bureaucratic questions about who is in position to explain the mandatory graduate course of engineering pedagogy in a modern technical university: professional engineer (specialist in technical sciences) or professional educator (specialist in social sciences). There are several general requirements for a prospective TUPMFEE instructor regardless of the lecturer’s graduation and/or Ph.D. specialty:

- R.1. An engineering education instructor should be personally interested in practical application of mathematical, computer and cyber-physical modeling to the socio-physical and socio-technical spheres of multidisciplinary social sciences and, in particular, to the field of education in scientific and technical disciplines (Figures 15 – 19, 29 – 30, 32 – 33).
- R.2. An engineering pedagogic lecturer should be prepared to continuous self-study of contemporary theories, methods and techniques of social, educational, psychological, medical, data, network, cybernetic and control sciences (Figures 1 – 14, 20 – 28, 31, 34 – 37).
- R.3. An engineering didactics instructor should refrain from re-translation to his/her students the permanent hate speech, disdain, hostility and nonsense of many computationally-qualified but slightly arrogant and rather voluntarily narrow-minded engineers, mathematicians and physicists toward the “principally-unpredicted” spheres of social sciences, education, psychology, psychotherapy and social psychiatry (Figures 29 – 30, 32 – 33).
- R.4. An engineering education instructor should not allow himself/herself to retranslate to his/her students the dismissive and

moderately-disgusted attitude of creative specialists in social sciences, arts and humanities toward engineers, mathematicians and other STEM professionals (Figures 29 – 30, 32 – 33).

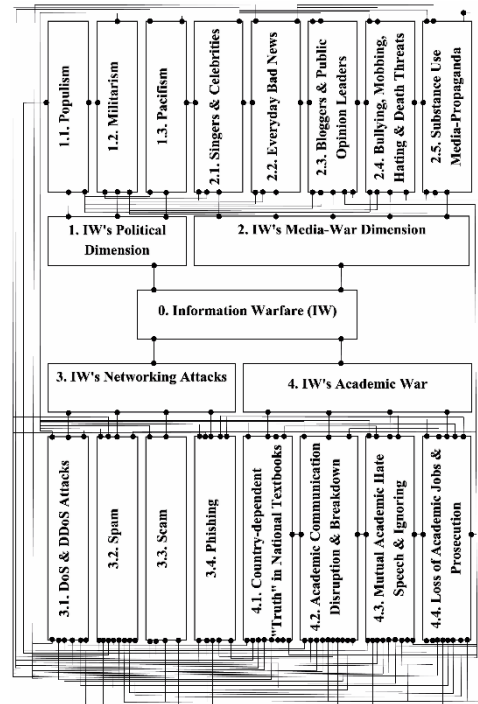


Fig. 32 An author-proposed simplified schematic of modern information warfare-induced everyday negative impact on academy community wellbeing and higher education quality, integrity, productivity and sustainability.

Persistent, “never-ending” and lifelong curriculum development activity is a mandatory obligation, heavy burden, bureaucratic routine, integral part of lifestyle, the way of thinking and the only practically available outlet for professional creativity for every successful technical instructor who is officially employed in a teaching, pedagogical or scientific-and-educational position in university, college or any educational institution (Figures 5 – 14).

Every curriculum constructor (Figures 5 – 14) always works under a severe “descending” administrative pressure and an “ascending” student pressure (Figures 12, 20 – 28) when all course-involved actors from the academic community are permanently dissatisfied with the “low rate” of instructor’s mapping of the mandatorily original curriculum, “insufficient depth” of deadline-limited instructional course-narration, “insufficient complexity” and “insufficient relevance” of instructor-proposed original computational assignments (Figures 15 – 19, 29 – 30, 32 – 33).

Students also complain of the principal “instructor’s incompetence” to astonish everyone with the unprecedented author-proposed course, which could be easily studied without home preparation (Figures 15 – 19, 29 – 30, 32 – 33).

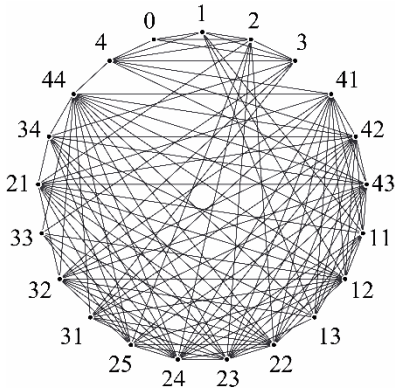


Fig. 33 Wolfram language-enhanced and Circular Embedding-based computational visualization of the main socio-political and socio-educational components of the author-simplified structure of new cold war-induced modern Information Warfare (IW), 2D-plotted in the form of the following undirected un-weighted graph with 21 vertices and 118 edges: {0-vertex. IW}; {1st-vertices level. IW's Political Dimension: 11. Populism; 12. Militarism; 13. Pacifism}; {2nd-vertices level. IW's Media-War Dimension: 21. Singers & Celebrities; 22. Everyday Bad News; 23. Bloggers & Public Opinion Leaders; 24. Bullying, Mobbing, Hating & Death Threats; 25. Substance Use Media-Propaganda}; {3rd-vertices level. IW's Networking Attacks Dimension: 31. DoS & DDoS Attacks; 32. Spam; 33. Scam; 34. Phishing}; {4th-vertices level. IW's Academic War Dimension: 41. Country-dependent "Truth" in National Textbooks; 42. Academic Communication Disruption & Breakdown; 43. Mutual Academic Hate Speech & Ignoring; 44. Loss of Academic Jobs & Prosecution}.



Fig. 34 An allegorical representation of the spring season of an author's life in academic publishing. Alternatively speaking, TUPMFEE course-enrolled Ph.D.-student believes that her new educational paper will be suitable for a Scopus-indexed international journal. However, she knows that educational studies take a long time to conduct and go through peer review so there may be some delay before she sees the first citations.



Fig. 35 An allegorical representation of the summer season of an author's life in academic publishing. Alternatively speaking, TUPMFEE course-enrolled Ph.D.-student is rather surprised with high criticism of received peer review reports and significant difficulty of reviewers' requirements.



Fig. 36 An allegorical representation of the autumn season of an author's life in academic publishing. Alternatively speaking, TUPMFEE course-enrolled Ph.D.-student notices that it took a lot of her time to prepare the revised educational manuscript with detailed and comprehensive answers to all numerous questions of reviewers.

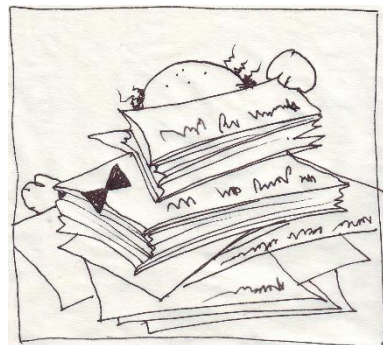


Fig. 37 An allegorical representation of the winter season of an author's life in academic publishing. Alternatively speaking, TUPMFEE course-enrolled Ph.D.-student is sad to know that her revised educational manuscript still requires the second major revision in view of the second wave of peer reviewers' criticism with dozens of new complex questions.

Quite often TUPMFEE course attendees have very complex practical questions concerning the formulation of original socio-technical analogies for engineering education (Figures 10 – 11, 12 – 13, 14, 15 – 19, 20 – 21, 22 – 23, 24 – 25, 26 – 28, 29 – 30, 4, 31 – 33, 34 – 37). The first question students often ask themselves and the instructor is: “Where do these socio-technical/socio-physical ideas (Figures 10 – 11, 12 – 13, 14, 15 – 19, 20 – 21, 22 – 23, 24 – 25, 26 – 28, 29 – 30, 4, 31 – 33, 34 – 37) come from?” After students read a socio-technical paper, another student question arises: “Why didn’t the author-proposed socio-physical idea (Figures 10 – 11, 12 – 13, 14, 15 – 19, 20 – 21, 22 – 23, 24 – 25, 26 – 28, 29 – 30, 4, 31 – 33, 34 – 37) come to them, for instance?” It is necessary to confess that both student questions are really complex issues to answer. The TUPMFEE course instructor could briefly answer these questions and note that the gradual engineering transition (switching) from technical to social sciences is really a very individual mental process (Figures 1 – 37). The lecturer could also add that prospective technical instructors could be quite convincing with their endeavors if they base original socio-technical analogies on numerous physical (Figures 12 – 13, 14, 20 – 21, 22 – 23, 24 – 25, 26 – 28) and/or computational (Figures 15 – 19, 29 – 30, 32 – 33) experiments, previously provided by them and/or their teams.

The TUPMFEE course running additionally provokes numerous questions from other lecturers who ask detailed explanations of engineering pedagogy instructors if they are really satisfied (Figures 34 – 37) with their engineering students? Other technical instructors honestly complain that they are not because their engineering students are “completely uninterested” for them (Figures 12 – 13, 20 – 22, 25, 27 – 28, 29 – 30) and that “disarms” the instructors (Figures 36 – 37). This question formulated by colleagues is really much more complex than the previous one. The simplest brief answer to an instructor’s colleague could be to partially agree with the question because most of the students are really extremely detached (Figures 12 – 13, 21 – 22, 25, 27 – 28, 29 – 30, 36 – 37). To finish this long conversation it is possible to add that among engineering students community technical instructors could occasionally find their future co-authors who could easily draw marvelous original sketches in their common educational paper (Figures 1 – 4, 31).

Curriculum development (Figures 5 – 14) often raises additional ethical questions of educational integrity and social justice (Figures 31 – 37). Faculty bureaucrats at department and university levels often have a mixed or negative attitude with regard to an instructor’s efforts to improve original curriculum development (Figures 5 – 14).

Quite often university administrators are satisfied with the quality of most instructor-proposed original curricula (Figures 5 – 14) but they do not feel that curriculum development should be coming from the instructor with a Ph.D.-academic level, i.e. they are principally not satisfied with the “insufficient” academic level of the involved curriculum developer (Figures 2, 34 – 35). They feel that superior curricula development (Figures 5 – 14) is always done by the aged senior (Dr.Sci.-level) professors, most of whom are decades behind in their thinking (Figures 36 – 37). Some are so old that they have difficulty thinking at all (Figures 36 – 37).

It has been the habit of university bureaucrats all over the world for at least two centuries to put more importance on the degrees of the authors or curriculum developers (Figures 34 – 37) than the substance and quality of what is written (Figures 1 – 33). The false premise of assuming that everything written by someone who holds multiple degrees (Figures 36 – 37) is always superior many times leads to the publication and occasional application of outdated material and useless garbage (Figures 4, 31, 32 – 33).

So the question presents itself as to what university bureaucrats should do if they strongly need a Dr. Sci.-level of name (Figures 36 – 37) on a new curriculum (Figures 5 – 14), but the original curriculum (Figures 5 – 14) was factually developed by an instructor with a Ph.D.-level under severe administrative pressure (Figures 2, 34 – 35). The answer to the question is often to simply add the name of a Dr. Sci. as senior author, who actually had absolutely nothing to do with the development (Figures 36 – 37). I.e. such bureaucratic maneuvers often result in an uncoordinated shift (at best) or removal (at worst) of factual curriculum developer name (Figures 2, 34 – 35) from his/her original curriculum in a favor of a junk name of a Dr. Sci.-level administrator (Figures 36 – 37). This practice results in an ethical “black eye” for the university (Figures 4, 31, 32 – 33) and a loss of the proper credit to the actual developer (Figures 2, 34 – 35). Such practices should be classified as outmoded and dishonest (Figures 4, 31, 32 – 33) and relegated to the trash heap of other historical errors.

Unfortunately, a new nominal “curriculum developer” of Dr. Sci.-level (Figures 36 – 37) is principally incompetent to present and defend “his/her” original curriculum before NAQA external peers and prefers to hide from NAHEQA experts (Figure 37). Therefore the factual curriculum developer of Ph.D.-level (Figures 2, 34 – 35) must present to NAHEQA experts his/her own curriculum (Figures 5 – 14) but explain that the proposed original curriculum (Figures 5 – 14) was developed by another instructor of Dr. Sci.-level (Figures 36 – 37) who is “absent today due to illness” (Figure 37).

It is obvious that these “force majeure” occupational conditions usually result in formation of inferiority complex and additional depression among all participants of “educational process” (Figures 1 – 37). The fact that these practices have been in place for many years does not classify them as “justified” (Figures 4, 31, 32 – 33). Nothing is more discouraging to younger university instructors (Figures 2, 34 – 35) than this larcenous practice of stealing credit for good work (Figures 5 – 14) from the actual originators (Figures 2, 34 – 35) and giving it to undeserving, unproductive holders of higher degrees (Figures 36 – 37). And it can and does result in highly qualified younger instructors (Figures 2, 34 – 35) losing their faith in the educational system (Figures 5 – 14) and departing for other employment (Figures 4, 31, 32 – 33).

CONCLUSIONS

The author-constructed TUPMFEE-course has found successful didactical implementation in the graduate and Ph.D.-level curriculum in the control-engineering department of Donbass State Engineering Academy, Kramatorsk, Ukraine.

The key didactical concepts of the present educational paper were independently peer-reviewed by eight external experts of the National Agency for Higher Education Quality Assurance NAQA (NAHEQA) in October 2020, April 2021 and September 2021.

Four external NAQA (NAHEQA) experts in October 2020, two external NAQA (NAHEQA) peers in April 2021, and two external NAQA (NAHEQA) experts in September 2021 were NAQA-assigned for independent peer review and open evaluation of the author-proposed TUPMFEE-course curriculum.

The first two external NAQA-peers, who are the Ph.D.-level specialists in computer networks, have approved the author-narrated TUPMFEE-curriculum in October 2020 but strongly suggested additional enhancement of the proposed curriculum with mandatory topics of crowdfunding seeking and grant funding solicitation. However, the course author rather disagrees with this suggestion because the requested additional topics go far beyond the aims and scopes of the proposed TUPMFEE-course.

The second two external NAQA-assigned peers, who are the Dr.Sci.-level and the Ph.D.-level specialists in control engineering and automation, have confirmed the actuality and originality of the author-proposed TUPMFEE-curriculum in October 2020 but complained of the “engineer-confusing” sound of numerous mandatory psychological and educational terminology like “instructor’s charming”, “course enchantment” etc.

The third two external NAQA-assigned peers, who are the Dr.Sci.-level and the Ph.D.-level specialists in control engineering and automation, have positively characterized the proposed TUPMFEE-curriculum in April 2021 but suggested mandatory English-language running of the author-narrated TUPMFEE-course and additionally requested further development of new original socio-technical examples for this emerging socio-technical course of engineering pedagogy.

The fourth two external NAQA-assigned peers, who are the Ph.D.-level specialists in control engineering and automation, have also approved the core paper ideas in September 2021 but additionally suggested the further course enhancement with development of engineering-friendly computational assignments for socio-cybernetic and educational-cybernetic description of learning-and-instruction processes in cyber-physical socio-technical systems.

All eight external peers from NAQA (NAHEQA) in autumn 2020, spring 2021 and autumn 2021 independently confirmed the principal originality, thought-provoking nature, friendliness for graduate engineering students, attractiveness and the “enchantment” of the author-mapped curriculum for the TUPMFEE-course.

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