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ARA Journal of Sciences no. 5/2022 “Creating the Society of Consciousness"

Prof. dr. habil. Dumitru TODOROI, President of the Association „AESM Seniors”, AESM, ARA Corr. Member, Chșinău, Editor-in-Chief of ARA Journal of Science,
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Abstract. The 11th edition of the International TELECONFERENCE of young researchers, themed "Creating the Society of Consciousness" (TELE-2022), was held on March 18-19, 2022, under the stewardship of the Research Directorate. This conference aimed to explore "The friendly interaction of adults in continuous intergenerational cooperation in the workplace until advanced old age." The program featured 42 research results across various domains and communicated at TELE-2022. The Association "Seniors of AESM" and its global partners proposed investigative activities aligned with the conference theme, spanning topics such as designing age-friendly environments, digital solutions, healthcare, psychology, innovative ICT solutions, and digital economic development. The collaborative efforts aimed to address the aspirations of older individuals to continue engagement in the workplace, fostering intergenerational communities for sustained activity. The TELE-2022 conference provided a platform for the presentation and discussion of initial research findings, with outcomes holding practical significance for global working groups and facilitating cross-disciplinary collaboration among researchers.

The 11th edition of the International TELECONFERENCE of young researchers, themed "Creating the Society of Consciousness" (TELE-2022), took place on March 18-19, 2022, under the auspices of the Research Directorate. The focus of this edition was on "The friendly interaction of adults in continuous intergenerational cooperation in the workplace until deep old age."

A comprehensive program was prepared, encompassing 42 research results intended for presentation at TELE-2022. The Association "Seniors of AESM," along with its partners, proposed various investigative activities aligned with the conference theme. These activities were categorized into different sections for effective communication:

- Plenary Section I (6 research results).
- Section 1: "Designing age-friendly intellectual and emotional environments and communities" (4 research results).
- Section 2: "Digital solutions and large-scale sustainable deployment" (6 research results of investigations: communicated at TELE-2022).

- Plenary Section II (4 research results).
- Section 3: „Impact and sustainability of SHAFE: policy making, funding forecasts and cost-benefit assessments" (4 research results).
- Section 4: "Medical assistance, psychology and ergonomics of professional ecosystems of employees, associates and affiliates" (4 research results)
- Section 5: "Design and creation of innovative ICT solutions integrated in intelligent support for active ageing" (5 research results)
- Section 6: "Digital economic development" (9 research results).

The objective of these investigations was to address the needs and aspirations of older individuals, particularly those around the retirement period, who express a desire to continue their engagement in the workplace. This includes employees in the last 5-6 years before retirement, retired individuals with part-time work engagement, and retirees without current activity.

The formation of intergenerational communities, such as the Association "Seniors of AESM," aims to facilitate the continuation of activities among these groups within the workplace environment. Collaborating with younger counterparts is seen as psychologically beneficial and contributes to a sense of continuity and purpose.

The research activities proposed for 2022 within the "Creating the Society of Consciousness" initiative encompassed diverse areas such as designing age-friendly environments, digital solutions, healthcare and psychology considerations, innovative ICT solutions, and digital economic development. A list of such activities is presented as follows:

(1) Designing age-friendly intellectual and emotional environments and communities.

(2) Digital solutions and large-scale sustainable deployment.

(3) Impact and sustainability of SHAFE: policy making, funding forecasts and cost-benefit assessments.

(4) Healthcare, psychology and ergonomics of the professional ecosystems of employees, associates and affiliates.

(5) Design and creation of innovative ICT solutions integrated into the smart support for active ageing,

(6) Digital economic development.

During the TELE-2022 conference, 11th Edition, held on March 18-19, 2022, the initial research findings from these directions were presented and discussed. The outcomes of these research endeavors hold practical significance for all members of the WG1-WG5 Cost Working Groups CA19136, fostering collaboration and knowledge exchange among participants from the Association "Seniors of AESM," its global partners, and the broader research community.

Digital Interventions for the Mental Wellbeing of Older Adults

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ABSTRACT:

Purpose: Technology might provide improved mental health and enhanced quality of life for the elder population (individually or as a group), especially if addressing individual needs. The current paper attempts to raise awareness and launch discussions serving as a starting point for further theorizing.

Design/Methodology: A systematic review was performed on several databases, aimed at identifying how the existing studies investigated User Engagement Indicators (UEI) and attempting to differentiate between objective and subjective criteria in the assessment of UEI.

Findings: There were no two studies using the same combination of either subjective or objective criteria for assessing UEIs.

Limitations: The fragmentation of the existing experimental research does not allow the identification of a unified, standard index, partly because of lacking specifications for data acquisition procedures.

Practical implications: The field of digital interventions for seniors is emerging, however it is still insufficiently studied and known, therefore results are scarcely assessed and standardized. It is therefore of the utmost importance to theorize and develop such standards for the purpose of better understanding the benefits and risks associated with digital interventions.

Keywords: digital mental health interventions, older adults,

Declarations of interest: none

Acknowledgements: We thank Dr. Răzvan Ioan Trașcu, MD, MPH (Ana Aslan International Foundation) for useful comments and proofreading this manuscript. We also thank the "Carol Davila" University of Medicine and Pharmacy in Bucharest for providing full access to the e-library.

General context

Throughout the past couple of years there has been an increase of popularity and availability of digital mobile technologies, which triggered and propelled the development of Digital Mental Health Interventions (DMHI), which lead to smartphone apps, long-distance monitoring devices and portable gadgets like smartwatches and virtual / augmented reality headsets.

The World Health Organization (WHO), the National Health Service in the United Kingdom and the National Institute of Mental Health in USA have recently appreciated smartphone, desktop and tablet apps as effective, cost-effective and valuable methods

of providing accessible care for mental disorders like depression and anxiety.

Recent research suggested that DMHIs may be used to early identify, diagnose, manage and analyse the mental health status in adult patients. However, significantly less studies are focused on older adults, in spite of them having unique needs and preferences in terms of technology-based health interventions. Managing daily activities for older adults is extremely complex since most older adults are also facing a plethora of late-onset chronic disorders.

Moreover, more vulnerable older adult populations, i.e., those living in rural areas, are confronted with scarce mental healthcare options due to the lack of care facilities and to lesser mental healthcare professionals and services available in nonurban areas. We therefore need to admit that the use of DMHI is not limited to primary mental healthcare facilities but may also be used by people dwelling in isolated communities and residential centres.

Purpose and rationale

Technology may provide older adults, individually or in groups, access to physical exercising using motion sensors or exergaming-based technologies, which may then alleviate depression and anxiety symptoms and further improve their general wellbeing and quality of life.

Moreover, improvements in mental health and in the quality of life may also be a side effect of using technology-based services addressing individual needs, including, for instance, access to transportation, the ability to attend teleconferences, remote education and socialization.

DMHI research yields the potential to lead to major breakthroughs about disease/disorder interventions, since it may reach populations which may otherwise lack standard mental health interventions; it may also widen the limitations of available healthcare services and it may assist in overcoming geographical barriers by providing healthcare services in remote areas.

In spite of the promises held by DMHIs, some perils also arise from digital gaps. Older adults may feel unfamiliar with new technologies or even excluded by them, and this may further lead to an exacerbated perception of inequitable healthcare, may exacerbate help avoidance behaviours and may even trigger self-depreciation.

The fundamental benefit of DMHIs is the opportunity they yield in evening mental healthcare accessibility inequities. There are however relatively few studies investigating the effects of DMHIs in populations specifically facing significant social and physical challenges.

Despite the potential benefits of mental health mobile apps, real-world results point to involvement issues due to low usage or to the lack of consistently using such apps [1]. For better understanding this there have been some studies focused on examining to what extent the existing studies have measured and reported user engagement indicators (UEIs) for mental care apps.

Design / methodology

We performed a systematic review of several databases based on mental health apps available in July 2018 for depression, bipolar

disorder, schizophrenia and anxiety, which also reported UEIs, i.e., usability, user satisfaction, acceptability and feasibility. We extracted from each study the subjective and objective criteria used for assessing UEIs.

Results

Out of 925 studies only 40 were eligible. Each study reported positive outcomes for usability, satisfaction, acceptability or feasibility of the app.

Out of the 40 studies, 36 (90%) have used a number of 371 indistinct subjective criteria being assessed using either surveys, interviews or both, while 23 studies resorted to subjective personalized scales instead of pre-existing standardized assessment tools. A total of 25 studies (63%) did use objective criteria – with 71 indistinct measures. No studies were identified with the same combination of subjective and objective criteria to assess app UEIs.

Within the (already vulnerable) older adult population there are more vulnerable subpopulations including (but not limited to) those dwelling in abusive families, the homeless, the pauper, racial minorities, refugees, gender/sexual minorities, those having physical disabilities and/or chronic diseases.

Schueller et al [2] widely covered how digital interventions may provide opportunities for alleviating mental health disparities amongst marginalized populations and stated that technology may be adapted to be more culturally sensible for lesser costs and may also help in overcoming time, location and language barriers. In spite of all this progress, however, each marginalized subpopulation of older adults has different strengths and needs in terms of DMHI usage. Intensive work is required to bring into real life settings the potential of responding to the specific mental healthcare needs of various marginalized older adult subpopulations.

Conclusions

The increased heterogenicity observed and the use of personalized criteria for assessing mental healthcare apps in terms of usability, user satisfaction, adoptability and/or feasibility are of poor assistance in understanding the low usage of such tools in real life settings. Each one of the revised studies claimed that the UEIs for each application were adequately assessed, and this leads to an increased need to focus research on drafting standards for proper reporting and to review all implications more carefully.

IT&C interventions may assist in providing healthcare for older adults with chronic diseases by increasing compliance to treatment and by promoting a healthier lifestyle. However, incorporating IT&C interventions in medical practice is still a challenge. The involvement of clinicians is crucial in determining those afflicted by chronic disorders to adopt IT&C interventions for better self-management. We definitely need to raise awareness and train both older adults and healthcare providers about existing IT&C interventions which are already available and effective. Wide-scale implementation of IT&C interventions would also require more durable approaches in terms of funding and reimbursement. It is advisable to involve both clinicians and caregivers whenever designing IT&C interventions to be integrated as part of routine medical healthcare.

Practical implications

One of the most recent analyses (Bin Zaman et al., 2022) [3] outlines potential benefits of IT&C and eHealth interventions (for instance, mHealth and mobile apps, EHR, remote monitoring, CDSS and telemedicine) for supporting the self-management of chronic disorders in older-aged adults. It also pointed out some of the operational and technical barriers preventing the use of such IT&C interventions for older adults. They identified age-related barriers, like knowledge, motivation, physical limitations (poor eyesight or limited motor skills) and perception, which limited the adoption of IT&C interventions by older adults with chronic diseases. In such situations, personalized training may assist in satisfying the needs, interests and unique skillsets of individual users in order to circumvent such limitations.

Some of these limitations may be solved by optimizing the design of IT&C interventions, for instance by increasing screen contrast to compensate for decreased visual acuity, or by simplifying physical tasks in order to facilitate the use of IT&C for patients suffering from arthritis or physical disabilities. A series of challenges and contributing factors to integrating IT&C solutions in routine care were also identified. Unfortunately, most of the studies were either piloting interventions or were short-term interventions in a controlled environment. Hence, we should prioritize longitudinal studies aimed at assessing long-term efficacy of IT&C interventions.

The results of the analysis point that some older adults with chronic diseases may have their reserves when becoming involved in IT&C interventions. There were challenges related to operational and technical issues, like the lack of desire to acquire new skillsets, decreased self-confidence and the lack of abilities required for operating IT&C devices.

Such findings coincide with results of other studies in which older adults showed no interest adopting new technologies and had difficulties in appreciating the need for such applications as part of their own routines. The acceptance of electronic or digital technologies may be more challenging for the current generation of older adults, which were not exposed to such tech when growing up. Short e-learning sessions were useful for increasing the IT&C literacy of older adults (for example, 2 weeks of 10-minute daily sessions).

There is an increased motivation and desire for using IT&C interventions with older adults because of the non-pharmacological nature of the intervention. The self-management of chronic diseases includes having a healthier lifestyle and better compliance with medication.

However, older adults seem to need specific motivation for making practical changes, like adopting a healthy diet and becoming physically active, even if they seem to be aware of the value of such interventions.

The traditional model of episodic care as provided by clinics and hospital support systems may not be enough for preventing chronic disease without the inclusion of IT&C interventions as part of routine healthcare. Healthcare providers should therefore be motivated to use IT&C interventions to communicate with their patients for the purpose of identifying if their advice is diligently observed. It is also imperative to understand the duration of time needed before getting a

profitable return out of IT&C interventions.

The findings of this analysis suggests neither older adults with chronic diseases, nor their caregivers were willing to pay for using IT&C interventions, in spite of being content of the service. Most of participants were only willing to pay in part.

One of the possible explanations for this result is that all study participants originated in high-income countries and frequently reported the lack of proper insurance and reimbursement for the devices needed for IT&C interventions. Without adequately dealing with the payment models, it will be challenging to secure proper usage of IT&C interventions as part of healthcare routine, even though older adults are willing to adopt them. Therefore, a proper, more durable model for funding and reimbursement is crucial for promoting IT&C intervention adoption.

Besides the financial aspects previously factored, the amount of work effort needed was also an additional factor in the adoption of IT&C interventions. The management of life-threatening conditions, like arrhythmias and heart attacks, require swift response from healthcare providers and such swift responses may be difficult to provide, particularly in hardly accessible regions.

Failure to provide a swift response to patients may exacerbate the risks faced by older patients with chronic diseases and may expose susceptible healthcare providers to face negligence liabilities. There are also risks for false positives with such IT&C interventions which may require physical checks. Such alerts would increase the work effort for clinicians when required to personally investigate each call. This may explain why not all clinicians were receptive to adopting IT&C interventions for their patients. Adequate training may significantly improve the availability of healthcare professionals to using or convincing their patients to use IT&C interventions at home.

Future app developers should consider the engagement of end-users in the design and development of IT&C interventions. Having the clinicians involved with recruitment seems to influence study attendance decision for participants. Their involvement is therefore crucial in motivating patients to use IT&C interventions.

Healthcare providers should also be encouraged and convinced to recommend IT&C solutions to their patients. Otherwise, the desire to use IT&C interventions would never arise within patients, in spite of their literacy in operating such devices.

The general assumption that education is a relevant factor in the adoption of IT&C may not always be accurate, since authors of one paper reported that the education level yielded no positive correlation with the adoption of IT&C interventions in their sample. Medical healthcare providers may become an additional barrier for the adoption of IT&C intervention by older patients.

One study reported that 30% of EHR (Electronic Health Records) system implementations worldwide failed because of insufficient or inadequate usage from clinicians. Study authors identified the concept of medical authority as being critical in the implementation of EHR. Medical authority seems to be an essential factor in implementing other IT&C interventions. The management of chronic disorders may involve several

healthcare providers. This may be too complex for older adults with chronic diseases which imply disabilities or dwelling in rural areas, specifically in hard-to-reach locations. IT&C interventions may play an important role there by providing connectivity between several providers. Some IT&C interventions (CDSS and EHR) provide valuable features, like data sharing with other providers (interoperability) and providing patient-specific information, like medication compliance.

However, at the same time, such interventions raise ethical and legal concerns about data sharing between multiple providers (i.e., data confidentiality and security). Such barriers may be overcome if doctors, healthcare workers and providers are compelled to maintain confidentiality and to report all deleterious events related to IT&C intervention usage.

Continuously monitoring the wellbeing of older adults is to become a priority in the context of accelerated ageing worldwide [4]. The intrinsic capacity concept (IC), which implies unified wellbeing, was suggested as a standard by the WHO in the 2015 world report on ageing and health. WHO defined IC as a composite of all d physical and mental capacities that an individual can draw on at any point in time. Building on this concept, the functional capacity is determined by the interactions of an individual with the surrounding environment. Although a large number of studies concentrate on assessing the various fields of operation at different life stages, little effort was put into aggregating all fields and reporting a general score of older aged adults' wellbeing. A key point of the IC concept is the holistic and continuous monitoring of patient's overall capacity. This would imply an early diagnostic of declining healthcare and wellbeing abilities, for the purpose of creating a personalized, adequate intervention plan to prevent the decline and to revitalize the declining capacity.

Today's literature does not however clarify how the IC score should become operational. Various authors did validate the approach by comparing retrospective data and IC scores using various factors and procedures. The fragmentation of existing experimental results does not allow the identification of a unified, standard index. Part of the problem originates in the lack of specifications for data acquisition procedures. The comprehensive and regular monitoring of the biological status of a patient implies specific technical requirements need to be met. Adopting common standards may yield a significant impact on the reproducibility of experimental results in the field.

The main available guide for implementing the IC evaluation is the Integrated Care for Older People manual (ICOPE) published by WHO. According to ICOPE, the IC score is a composite of six generic domains: vitality, locomotion capability, visual capability, hearing capability, psychological capability and cognitive capability. One should note that the literature also speculates that the visual and hearing capability may sum up as a single field, namely sensory capability.

The ICOPE manual specifies in each field a set of reliable clinical and non-clinical measurements, suggested and validated by clinicians. However, such tests are conceived for use within clinical settings, thus limiting the frequency of data collection. To overcome these limitations, adequate technologies need

to be implemented.

Throughout the past couple of years there was an increase in the interest shown to portable devices. Intelligent devices like smartphones, fitness bracelets, Bluetooth-capable blood pressure monitors, smart scales and medication dispensers enable the continuous monitoring of patient activities and may have a significant impact on the data collection process quality in terms of accuracy and complexity.

Each measurement has a specific weight in the IC score, albeit not clearly defined in the ICOPE and being subject to debates. Complexities related to specifying a unique solution for the calculation of the IC mainly have two underlining root causes: firstly, due to the non-universal character of all factors involved in the IC within various geographical / cultural populations worldwide, and secondly due to the different efficacy degrees of all composite factors of the individual IC score. In other words, we have no unified applicable prescription for deriving the IC from the measurements performed.

A possible solution lies within Machine Learning (ML) algorithms, which may tackle all these complications in studying the IC score; the use of ML and statistical models should enable the identification of the most relevant factors for the IC, while the adoption of new training models should enable predicting IC score variations and preventing any possible IC falls by means of adequate interventions.

Continuously monitoring the IC for preventive purposes not only requires analytical capabilities for identifying the most effective parameters and suggesting the applicable solution, but also needs to be urgently engineered within monitoring activities.

The digital mental health intervention field of research is barely emerging and insufficiently studied so far; assessing and standardizing results is a challenging task. There are specific challenges: accurately assessing the prevalence and the individual, societal, economic and financial impact of mental disorders in older adults; knowing and understanding the benefits of digital interventions; last, but not least, acceptance of these technologies in the specific age group (i.e., overcoming technical barriers).

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Product „SENIOR Association”.

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Abstract. The clarity and relevance of the objectives of the "Seniors Association ASEM" product are examined within the framework of its activity regulations, ensuring the continuity of activities for 143 adults of ASEM until advanced age. Elderly professors of ASEM are categorized into three groups: Employees, Associates, and Affiliates, engaging in special interest intergenerational activity groups and contributing to ASEM's evaluation towards a Research-Education University model. The proposed approach harnessed the advanced intellectual capabilities of "Seniors Association ASEM" members to address societal and economic challenges. They actively participate in various key activities aimed at meeting the pressing needs of the elderly population and improving their psychological well-being, independence, and autonomy. Established in 2019, the intergenerational organization, "Seniors Association ASEM," has demonstrated successful operation. Special Interest Groups within the association tackle institutional problems across economic, financial, accounting, business, public administration, business administration, informatics, international economic relations, tourism, and legal domains. Collaborating with young professors, doctoral candidates, master's students, and ASEM students, the association has organized international intergenerational TELECONFERENCES (TELE) focusing on "Creating Society of Consciousness" over the past three years. Research outcomes from these conferences have been published in esteemed journals. The proposed works demonstrate ambition, innovation potential, and surpass the current state of technology. Organizations like "Seniors Association ASEM" ensure the psychological well-being of the elderly in society, representing innovative approaches to intergenerational survival in a society experiencing accelerated aging trends. These intelligent societies surpass current aging technology stages. Through the invention of continuity in elderly activities, SIGs of the "Seniors Association ASEM" ensure continued elderly activity within the "mother enterprise" until advanced age.

Keywords: Seniors Association ASEM, intergenerational cooperation, special interest groups, transdisciplinary approach, psychological well-being, societal aging, research and development.

Claritatea și pertinența obiectivelor PRODUSULUI „ Asociația „Seniorii ASEM””. Asociația „Seniorii ASEM”, prin Regulamentul său de activitate, asigură continuitatea activităților a 143 de adulți ai AESM până la adânci bătrânețe. Profesorii vârstnici ai ASEM sunt asociați în 3 grupe de adulți: Angajați, Asociați și Afiliați. Membrii asociației sau asociat în Grupe intergenerațională Speciale de Interese de

activități și participă la evaluarea ASEM spre o Universitate de tip Cercetare-Educație.

Credibilitatea abordării propuse. Membrii Asociației „Seniorii ASEM" dispun de posibilități intelectuale avansate, care asigură activități de valoare în domeniile sociale și economice din Societate. Ei se implică în multe activități de interes cheie pentru a răspunde nevoilor presante ale persoanelor în vârstă, precum și oferă soluții pentru a îmbunătăți **sănătatea psihologică, bunăstarea, independența** și **autonomia** persoanelor în vârstă. Organizația intergenerațională, Asociația „Seniorii ASEM", **activează cu success** din anul 2019.

Primele Grupele Speciale de Interese ale Asociației „Seniorii ASEM" activează în cadrul soluționării problemelor instituționale din domeniile: economic, financiar, contabil, business, administrare publica, administrarea afacerilor, informaticii, relații economice internaționale, turism și juridic. Membrii **Asociației „Seniorii ASEM"** în colaborare cu profesorii tineri, doctoranzii, masteranzii și studenții ASEM și co-partenerii lor au organizat în ultimii 3 ani de activitate TELECONFERINTE internaționale intergenerationale (TELE) cu Genericul „Crearea Sociatății Conștiinței".Rezultatele cercetărilor, effectuate și prezentate la TELE au fost publicate în Revista Europeană „Society Consciousness Computers" și în Revista „ARA Journal of Sciences" editată de ARA Publishing House, Universitatea Davis din California.

Soliditatea conceptului, inclusiv considerații transdisciplinare, după caz. Adulții ASEM **sunt cooptați** în Grupe Speciale de Interese (GSI) cu activități structurate în „P**roiectarea proiectelor", „Cercetare seniorală", "Curricula 2030"** și **„Audit profesoral". Membrii asociației** „Seniorii ASEM" reprezintă partea cea mai inteligentă a colectivului ASEM, fiind profesioniști de înaltă calificație cu activități transdisciplinare inovatoare de cercetare și educație. Împreună cu m**embrii-asociați** ai asociației (profesorii tineri, doctoranzii și studenții ASEM), **membrii asociației** activează în calitate de co-parteneri și membri ai Grupelor intergenerationale Speciale de Interese ale Asociației „Seniorii ASEM" (GSI) pentru asigurarea activităților de soluționare a problemelor ASEM legate de evoluțiile contractelor și acorduriloor încheiate recent de ASEM cu întreprinderile și organizațiile republicane și internaționale și în cadrul celor 5 Direcții de Cercetare și Dezvoltare a Republicii Moldova din Programul „Moldova 2030".

Măsura în care lucrările propuse sunt ambițioase, au potențial de inovare și depășesc stadiul actual al tehnologiei. Organizațiile de tip Asociația „Seniorii ASEM" asigură bunăstarea psihologică a vârstnicilor în Sociatate. Ele reprezintă abordări noi inovatoare de supraviețuire intergenerațională în Societatea Umană, societate, care are tendințe reale de înbătrânire accelerată. **Societatățile inteligente** de acest tip **depășesc stadiul actual al tehnologiei înbătrânirii.** Grupurile Speciale de Interese ale asociației „Seniorii ASEM", prin **invenția** de **continuitate a activităților vârstnicilor,** asigură activitatea în continuare a vârstnicilor la întreprinderea – mama" **până la adânci bătrânețe**.I. Marca Noastră. (Our Brand)

Atât nevoia de continuitate și de conlucrare inter-generațională autentică a vârstnicilor, cât și nevoia de menținere și de schimbare pozitivă a bunăstării psihologice a vârstnicilor, a devenit mai degrabă o necesitate decât doar o dorință de a crea "Asociații SENIORALE".

1.1 Cine suntem? (Who We Are?) O paradigmă nouă: „Asociația SENIORALĂ”

1.2 De ce? (Why?)

Împreună, creăm o societate mai bună. În condițiile îmbătrânirii accelerate a societății pensionarii necesită să contribuie la crearea bunurilor în societate. Fiind liber de împuterniciri de serviciu, savantul deprins să creeze, din inerție continue să creeze, doar că în situația nouă de pensionar, independent, nimeni nu-l silește, nu e supravegheat, el e liber creator!

Ex.: În prezent avem Asociația „Seniorii ASEM”. Dar, când am inițiat asociația, noi aveam doar o simplă dorință: profesorii pensionari să se simtă în continuare necesari pentru societate!

Având această dorință noi am creat Asociația profesorilor pensionari din ASEM pentru caei să-și continue activitățile până la adânci bătrânețe. Spiritual și psihologic e mult mai binevenit ca persoanele în vârstă de la ASEM să-și continue activitățile la întreprinderea – mamă, care e o societate adecvată îmbătrânirii decente.

1.3 Cum? (How?)

Conectăm oamenii cu experiențe semnificative și testate de vreme pentru a putea: să creeze, să implementeze, să mențină și să dezvolte colaborarea inter-generațională, să învețe continuu, să stârnească schimbarea, să se reîncarce, să se inspire, să se distreze.

Ex.: Ca să asigurăm bunăstarea psihologică de trecere la pensionare și susținere a profesorilor adulți, am hotărât să ne numim în continuare „Seniorii ASEM” și să continuăm activitățile noastre inter-generaționale la întreprinderea - mamă.

1.4 Ce? (What?)

Am alocat spații pentru a ne socializa, a educa, a cerceta, a studia, a învăța și a ne odihni. Mai mult decât un grup de spații lucrative, asociațiile seniorale dispun de experiențe semnificative și distractive, care reunesc o comunitate locală inter-generațională strâns unită cu o comunitate globală într-una singură.Destinații pline de viață pentru cei inspirați și inspirațională, asociațiile seniorilor sunt locul în care comunitatea noastră vibrantă și diversă se poate conecta, crește, menține potențialul maxim și conduce schimbări pozitive.

Ex.: Mediul pensionării profesorilor l-am divizat în trei etape: etapa de pre-pensionare, etapa pensionării și etapa de post- pensionare. Am considerat, că e esențial de asigurat bunăstarea psihologică a adulților în perioada „de trecere” de la angajat la asociat și, de acolo, la afiliat la întreprinderea – mamă, în esență, seniorii „să nu observe incomoditatea pensionării”.

Știți voi oare că? (Did you know?) În ASEM 40% din profesorii adulți sunt seniori angajați și asociați și 60% sunt profesori voluntari. Toți, conform Statutului „Asociației ASEM”, sunt afiliații ASEM.

II. Valorile noastre (Our Values)

2.1 Ceea ce susținem: (What we stand for:) Valorile noastre nu sunt reguli rigide după care trăim, ci însăși esența a ceea ce suntem. Reflectând în tot ceea ce facem, valorile noastre scot la iveală ce este mai bun în noi și în comunitatea noastră de oameni care gândesc la fel.

2.2 Distractivi: (Fun:) Cu inteligență și observație, nu luăm niciodată viața prea în serios și credem că acționarea cu scop poate fi totuși distractivă.

2.3 Curioși: (Curious:) Mereu interesați și implicați, nu ne temem niciodată să încercăm lucruri noi și întotdeauna inspirați să ieșim din zona noastră de confort.

2.4 Experimentali: (Experimental:) Entuziasmați și ambițioși, inovăm cu entuziasm și pionierat fără să ne temem de eșec.

2.5 Conștienți: (Conscious:) Punem impactul social și de mediu pe primul loc, străduindu-ne întotdeauna să luăm decizii responsabile pentru comunitatea noastră, oraș, republică și pentru planeta noastră.

2.6 Îndrăzneți: (Bold:) Acționând cu curaj și inimă, ne susținem întotdeauna convingerile și nu ne ferim niciodată de discuții sau decizii dificile, care au un impact pozitiv.

2.7 Personalul asociat: (Associated staff) Noi am analizat contingentul profesorilor adulți din ASEM, începând cu cei, care au cinci ani până la pensionare (angajații, perioada de pre-pensionare), prelungind cu cei cu activitate parțială (asociații, pensionarii cu activitate) și, terminând cu cei, care nu au activitate (afiliații, pensionarii cu activitate voluntară). Așa am evidențiat 3 categorii de profesori pensionari, toți fiind, conform Statutului „Asociației ASEM", asociați ai ASEM: profesorii angajați, profesorii asociați și profesorii voluntari.

Știți voi oare că? (Did you know?) Asociației pensionarilor i-am atribuit numele de Asociație „Seniorii ASEM" inspirați de comentariile Profesorului Radu Mihalcea, Doctor Honoris Cauza al ASEM, Senior din Orașul vârstnicilor din Chicago, SUA.

Ex.: Crearea asociației. Discutarea și aprobarea Asociației pensionarilor adulți din ASEM și a Statutului ei a fost efectuată de către Senatul ASEM în ziua de 24 decembrie anul 2019 a, și, în continuare, a fost confirmată prin Ordinului Rectorului ASEM din 2 ianuarie 2020. Asociația „Seniorii ASEM" (AS ASEM) și-a ales Consiliul de Administrare (CA AS ASEM), care a inițiat, discutat și a aprobat agendele de activitate a asociației pe termen scurt și îndepărtat. Au fost aprobate direcțiile principale de activitate. Au fost specificate Grupele Speciale de Interese (GSI) a AS ASEM. Au fost create agendele de activitate a GSI-urilor AS ASEM.

Acțiunile asociației „Seniorii ASEM" sunt lunar organizate și conduse de Consiliul de Administrare a AS ASEM, cu decizii Statutare efectuate anual de Adunarea Generală a AS ASEM.

2.8 Misiunea de sustenabilitate. (Sustainability mission.)

Sustenabilitatea înseamnă crearea longevității și a unei societăți echitabile pentru oameni și planetă. Deci, este în regulă dacă începeți cu atenuarea impactului asupra mediului. Dar pentru a lucra cu adevărat la sustenabilitate și a deveni afacerea generabilă, trebuie să mergi dincolo de asta și să te concentrezi pe definiția completă - investind în mediu și oameni.

Literalmente în centrul a ceea ce suntem, suntem sociali în personalitatea noastră și în inițiativele pe care le alegem ca o subdiviziune a universității economice. Oamenii și planeta merg mână în mână și trebuie să avem grijă de ambele pentru a crea o adevărată durabilitate.

Aici se întâmplă lucrurile distractive.

Ex.: Activitățile, incluse în Parteneriatele ASEM de colaborare cu organizațiile și întreprinderile din Republică și de peste hotare, în favoarea evoluării și evoluției Programului statal „Moldova 2030", sunt susținute de

Asociația ”Seniorii ASEM”. Analizele, cercetările și implementările rezultatelor activităților AS ASEM în prezent sunt organizate și dirijate de AS ASEM prin intermediul acțiunilor Grupelor Speciale de Interese „Proiectarea Proiectelor”, „Audit Senioral”, ”Cercetare Profesorală”, „Curricula 2030” și „Cultura și Odihnă”.

2.9 Identitatea mărcii. (Brand identity.)

Asociația SENIORALĂ: Unicum (The one and only); O răscruce de drumuri unde oamenii și experiențele converg; În centrul comunității; Unul pentru toți, și toți pentru unul.

Simbolul comunității noastre: Logo-ul nostru exprimă vizual esența noastră - reunindu-ne din diferite direcții, medii și categorii sociale pentru a ne aduna în jurul asociației. O comunitate de intergânditori, interconversatori, intermeditatori, asemănători în gândire, activități (meditații) plăcute (like-minded), curioși, conștienți, antreprenoriali, îndrăzneți și distractivi, forma logo-ului ilustrează diferite părți care se unesc.

2.10 Ilustrarea personalității noastre: (Illustating our personality)

Concepute pentru distracție și infuzate cu personalitate, ilustrațiile noastre se joacă cu logo-ul nostru, liniile îndrăznețe, spațiul negativ și culorile mărcii pentru a conecta numele nostru cu experiența noastră.

Ex.: Asociația „Seniorii ASEM” asigură continuitatea activităților membrilor ei în favoarea menținerii și dezvoltării, în primul rând, a bunăstării psihologice a profesorilor adulți la întreprinderea – mamă. Activitățile AS ASEM sunt ghidate de scopul măreț de avansare a ASEM spre o Universitate de tip Cercetare-Educație, Universitate a viitorului! În final, și nu în ultimul rând, Asociația „Seniorii ASEM” activează în cadrul Programului statal „Moldova 2030”.

Asociația „Seniorii ASEM” activează cu drapelele: „ASEM e Casa mea” și „Casa mea e ASEM”. Această constituie o nouă paradigmă de comunitate a activităților adulților și esențial diferă de alte comunități analogice ale vârstnicilor. Scopul final al AS ASEM: toți profesorii adulți să fie afiliații ASEM ca să-și continue activitățile inter-generaționale la întreprinderea – mamă până la adânci bătrânețe. Asociația „Seniorii ASEM”: de la ideea de creare a ei din aprilie 2019, spre aprobarea ei din decembrie 2019 și până în prezent, când ea se încadrează în evoluțiile Parteneriatelor ASEM

The Impact of Taxation on the Flow of Investments in the Indigenous Economy

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Abstract: In this article, the author aims to demonstrate the importance and emphasize the impact of fiscal policy, through the prism of taxes, on investment flows and investment processes in the Republic of Moldova, but also in other states, subsequently making a comparison of this interdependence on a national and international level. In this work we focused on the analysis of the chain of effects that foreign investments create on the economy of a country, which is indisputable, and therefore they influence both the production of goods and services, as well as consumption, simultaneously motivating the demand and supply of respective goods and services. Investments represent the incentive that generates new economic activities indispensable to a market economy and creates the possibility of capitalizing on the economic potential of a state.

Keywords: fiscal policy, taxes, investment flows, investment processes, foreign investments, production of goods and services, consumption, demand and supply.

1. Introduction

The investment climate represents the level of attractiveness of a country/branch/area for investment allocation. In assessing this entry, a lot of economic, political, social, financial, cultural, etc. factors can influence the investors' view of the investment prospects in the region [10].

The investment climate in the Republic of Moldova can be seen differently, depending on the perspective with which it is viewed:

• The macroeconomic factor – the Republic of Moldova is characterized by macroeconomic instability (inflation, unemployment rate);

• Social factor – social instabilities, protests, strikes, which may present a risk to foreign investors;

• Legislative factor – reforms at the legislative/judicial level;

• Transparency – the induced exceptional situation.

Economic growth is one of the main objectives of the state's economic policy. Investments have been and continue to be crucial in stimulating the development of a country's economy. The crisis generated by the war in Ukraine highlighted the low production capacities of the Republic of Moldova and the acute dependence on imports, problems largely generated by the lack of an attractive investment climate in the Republic of Moldova and, respectively, the lack of necessary investments to increase production capacities. The research analyzes the way in which the state can stimulate the volume of investment flows through fiscal policy. At the current stage, a special concern is given to increasing the volume of investments and maintaining it at

a high level, mostly by implementing an appropriate fiscal policy. Namely, by establishing an attractive tax environment, a sufficient volume of capital can be collected for economic growth and the improvement of the population's life standarts.

One of the basic economic problems in the Republic of Moldova is the insufficient level of investment resources. Investments are attributed to the main factors that contribute to economic growth, namely one of the levers for influencing investment processes through fiscal policy is the tax on the income of legal entities.

2. Factors that influence the volume of investments

The attraction of investments is conditioned by a series of factors, which are taken into account by investors, such as: the general economic and social environment of the country, the quality of the institutions; legislation and tax burden; the economy's development degree; the economy's openness degree, the development level of the transport and communications infrastructure; market size; the labor market, the endowment with natural resources to which monetary and trade policy is also added. According to a study carried out by the World Bank, regarding the orientation of FDI flows to countries in transition, it was found that they were directed to countries that:

• established a stable legislative regime favorable to investments and foreign investors;

• show political and social stability;

• removed the barriers to foreign investments;

• have a commercial regime and a free currency exchange system;

• have a low taxation level;

• they have qualified and cheap labor;

• ensure an appropriate market.

So, we note that the level of taxation in the respective country is among the determining factors of investment decisions. We are referring here especially to the aspect of income and profit taxation. The practice of fiscal administration is directly related to the fiscal policy. The instability of the tax policy rules, correlated with the administration problems from the tax authorities have caused several conflicts with foreign investors in the Republic of Moldova, some of them strategic. Thus, in addition to the development of attractive and consistent fiscal policies, the authorities must equally take into account the good practices of implementation and administration by state bodies of these policies.

Taxation plays a fundamental role in creating a just society and building a strong economy. Fiscal policy can also have a large influence on employment decisions, investment levels and on entrepreneurs' willingness to expand their activities, all of which lead to stronger economic growth.

3. The importance of investments for the national economy

Investments for a national economy are of extreme importance, namely they train the saved capital to obtain new benefits, both for the country and for investors and employees. Thanks to the investments, new jobs are created and sustainable economic growth is ensured. To strengthen these statements, it is necessary to analyze the effects of foreign direct investments (FDI), as well as domestic ones, on

the economy of the Republic of Moldova.

Analyzed according to the origin of the resources spent, investments in the economy of a country can be divided into investments of own resources and investments of foreign resources. Therefore, different examples of these two cases will be analyzed.

Investments of own resources

By the notion of investing own resources, it is assumed that the investor, who has resources, is willing to use them for the development of domestic products, and therefore the expenses are produced in the country where he is a resident.

One of the most telling examples of investing in one's own economy is South Korea in the 20th century. The historical context assumes the existence of an authoritarian regime for more than half a century, which adopted an autarkic economic policy. This fact implies economic self-isolation, giving up the maintenance of economic relations with other countries and, respectively, the need for effective production methods of all the needs of the population within the own economy.

The refusal of American technologies meant the need to increase South Korean technologies, the refusal of Japanese machines implies the need for the appearance of South Korean ones, the abandonment of Italian and French films in vogue at the time, led to the appearance of Korean cinema.

Due to the sheer impossibility of consuming imported products, during that period businesses such as Hyundai, Kia, Samsung, etc. experienced their greatest growth, becoming some of the most innovative and efficient companies on the world market.

A similar process is currently happening in Singapore, which, being an authoritarian regime, in a relatively short period of time has become one of the largest manufacturers of chips and microcircuits in the entire globe.

It should also be noted that in the GDP of a country, institutions are not only represented by the letter I (investments), but also mostly by the letter G (government expenditures).

The state, being usually the richest institution of a country, is usually a very large investor within the country. In addition to the state orders that can be made from independent companies - which can be interpreted as a way to invest in it, the state makes a lot of investments that aim to achieve a social effect.

The most illustrative examples of the state as an investor are the Scandinavian countries, where most medical, educational and public institutions are nationalized. The state invests in infrastructure and social order.

Statistics show that people from countries like Norway, Sweden, Finland, Denmark turn out to be among the happiest, longest living and richest people on the earth in average. The connection between these kinds of investments and the country's economy is not direct, and yet characteristics such as health and happiness indirectly influence the labor productivity of every working man within the state.

Foreign capital investment

Foreign capital investments assume that the investor in the given country's economy is a non-resident. In this case, natural persons can appear as investors, but more often large companies or entire states.

An eloquent example where the state appears as an investor in the economy of another state can be that of the United States

and Japan, in which during the second half of the 20th century, thanks to the post-war financial aid received from the US, Japan experienced a period of sudden economic growth, known as the Japanese economic miracle, and which allowed Japan to develop from a predominantly agrarian country, where feudal remnants were still preserved, to one of the largest economies in the world. A specific feature of this case is that a large amount of American investment was used for the development of the educational system, the US facilitated the Japanese expo to America, which was a great opportunity for the growth of such companies as Sony, Toyota and Nintendo.

A case of inefficient US investments in the economy of other countries is represented by African countries. The investments, in this case, actually took the form of humanitarian aid, but their ineffective management did not lead to a development similar to that of Japan, most of the resources were not invested in creating an infrastructure and a business environment, but on expenses without perspective.

A method by which large companies invest their capital in other countries is according to the principle "the holy place does not remain vacant", thus large companies such as Nike, Apple and others open their subsidiaries and factories in a large number of countries that are economically less developed, and which usually constitutes a favorable environment for producing goods. Countries such as Pakistan and Vietnam, where Nike's largest factories are located, are characterized by very cheap raw materials and labor and usually much more relaxed tax regimes. The effect of a type of investment presented above consists of the following:

1. Increasing state revenues - the production in very large quantities of the companies coming to these states implies imposing revenues, and although the fiscal pressure in the given states is relatively lower, the absolute amount of taxes paid to the state is very high;

2. Increasing the income of local people – these companies create a lot of jobs for local people, with salaries higher than the market average.

The impact of foreign investments on a country's economy is undeniable: the chain of effects they create has an influence on both the production of goods and services, as well as on consumption, simultaneously stimulates the demand and supply of those goods and services. Investments represent the incentive that generates new economic activities indispensable to a market economy and creates the possibility of exploiting the economic potential of a state [9].

The influence of taxes on investment processes also has a rather large weight in the analysis of the policy of attracting investments in different sectors of the economy, because there is a direct link between the fiscal and investment policy of a state. Thus, the basic trend in the development of a state is to create an investment climate as attractive as possible, including from a fiscal point of view for increasing the volume of investments in the economy [12].

An attractive tax environment provides for the existence of an important set of tax incentives, such as:

• total or partial exemption from taxation of profits;

• reduced corporate income tax rates on certain profits;

• reduction of taxes for investment purposes (reductions for reinvested profits);

• accelerated depreciation of capital costs;

• credits for investment taxes/taxes;

• VAT exemptions/reductions (or other forms of sales taxes);

• reduced rates of taxes/withholding taxes on transfers of amounts in the country of origin (residence);

• reduction of import taxes and customs duties;

• exemption from land taxes; special taxes from preferential zones, such as customs zones, foreign trade zones, free economic zones, or from certain priority geographical zones.

On the international level, the resources of commercial banks play a rather important role, so through fiscal policy, the state has the opportunity to take measures to stimulate banks in long-term lending for investment projects, therefore commercial banks are totally exempt from income tax obtained from loans granted for a term of over 3 years and at a rate of 50% for loans granted for a term of 2 to 3 years. This exemption is granted only if the purpose of the economic agents is the financing of capital investments intended for the design, development and implementation of new technologies.

Analyzing Tables 1 and 2, we notice that in the assembly there was an increase in investments in fixed assets during the last 5 years, thus in the period 2017-2021, investments increased by 11,912.9 million lei, which means an increase in the index of dynamics up to 150.69%, i.e. investments increased 1.5 times.

Table 1. Dynamics of investments in tangible and intangible fixed assets in the period 2017-2021 in the Republic of Moldova

Indicators, millions of lei	2017	2018	2019	2020	2021
Total	23498.3	27464.7	31253.2	30089.6	35411.2
Intangible assets	531.8	640.3	962.2	587.0	716.8
Tangible assets	22966.5	26824.4	30291.0	29502.6	34694.5

Source: developed by the author based on [6]

Table 2. Percentage evolution of the level of investments in intangible and tangible fixed assets in the period 2017-2021 in the Republic of Moldova

Indicators, in percentage compared to the previous year	2017/ 2016	2018/ 2017	2019/ 2018	2020/ 2019	2021/ 2020
Total	103.5	112.9	110.2	96.9	109.8
Intangible assets	118.8	116.3	145.5	61.4	113.9
Tangible assets	103.1	112.8	109.3	98.0	109.7

Source: developed by the author based on [6]

On the other hand, if we analyze the most recent data (2019-2021), we see a decrease in the growth rate of investments from 110.2% in 2019 to 96.9% in 2020, i.e. a decrease in the rate by 13.3%, but subsequently an increase of 12.9% for the year 2021. This phenomenon can be explained by the presence of the global pandemic crisis that has diminished the interest of investors towards the import of capital into the Republic of Moldova.

Table 3. Dynamics of Foreign Direct Investments (FDI) in the Republic of Moldova, mln. lei

ISD	2017	2018	2019	2020	2021	2020-2021 growth rate %
FDI inflows	3592	4051	4706	4708	4780	1.5
FDI outflows	222	259	299	298	322	8

Source: developed by the author based on [3]

The analysis of the figures indicated in table 3 allows us to note a constant increase in Foreign Direct Investments. Thus, for the last 5 years we observe an increase from 3 592 mln. lei to 4 780 mln. lei, i.e. an increase of 1 188 mln. lei, and the biggest increase is seen in the period of 2018-2019, where we highlight an increase from 4 051 mln. lei to 4 706 mln. lei, i.e. an increase of 655 mln. lei, which means an increase of 1.16 times in just one year.

Starting from 2012 and up to the present, the rate of taxation of the income of legal entities applied in the Republic of Moldova is 12%. The evolution of investments in the analyzed period is illustrated in table 4.

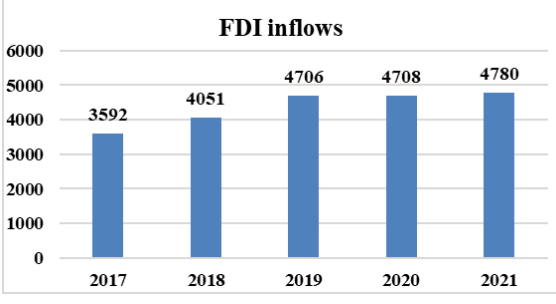


Figure 1. Dynamics of Foreign Direct Investments in the Republic of Moldova (million lei). Source: developed by the author based on [3]

From the analysis of table 4, we notice that the total volume of annual investments maintains an increasing trend during the entire analyzed period, in the context of a constant tax rate. The largest volume of investments was recorded in 2021, in the amount of 35,411.2 million lei, as a consequence of the change in the political situation in the Republic of Moldova and the reduction of investors' uncertainty about the future. At the opposite pole is 2017, with 23,498.3 million lei.

When we talk about foreign direct investment, then here things look like this. FDI in the analyzed period fluctuates from year to year, highlighting the sensitivity of foreign investors to domestic events. Most foreign investments were recorded in 2019, and the minimum was reached in 2021, which tells us that foreign investors are losing interest in our country and immediate reforms are needed.

From a macroeconomic point of view, investments are seen as an element whose size has a causal connection with the level of GDP, which remains one of the most effective methods of evaluating the degree of development of a country's economy [8].

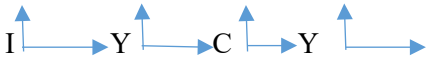
Table 4. Investments in fixed capital and the corresponding income tax rate in the Republic of Moldova (2017-2021)

Name	2017	2018	2019	2020	2021
The tax rate on the income of legal entities	12%	12%	12%	12%	12%
Investments in fixed capital, million lei	23,498.3	27,464.7	31,253.2	30,089.6	35,411.2
Foreign direct investments, million lei	1,489.0	1,439.0	1,790.9	1,261.3	1,240.0

Source: developed by the author based on [3] and [1]

This is how the transmission effect of investments is described, which looks like this:

$$Y = C + I + NX + G$$



The GDP equation assumes that investments are a component of it, thus, trivially, even from this it can be deduced that an increase in investments causes an increase in GDP, although the effect over a long period is more well presented by the mechanism of investment transmission, which assumes that the increase in GDP caused by the increase in investment leads to a subsequent period of increase in consumption, which leads to the formation of a chain of economic development through the increase in income and GDP.

For a more accurate calculation of the effects produced by investments in the country's economy, a derived indicator called the investment multiplier was developed. The multiplier represents the ratio between income growth and investment growth and shows how income changes as a result of a one-unit change in investment.

$$m = \Delta Y / \Delta I$$

From a mathematical point of view, the presented relationship demonstrates the connection between the one-unit change in investments and the change in GDP. Considering the investment transmission presented above, the multiplier is a magnitude greater than one, which means that investment is a process that brings higher income to the country's economy and therefore positive effects.

Table 5. Dynamics of the share of Foreign Direct Investments (FDI) in the Gross Domestic Product (GDP) in the Republic of Moldova

	Relative to GDP (%)				
FDI	2017	2018	2019	2020	2021
FDI inflows	37,1	35,4	39,3	40,8	35
FDI outflows	2,3	2,3	2,5	2,6	2,4

Source: developed by the author based on [2]

Analyzing the correlation between FDI and GDP in the Republic of Moldova (Figure 2 and Table 5), we can deduce that in the period 2017-2018 there was a decrease in the share of Foreign Direct Investments in the Gross Domestic Product of the Republic of Moldova from 37.1% to 35, 4%, i.e. a decrease of 1.7%. Later we highlight an increase in weight up to 40.8% in 2020, respectively an increase of 5.1%, thus we constantly notice a positive dynamic starting from 2018 until 2020. An opposite way of the dynamic is witnessed in 2021, where a decrease in the share of FDI in the GDP of the Republic of Moldova increased to 35%, which would mean a decrease of 5.8% caused by the global pandemic crisis.

Below in Table 6 we will compare the situation regarding the level of foreign investments in the GDP of some EU countries and the Republic of Moldova.

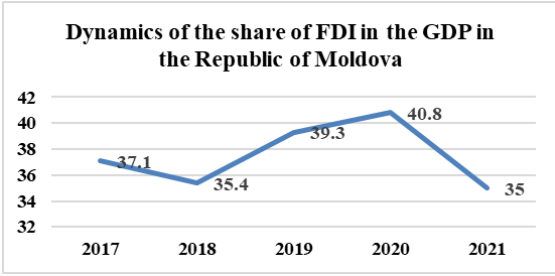


Figure 2. Dynamics of the share of Foreign Direct Investments in the Gross Domestic Product in the Republic of Moldova (%). Source: developed by the author based on [2]

Table 6. Dynamics of the share of Foreign Direct Investments in GDP on an international level

Country	Share of FDI in GDP (%)				
	2017	2018	2019	2020	2021
Romania	43	38.5	39.7	44.6	38.4
Germany	26.1	23.6	24.8	28.8	27
France	31.6	29	31.3	36.8	33.3
Italy	21.7	20.8	2.1	25	21.6
Denmark	34.9	33	37.1	41.7	39
Norway	37.3	35.5	42.1	46.6	31.1
Poland	45.6	39.1	40.3	41.9	39.9
Republic of Moldova	37.1	35.4	39.3	40.8	35

Source: developed by the author based on [2]

The downward trend in the share of Foreign Direct Investments in GDP during 2017-2018 is noted, for example in Germany they decreased from 26.1% to 23.6%, i.e. a decrease of 2.5 percentage points, and for France in the same period, there is also a decrease in the weight by 2.6%. On the other hand, we observe an increase in the weight for the years 2019-2020, Germany reaching from 24.8% to 28.8%, which means an increase of 4%, for France the same situation is valid, the evolution being about 5 ,2%. In 2021, we identify a downward trend in the share of FDI in GDP, i.e. a decrease for Germany by 1.8%, and for France, a decrease by 3.5%, this phenomenon being influenced by the global economic crisis, the impact being felt towards the end of 2021.

4. Analysis of the relationship between fiscal policy and investments in the Republic of Moldova

Another aspect that illustrates the importance of investments for the autochthonous economy is the contributions to the BPN. FDI enterprises make a significant contribution to the formation of the budget by paying taxes, in particular, income tax.

Table 7. Dynamics of the volume of tax revenues in the Republic of Moldova, mln. lei

The name the tax	Collected 2020	Planned 2021	Collected 2021	Deviations: cashed2021/ planned 2021		Deviations: cashed2021/ planned 2020	
				+/-	%	+/-	%
Income tax	9,353.80	10,443.20	11,213.10	769.9	107.40	1,859.30	119.90
Property taxes	582.3	679.9	750.2	70.4	110.30	167.9	128.80
VAT	7,813.30	8,715.40	8,918.30	202.9	102.30	1,105.10	114.10
Excise duties	570.9	724.2	903.8	179.7	124.80	332.9	158.30

Source: developed by the author based on [7]

Analyzing Table 7, we can deduce that the most receipts within the State Fiscal Service took place from income tax, thus we observe an increase from 2020 to 2021 by 1,859.3 million. lei, i.e. an increase in the dynamics index by 119% and a growth rate of 0.19%. The same situation can be noted for the Value Added Tax, thus we observe an increase of 1,105 mln. lei and respectively an evolution up to 114.1% with a growth rate of 14.1%, this phenomenon also being caused by the increase in the volume of foreign direct investments in the Republic of Moldova.

Of course, we cannot overlook the investments made by domestic investors. These

have effects similar to those of FDI, such as: creating new jobs, respectively decreasing the unemployment rate, increasing the supply of goods, which could decrease the inflation rate, increasing labor productivity, implementing new technologies, obtaining more profits high, which generate higher receipts in the BPN account and overall economic growth in the form of real GDP growth. However, since local investors do not have the same experience and knowledge as foreign investors, these effects are expected for a long time. As it follows from the above, we conclude that investment flows are important for any economy, not only the Republic of Moldova, but our country has the most acute need for them. Attracting new investments in the economy is one of the ways to overcome the current crisis, and the powers for this belong to the state, through its levers, especially those within the fiscal policy.

Usually, two contradictory objectives are placed in front of fiscal measures: obtaining as many financial resources as possible in the National Public Budget and stimulating the business environment [12]. When we talk about stimulating the business environment, we mean bringing some activities out of the shadow economy to the surface, but also attracting new investments to increase productivity and, respectively, the level of economic development. An ideal balance cannot be achieved exactly, being analogous to the Laffer curve, where the most favorable point for the economy cannot be established in reality. In the course of achieving that ideal balance, numerous measures have been implemented in the Republic of Moldova to attract investments and create an attractive investment climate, among which we highlight:

1. ***Reduced fiscal pressure*** – the tax on the income of legal entities, in the Republic of Moldova, is applied at the rate of 12% of taxable income. In the case of dividends (the form of profit distribution), they are taxed separately at the rate of 6%. Comparing these rates with those of neighboring countries: Romania (from 2023, 8% for dividends and 16% - profit tax) and Ukraine (18% - profit tax and 15% - dividends), we conclude that our country is more attractive from this point of view, motivating investors with a larger amount of profit left for reuse.

2. ***Creation of Free Economic Zones (FEZ)*** - Free Economic Zones (FEZ) have had a significant impact in attracting FDI to the Republic of Moldova. According to the situation as of December 31, 2021, 229 residents were registered in 7 free economic zones, or 3.2% more compared to the same period of the previous year. The total value of investments made within the free zones during their entire activity, until December 31, 2021, was 506.2 million US dollars, increasing by the end of 2021 by 10.3% or by 47.2 million US dollars compared to the previous year.

It should be noted that the economic agents operating in the FEZs benefit from a series of facilities, among which are: 50% exemption from the tax rate established in the Republic of Moldova for the income obtained from the export of goods (services) originating in the free economic zone outside the territory of the Republic of Moldova; 25% exemption from the tax rate established in the Republic of Moldova for income obtained from other activities than the export of goods (services); Total exemption for 3 years from paying tax on the income obtained from the export of goods (services)

originating in the free economic zone outside the territory of the Republic of Moldova, as a result of the investment in the free zone of at least one million USD; Total exemption for 5 years from paying tax on the income obtained from the export of goods (services) originating in the free economic zone outside the territory of the Republic of Moldova, as a result of the investment in the free zone of at least five million USD; VAT does not apply to goods (services) delivered inside free zones; Zero rate of VAT for goods (services) delivered to the free zone outside the Republic of Moldova, goods (services) delivered from the free zone outside the Republic of Moldova, goods (services) delivered to the free zone from the rest of the territory of the Republic of Moldova, goods (services) delivered by residents of different free zones from the Republic of Moldova to each other; Exemption from payment of excise duties for goods introduced into the free zone from outside the Republic of Moldova, from other free zones, from the rest of the territory of the Republic of Moldova, as well as goods originating from this zone and exported outside the Republic of Moldova; Deliveries of goods within the free zone and deliveries of goods from one free zone to another are not subject to excise duty.

3. ***Tax exemptions for farmers*** who suffer weather-related losses.

4. ***Facilities for companies in the IT park*** - member companies of the IT Park pay a monthly one-off fee of 7% of the income from sales.

5. As a result of reforms in the field of ***digitization of tax services***, all tax returns can be submitted electronically, as well as many relationships with other authorities can be regulated electronically, remotely.

6. The Republic of Moldova has currently signed 50 ***international treaties*** for the avoidance of double taxation and the prevention of fiscal evasion regarding income and capital taxes, thus gradually eliminating unfair competition from economic agents in the underground economy.

7. Another fiscal facility is the exemption from paying ***customs duties for material values***, imported into Moldova as a material contribution to the formation and increase of the statutory capital of companies with foreign investments.

8. Exemption from ***payment of customs duties on goods***, raw materials, semi-finished products imported into Moldova for the manufacture of products intended for subsequent export, which aim to process the raw material by very cheap labor forces from the Republic of Moldova.

Thus, we conclude that the fiscal measures resorted to by the previous and current governments were not effective enough to influence on their own, in a positive sense, the investment flows in the domestic economy.

5. Measures to stimulate the volume of investments through taxation

Stimulating investment has been an important priority of recent fiscal reforms, especially in countries affected by the crisis. Efforts have also been made to simplify the business environment in terms of taxation. However, the government can get more involved in stimulating investment through fiscal policies. From the above, some recommendations can be formulated regarding the most effective application of taxes in order

to stimulate investment activity:

• the use of the fiscal investment credit, which would allow economic agents to deduct from the income tax from entrepreneurial activity the amounts corresponding to the volume of investments made;

• granting additional fiscal facilities to local and foreign investors, who direct their capital in the priority economic and social fields. For example, the tax exemption of reinvested profit, the import of technical means and modern technologies without paying taxes, the reduction of requirements regarding mandatory reserves and taxes for authorized banks, which participate in the financing of projects;

• developing methods of controlling the activity of foreign companies and creating a responsible department, with the aim of avoiding the possibility of adverse influence on the national economic system, given the fact that there is a danger that foreign investors defy the activity of local investors;

• maintaining the corporate income tax rate at 12%, a competitive level compared to other states

6. Conclusions

Finally, it is absolutely necessary to understand that investment activity depends to a large extent on the level of taxes within a state, so taxation has an indirect influence on investment activity, that is, with the increase in the levels of tax rates, investment activity will decrease, which it means an inversely proportional relationship between taxation and investment processes, as an example was Germany, France, Italy where with the increase in tax rates, the investment interest decreases, but in the assembly it still exists, because there are also other criteria of interest compared to the investment activity within a state. On the other hand, we noticed that with the decrease in the share of FDI in GDP, their volume is increasing, analyzing the Republic of Moldova, which indicates that investors are much more interested in investing capital in states that do not depend entirely on these investments [5].

Following the fulfillment of the suggested objectives, at first glance we can see that in the Republic of Moldova, investment flows are little influenced by fiscal measures. Of course, these also have their role, but before making the decision to invest in our country, an investor also takes into account other factors that have a greater weight, according to importance. This was demonstrated by the fact that, despite the existence of competition between the host countries in granting incentives, they are not the determining factor in the decision to invest, a fact demonstrated by comparing the level of taxation in Romania and Ukraine with that of the Republic of Moldova, which proven to be more favorable, but which still does not cause greater investment flows than in neighboring countries. In this sense, with reference to the experience of the Republic of Moldova, some local authors mention that: "The fiscal relaxation process has already taken shape in the Republic of Moldova, and the influx of investment resources has not followed. The problem lies, therefore, in other investment attractiveness factors. The level of corruption, political openness, legislative capacity, the quality of state institutions, effectiveness, governmental transparency and political stability tend to receive an increasing share among the selection criteria for the location of investments".

The same conclusions were reached following the analysis of this research, leaving room for other areas, with a much greater influence, to reform so that fiscal policy can play its role, later on.

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Emotional And Psychological Well-Being

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Abstract: In this report we analyze the level of emotional and psychological well-being of adults. Also, we identify factors that positively influence well-being, determine the causes that generate emotional instability and establish strategies to improve the level of emotional and psychological well-being. To investigate the situation of people's well-being at country level, we conducted a questionnaire among a group of people aged 20-60. The research shows that 55% of the interviewees say that they feel well, are happy and have a fulfilled life. Another 35% have a slightly more pessimistic view, have different expectations from society and think that a change would be good. 10% of the respondents refused to take part in the questionnaire, saying that "no change will be made anyway", which indicates a very low level of well-being.

Thus, in order to change the current situation, it is necessary to implement a series of measures and strategies that will improve the emotional state of the whole society, as a result, people will become calmer, more open to communication and collaboration and the level of emotional and psychological well-being will increase.

Key words: well-being, life, emotionality, improvement.

Introduction

The world is affected lately by a series of events of different kinds, which have a negative impact on the mental health and emotional condition of all people. Thus, more and more often we understand how necessary it is to have emotional and psychological well-being.

Well-being includes physical and mental health, happiness, prosperity and income levels. It also includes goal-holding, personal and professional satisfaction and interaction with different people. The World Health Organization describes 'wellbeing' as a 'resource for a healthy life' and 'a state of positive health' that is 'more than the absence of disease' and enables us to function well psychologically, physically, emotionally and socially [1].

Emotional and psychological wellbeing is when you feel good, are happy and experience positive emotions such as love of self and others, joy in all things that happen and empathy towards people in need. We can say that a person has a high level of well-being if they are satisfied with the life they have, are at peace with themselves and have good relationships with family, friends and other relevant people. Spiritual well-being can also include a sense of being connected to a higher power, the existence of meaning, purpose or feelings of peace or transcendence [1].

Therefore, in order to have a prosperous, healthy life and achieve as many successes as possible, it is important to have a good and adequate emotional state at all times, because only in such circumstances the brain is able to

think logically, make correct decisions and manage situations optimally. In the same context, it is essential to be aware of what influences our well-being, how we can improve it, and what measures we need to take to be physically and mentally well.

General Points

Emotional well-being is determined by a number of aspects of society, which in different ways influence our lives and habits.

Figure 1. What influences our Well-being. *Source:* Elaborated by the author

According to Figure 1 we can see the areas in society that have a major influence in creating and maintaining well-being. Thus, based on these criteria we can distinguish between factors with a positive and negative impact.

Positive factors:

A good job that is rewarding and well paid. This is a key moment in defining wellbeing, because for the most part, we spend our lives working and earning money, and when the job we do is a good one, we will be more productive, less tired and able to achieve a lot more;

Healthy eating also plays a very important role in maintaining wellbeing. This is due to all the vitamins and minerals we get from healthy food that help both the brain and the body to function well and have strength. It's important to consume a balanced diet of fruit, vegetables, protein and calcium [2];

Physical and mental health is another key component of a good emotional state. So, if we are healthy and we feel good, the likelihood that we will be well and happy is quite high. That's why we need to take care of our bodies, in order to get the most out of them;

Relationships based on trust and mutual help between family members and friends are another element that have a good influence on us. In this way, it is established that people who have a good family atmosphere and have true friends show a good emotional state and psychological well-being. This is because they feel constant support, understanding, compassion and empathy from their loved ones, which gives them a dose of optimism and strength to move forward;

Economic stability and social security also increase people's well-being. Thus, people in areas with a high level of security and a developed economy are likely to have a fairly high well-being index;

Free time spent qualitatively and pleasantly also has an important role in creating a state of well-being, because in this way we recharge our energy batteries and gain new strength to resume the proposed activities. Ex. travel; visits to the theatre, concerts, museums; walks in the open air, sufficient sleep, etc. [2];

Civic engagement and altruism are also relevant to well-being. By helping people around them, a person will feel useful and

important to society, which generates a range of positive emotions.

Factors with a negative influence:

A job that does not correspond to our preferences, that is monotonous, boring and does not bring income, is not beneficial to our well-being. At the same time, if we have more work than we are capable of doing, or are forced to do what we don't like, we risk having a poor emotional state;

Unhealthy eating can gradually cause vitamin deficiencies in the body, which will lead to lack of energy, lack of strength, slowing down cognitive processes. For this reason, it is necessary to avoid products that do not bring a favorable contribution to our organism;

Various diseases and health problems can also damage the emotional state and have long-lasting negative effects on the quality of life;

Economic instability and low life security can also cause crises in people's emotional well-being. This is caused by the anxiety, fear and insecurity of people going through complicated economic and social times;

Conflicts also have a negative impact on people's wellbeing, because getting involved and resolving them involves experiencing negative emotions, which is not good for anyone;

Insufficient time for recreation and rest can lead to a decrease in overall well-being, especially psychological well-being. This occurs when we have a fast pace of life, do not have a balanced rest regime and we neglect sleep.

3. People's level of well-being. Causes

Emotional and psychological well-being is one of the pillars of our personality, so we must constantly pay attention to our emotional state to prevent certain unpleasant situations. In order to get a comprehensive picture of the level of well-being of adults, I decided to survey a group of 100 adults aged 20-60 years, with different occupations, different social status, and different educational level. In this questionnaire people answered several items that aimed to establish their well-being index and identify areas in society that need to be improved in order that people feel comfortable. The following table presents the data of the assessment carried out.

Table 1. Questionnaire

Nr.	Questionaries	Answer in %
1.	How satisfied do you feel with your job? Why?	45% feel satisfied 35% partially satisfied 10% dissatisfied 10 % does not work
2.	How much time do you have in the medium for rest?	35% 8-10 h 32% 6-8 h 20% 4-5 h 13% 4 h
3.	How would you classify your relationships with your family?	53% very good 16% good 15% satisfied 16% strained
4.	Do you feel safe in your country?	35% Yes 40% Parțially 25% No
5.	Compared to the same period last year, do you feel better or worse?	43% Better 17% Just like then 40% Worse

6.	What areas in society do you think should be improved to strengthen emotional well-being?	40% Economy 30% Medicine 10% Education system 10% Social field 10 % They don't see the point in improving something because they are sure that no change will be achieved

Source: Elaborated by the author

Through the data provided by this table we can identify that most people are satisfied or partially satisfied with the life they have. At the same time, we have established that it is important for people to be appreciated and supported, as the interviewees who indicated that they are satisfied with their job report that their boss appreciates their work, they get small bonuses and their job is to their liking. Also, those who were dissatisfied, it is largely due to strained relations with the company management and poor attitude towards them, which manifests in delegating difficult work, late payment of salary, etc. Regarding rest time, only 67% of the respondents manage to have a balanced work and rest regime, which is beneficial for their mental health and increases their productivity. However, 33% do not get enough rest time, which could cause deficiencies in their emotional well-being over time. From the perspective of family relationships, most people have good relationships and a pleasant atmosphere in the family, which has positive effects in maintaining good emotional well-being. A less favorable aspect is that only 35% of respondents feel safe in their country, and 40% feel worse socially compared to the previous year, which is currently the main cause affecting people's well-being to a quite large extent.

Thus, according to this data we have established that about 55% of people feel well, are happy and have a fulfilled life, which is a rather low indicator at the societal level. Also, 45% have a slightly more pessimistic view, have different expectations from society and only some consider that a change would be good, while a category of people consider that no change will happen anyway, which indicates a rather low level of psychological emotional well-being. In order to improve this data, urgent state intervention is needed in various areas of society, as well as the involvement of each and every one of us. Among the aspects that need to be optimized are the country's economy (overcoming the crisis, regulating prices, lowering inflation), health services (better conditions in medical centers, a wider variety of investigations), educational services and the social sphere.

4. Methods needed to enhance emotional well-being

In order to have a peaceful and prosperous life it is absolutely necessary to be emotionally and psychologically balanced, so there are a number of recommendations on how we can achieve a good emotional state and maintain it.

First of all, getting to know ourselves is the easiest way to achieve emotional well-being, but to do this, we need to take our time and learn to listen to ourselves. We need to be able to identify what is happening to us and know how

to express it. To know what pleases us and what displeases us. To accept ourselves as we are and understand that everyone is different, including ourselves. We need to be less harsh and forgive ourselves for not being perfect. It is clear that sometimes we will lose control and not be able to manage relationships with certain people, but this should not bring us down. All human beings are vulnerable. We need to find ways to control our emotions and learn from them [2].

Social interaction is another great way to reduce stress and take a more realistic view of what's going on around you. It's important to find someone around us who listens to us and who we can talk to on a regular basis. Someone who we feel is unconditional, who won't judge us and with whom we feel safe. It can be difficult, but it's more than possible. Seeking out people with whom we can establish quality two-way relationships will enrich us and help us have a full life [3].

Generosity and empathy are other concepts designed to increase well-being. The important thing is to give people around us positive emotions. Let's give care, encouragement, support, goods and other things that will serve as a support to those in need. In this way, by helping others, we will be able to derive tremendous satisfaction from the beautiful activities we do. At the same time, in the most unexpected moment, good done always comes back, so it is to our well-being that we benefit from being generous [4].

Another important aspect is motivation, which is the cornerstone of our lives. The ability to want to improve something or achieve a goal can influence the achievement of great things. So, if we lack goals and objectives, we will feel completely empty, always searching for the meaning of life and restless. That's why it is necessary to set small goals, so that later we can achieve our most desired ones.

Leisure time and entertainment are also very important for emotional well-being. Exercising, going to the cinema, visiting a museum, going to concerts or recreational activities will help us feel better and get to know ourselves better. At the same time, practising various therapies will have a beneficial effect on our general emotional state. These include: melotherapy (music therapy), art therapy, ludotherapy (play therapy), ergotherapy (work therapy), etc. All of these have an identical effect on the conscious mind and have a positive influence on cognitive and psycho-emotional processes [2].

A key concept in defining well-being is maintaining a healthy lifestyle. Sport has many benefits for our mental health, being physically active and eating healthily is a way to be fulfilled and happy. According to WHO (2018), if we have a healthy and balanced diet we could avoid cardiovascular diseases. In terms of emotions, a good diet will help to avoid insomnia and fatigue, plus we can prevent sudden mood swings. In the same context, I mention that for a happy life, sleep is very important, because it is while we sleep that the brain recharges with energy and is able for a new day and new challenges. So, it is of paramount importance to note the importance of observing the rest regime in order to not reach state of exhaustion and insomnia [5].

Another important moment in raising the level of well-being is determined by the implementation of political and economic reforms aimed at improving the economic and social situation in the country.

In this way, people will feel secure, and will have the hope that everything will reutrn to normal and they will be able to live a prosperous and peaceful life. The security of tomorrow will give all citizens a great feeling of well-being and an escellent emotional state.

4. Conclusions

Emotional and psychological well-being plays a very important role in physical and mental health. If I compare IQ with EQ, I can say that certainly, EQ is the aspect that defines and characterizes our lives. For a fulfilled and peaceful life, emotional intelligence is essential, because if people are emotional unstable, irritable and angry, in a short period of time they can reach crisis states or nervous breakdowns, which will also influence cognitive processes and is extremely unfavorable for the body. So, regardless of the economic and social situation, the quality of interpersonal relationships and the atmosphere in the family, well-being depends on us, on the way we think, act and the priorities we have. It is everyone's duty to make a small effort to strengthen both their own well-being and that of those around them. Finally, I can say that change comes from us, so we must be an example to society. Through our behavior and habits, we should aim to positively influence other actors in society.

Emotional and Psychological Well-being is the Key to a Happy Life

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Abstract: Elderly people have the same rights as other people. However, when it comes to exercising these rights, they face problems such as discrimination and social exclusion. The world's population is in a constant process of aging. In 2019, about 703 million people worldwide were aged 65 or over. Every day we can see more and more unhappy older people. The reasons for their dissatisfaction are clear to everyone: insufficient attention, the constant rise in food prices, the frequent need for help from relatives or strangers. That is why the emotional and psychological well-being of people at this age often suffers. The article presents an analysis of these problems and possible methods for their solution.

Key words: elderly people, emotional and psychological well-being, help, attention, problems.

1 Introduction

In our world, the demography of the world plays a huge role, thanks to which it is possible to obtain various data: the size and composition of the population, the number of births and deaths, the number of arrivals in the country, and much more. At the moment, the world population is 8 billion people. Each category of people is in different proportions. The age composition of the population is divided into three age groups: children (0-14 years old), adults (15-64 years old) and the elderly (65 years and older). In the structure of the world population, the share of children is on average 26%, adults - 65%, elderly - 9% [1]. Today, the elderly (aged 65 and over) are the fastest growing age group in the world. In 2018, for the first time in the world, the number of older people exceeded the number of children under the age of five, and by 2050 there will be more of them than adolescents and young people combined (from 15 to 24 years old) [2]. In many regions, there is already a problem with the help of people in this category of the population. As a rule, such people for some reason begin to lose their rights when they also belong to all groups of the population. But one should not devalue such a category of people, because due to the dynamic growth of this group of people, they will probably play a more significant role in society and the economy. Therefore, it is necessary to provide them with all the necessary conditions, both for psychological and emotional well-being, and for implementation in various fields of activity.

2 Analysis of the causes of emotional and psychological well-being

Emotions are an integral part of our daily life. Emotions govern the most important aspects of everyone's life and are the signals of events that affect our deepest beliefs and most meaningful relationships. They support our affections, love, energy and interest.

Sometimes, however, they force us to do things we don't understand or later regret. Many sources even began to create different maps with the emotionality of people from different countries, at different times. So, for example, the Gallup polling firm chose to do a survey in about 150 countries. They asked different types of questions: “Did people smile and laugh a lot yesterday?”. Unfortunately, the answer for many was "no". So, with the help of various methods, they were able to create a map of the world with a classification of more and less emotional countries (Figure 1).

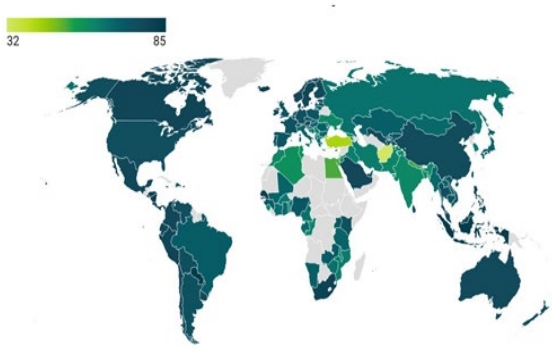

Figure 1. Gallup statistics - the emotionality of the countries of the world for 2022. Source: [3]

There is also an index of human happiness, which reflects the well-being of people and the state of the environment in different countries of the world. To assess national happiness, 6 factors are used: GDP per capita, social support, life expectancy, the freedom of citizens to make their own life decisions, generosity, and attitudes towards corruption. Below is a ranking of the top 10 countries in the happiness index for 2023. (Table 1)

In first place is Finland, which has been leading the global happiness index for 6 years in a row. The UN ranking notes that Finland's well-being is based on social support, good income, good health, freedom, charity and the absence of corruption.

Table 1. World Happiness Index Ranking 2023

№	Country	Index
1	Finland	7,804
2	Denmark	7,586
3	Iceland	7,53
4	Israel	7,473
5	Netherlands	7,403
6	Sweden	7,395
7	Norway	7,315
8	Switzerland	7,24
9	Luxembourg	7,228
10	New Zealand	7,123

Source: [4]

In the Republic of Moldova, the Human Happiness Index is constantly changing. The worst result was in 2019 when the country ranked 71st in the world rankings with a score of 5,529. In 2023, Moldova is in 63rd place with an indicator of 5.819. Below is a graph with changes in the level of the Human Happiness Index in Moldova (Figure 2).

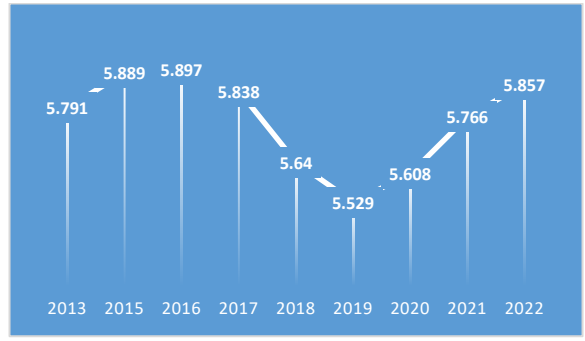

Figure 2. Graph of changes in the level of human happiness in Moldova. Source: [5]

All factors that are taken into account in the index of human happiness play an important role in the emotional and psychological state of people. Emotions play a key role in motivated behavior. As a rule, most often people do as they feel, rather than as their mind dictates correctly. It follows that in order to change behavior in order to achieve well-being, changes in the emotions that motivate this behavior are necessary.

As a rule, it is very difficult to cope with their emotionality for children, adolescents and the elderly. These categories of people are very vulnerable. Their well-being most of all depends on the people around them (relatives, friends). The older generation, of course, is also concerned about the financial component. Children don't really care about this. Thus, older people are deprived of the opportunity to work and are obliged to live on their pension. But, unfortunately, sometimes this pension is not enough to cover even basic expenses (food, utilities and medicines). At such moments it is good when there are children who can financially help.

Every year our life becomes more and more unpredictable. The University of Michigan National Poll on Healthy Aging (NPHA) asked a national sample of U.S. adults age 50–80 about lack of companionship and isolation (loneliness), social interactions, and health behaviors in June 2020. This was a follow-up to a similar NPHA survey conducted in October 2018 among a different national sample. The comparisons that follow show a substantial increase in loneliness among older adults from before the COVID-19 pandemic to the period March–June 2020 (Figure 3).

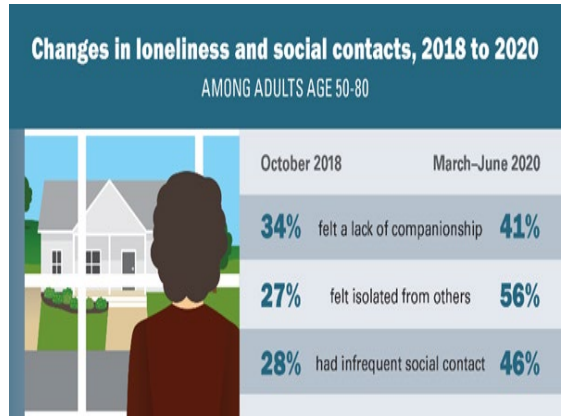

Figure 3. Changes in loneliness and social contacts. Source: [6]

Thus, we can conclude that this problem has always existed. People lack communication, feel isolated and have infrequent social contacts. These measures were created to preserve people's health, but they negatively affect emotional and psychological well-being.

The main problems of older people of a social nature are distinguished [7]:

- loss of ties with society, self-isolation.
- psychological protection from everything new, aggravation of stereotypes.
- slow sense of time, excessive caution, thriftiness.
- hypertrophy of negative character traits - irascibility, irritability, grumpiness.

In addition to social problems, health problems, fear of death, loss of the meaning of life, lack of financial resources are also added.

3 Ways to solve problems.

But every problem has a different way out. There are various ways to achieve the emotional and psychological well-being of

older people. As we analyzed earlier, most of the problems are due to insufficient attention to this category of people.

A person is surrounded by other people all his life. Among them, one can always single out those who are especially close. Emotional relationships with such people are of great importance. As a rule, relatives are the closest.

The first way to solve the problem is to spend as much time with relatives as possible in the circle of your family. Through communication with loved ones, a person is convinced that he is a person. Relations with different people are built in their own way: to some people they prefer to tell all the information, sincerely share emotions, and to others only superficially. Thus, if a person has enough communication with other people, he receives enough emotions, and in these relationships, he asserts himself and grows as a person. Thus, communication will eliminate the problem of uselessness in the elderly generation.

The second way is to organize various activities for the elderly. So, they will be able to find new interests and acquaintances. Often this category of people is forgotten, so the organization of various events is divided into two types: children and adults. Do not forget that each age has its own personal interests, and it is necessary to create events for different age categories of people.

The third problem is that older people often fail the musculoskeletal system, thus it becomes difficult for them to move or do anything. Nowadays, there are various volunteer organizations that help this category of people and do it free of charge. It is necessary to further promote such organizations, because they benefit society.

It is not a secret for many that there is a financial problem among the elderly. Of course, the majority depends on the state (pensions, benefits, etc.), but we can also make our own changes to this. Entrepreneurs can provide benefits to this category of people, thereby increasing the sales turnover. This will have a positive effect on their business. The next solution to the problem is the creation of various funds and organizations that will financially help this group of people.

Work in old age is one of the main problems of our time. As noted earlier, this group of people tends to grow, therefore, it is necessary to provide them with work. In most European countries, the retirement age starts at 65, but many people have the desire to continue their careers. Unfortunately, health very often fails these people, they need more time to recover. It is possible to change professional activities that require less physical and emotional costs (work in the field of consumer services, watchmen, watchmen, etc.). It is necessary to provide an opportunity to get a job or continue a career for this category of citizens. Thus, we will be able to solve several main problems of pensioners at once.

When a person retires, as a rule, a lot of free time is added. People do not know how and sometimes do not know how to use it rationally. Thus, they add unnecessary problems to themselves. Every person should have a favorite thing that brings positive emotions. Need help choosing a hobby. There are many options for practicing yourself: knitting, embroidery, drawing and more [8]. You can always find something to your liking. So, a person can distract his thoughts and not think

about the bad. Simple actions can make life easier for older people and increase their emotional and psychological well-being.

4 Applying Problem Solving Methods to Authors' Lives

People need our help almost every day. One of the authors of the work is a volunteer (Figure 4) in various organizations that work with different categories of people.

Figure 4. Practical use

The work was carried out very effectively during the COVID-19 pandemic, when the movement of people was limited. Elena was engaged in the delivery of necessary products and medicines for people who are carriers of the disease or are at risk. Applications were received with various requests. The main age category was people over 60 years old. The reasons for their appeal to the organization were different: someone suffers from diabetes, someone has difficulty moving, etc. As a rule, such people do not have close people who could help. But many have social workers who provide the necessary assistance.

Then why do they need our help? A little later we came to the point. Such people lack simple human communication. They contacted the organization to get the attention they needed. Many older people started the conversation on various topics: from their family history, photos in photo albums, to personal problems and fears.

The effect of loneliness on the human brain is similar to the effect of chronic stress. People want family and friends to support them. Few people consciously protect themselves from society, because communication and the feeling of being needed by others is very important for a person. This is his basic need. Unfortunately, some people in old age feel lonely and unnecessary, since communication with family members at their initiative is coming to naught. In lonely people in old age, mental disorders, diseases of the cardiovascular system, high blood pressure and dementia are not uncommon.

We should not discount the problems of this group of people, because we have seen from personal experience that there is a lack of attention for them. It is necessary for all people to try to give their relatives as much time and attention as possible, because only relatives are a reliable support and support.

5 Conclusions

Well-being is a state of a person or an objective situation when a person has everything that favorably characterizes his life in the eyes of others, his relatives and himself. To achieve this well-being, a person needs to have a healthy emotional and psychological state. This condition is based on various factors. Unfortunately, older people find it difficult to manage their lives for various reasons. They have many problems that negatively affect their condition. To do this, it

is necessary to create and maintain a balance so that a person's life is filled with colors. But in order for this balance to exist, a certain series of actions must be taken. It is we who can help the elderly, make them smile and, as a result, improve their lives for the better.

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Legal Culture of the Elderly

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Abstract: The notion of legal culture is a term used to describe the level of knowledge and understanding of law in a society. Legal culture reserves the totality of theoretical-practical knowledge, which helps society evolve into good practices for resolving disputes, including the basic principles of applying legal norms. The subject of legal culture in general is quite researched by different authors, scholars, who come to the conclusion that the elderly in the Republic of Moldova do not have enough legal knowledge, do not know all their rights and obligations and do not know how to protect their interests in a fair and just way. Based on my own research, I have come to the conclusion that all pre-retirees and retirees are not sufficiently familiar with all legal terms and situations, not to mention the ways to protect their rights. Inevitably, the precarious material situation and the insufficiency of resources make this gap bigger and bigger, which in the end directly affects one's own conceptions and visions of justice in the Republic of Moldova. Our elders, especially in the age of technologies, are limited in learning knowledge, for a society today, in terms of the great disadvantage.

INTRODUCTION

Legal culture is an integral part of human culture that defines the totality of legal knowledge, processes, rules and possibilities to use the law and to comply with it in everyday social-legal practice by members of a society [1]. Legal culture can be considered as the set of values, beliefs and attitudes of a society towards law and justice. It includes how people understand and apply legal rules and the importance they attach to them in everyday life. Legal culture can have a strong impact on how a society's legal system works and how people interact with it.

Experts believe that a person's legal culture is an indispensable element of a society's overall culture. The belief that a person can only be considered cultured and educated when he or she possesses legal knowledge and is able to apply it in practice must be firmly established in people's consciousness. Legal literacy refers to the way in which older people understand and apply the rules in their daily lives. This can include understanding their rights and obligations as citizens, as well as how they interact with legal institutions and other people in society. The legal culture of older people can be influenced by factors such as education, life experience and access to legal information.

The literature states that legal literacy, including that of the elderly, is a prerequisite for strengthening justice and the rule of law, based on democracy, fundamental values and the principles that underpin any system of law.

In the case of older people, legal culture is less advanced, but this does not prevent it from having an impact on their personality and personal training. Thus, its components: symbols, laws, norms, beliefs, customs, values play a key role in shaping one's own vision of justice in the Republic of Moldova.

CONTENT

The elderly are the wealth of a state. They are at the foundation of all the processes that take place through the very work they do or have done. They are former doctors, teachers, educators, who may not have had any tangent with the legal field, but it is to their benefit to know the most elementary knowledge. Our elders are vulnerable, they don't know how to defend themselves, where to turn, what their rights are and what they can do to save their dignity.

In the Republic of Moldova, there is speculation that the justice system does not work, which is why distrust of the legal profession is not only widespread among the elderly, but also among all categories of people, which is a destructive phenomenon for a state.

In an article "PROBLEM OF SOCIAL REINTEGRATION OF OLDER HOMELESS PEOPLE IN THE REPUBLIC OF MOLDOVA" by Maria DIȚA, lecturer, and Maria VÎRLAN, PhD, lecturer, [2] the problem of the legal culture of the elderly is partially illustrated, as it refers only to the homeless. In the first part of the paper, the problem was analysed by lawyers, and one of the ways to make the process of reintegration of homeless people more efficient is - legal literacy. In fact, this way is beneficial for absolutely all elderly people who have no or little legal knowledge.

In the Justice Sector Reform Strategy for the years 2011-2016 [3], under Pillar III "Access to justice and enforcement of court decisions" one of the areas of intervention required in that period is point 3.1.3. , "Promotion of legal literacy and access with legal character; reduction of legal nihilism". Among the responsible institutions were the National Council for State Guaranteed Legal Aid, the Ministry of Justice, the Ministry of Labour, School Protection and Family. As indicators of the level of implementation were:

- Legal education campaigns conducted, including through the involvement of NGOs in public-private partnerships;

- Primary legal aid system through a functional network of paralegals in rural communities, including the network of social workers, established and functional;

- Primary legal aid mechanisms for some vulnerable groups at urban level tested.

Expected results include:

-Activity of the National Council for State Guaranteed Legal Aid improved;

-accessible, diversified and qualitative state guaranteed legal aid services;

-increased level of legal literacy;

-functional primary legal aid delivery mechanisms.

The sad fact is that although this reform had noble aims, it did not have a favourable outcome for the citizens of the Republic of Moldova and especially for the elderly, who were in great need of it.

Ever since the independence of the Republic of Moldova, there has been talk about the importance of raising awareness that legal culture plays an important role, without which an effective democratisation process cannot take place. In the National Human Development Report [4], the low legal culture of citizens was noted, who are not used to defend their rights, to resort to forms of judicial protection, to petition state bodies.

To a large extent, this is due to the lack of confidence in the implementation of attempts to defend themselves against any manifestations

of violations of the law, which is why the current state of apathy encourages the creation of conditions conducive to legal chaos, complete vulnerability of the individual and his rights. That is why it is necessary to convince people that every person must be prepared to defend their rights, this being a manifestation of civic will. The practical participation of the majority of citizens in the struggle to establish order based on law is an extremely important and necessary prerequisite for the creation of a democratic state based on the rule of law.

It is essential that legal culture does not progress to the level required by a state in 2023, not to mention the category of elderly people who have had neither an education in this regard in the family nor an education by the law enforcement bodies, the competent structures.

Vladimir Sterpu and Tatiana Spătaru, in their work "FORMATION OF LEGAL CULTURE OF PERSONNEL" [5], consider that the low level of income of 80% of the population of the republic makes legal services inaccessible to most social segments. The poverty that has always existed in this territory has cultivated a spirit of fear and distrust of justice. The authors believe that even when their constitutional rights are violated most people comply without rebelling or seeking justice. A large part of the population of the Republic of Moldova does not know how to bring a legal case, what the hierarchy of national and international institutions is.

According to the questionnaire filled in by the citizens of the village of Susleni, Orhei district, there are people who do not know or have never heard of the term "rule of law" (Figure 1).

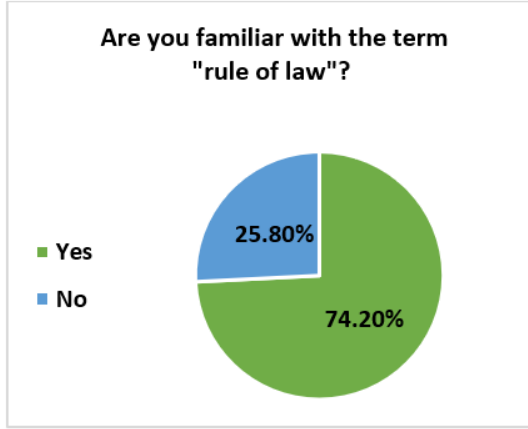

Figure 1. People's answers to the question: Are you familiar with the term "rule of law"?

Even greater was the disappointment when the question "What is the supreme law of the Republic of Moldova" was answered with answers such as "I don't know", "Freedom", "State". However, most of them specified that the supreme law of the Republic of Moldova is the Constitution.

When asked if they know what the rights of a citizen are, 96.8 % chose „yes" (Figure 2). This shows that the elderly people in Susleni village have basic knowledge and know that they have certain rights that will protect their life, property, health, opinion.

We all know that our society has not yet reached such a level of legal development and culture that when a problem arises we go directly to a lawyer to consult and discuss our next actions. Such behaviour has been demonstrated both by the elderly and by people who in the near future are going to reach retirement age. When asked whether they consult or have consulted a lawyer whenever they have a legal problem, only one person said they always consult a specialist, the other half

said never, the other half said occasionally (Figure 3).

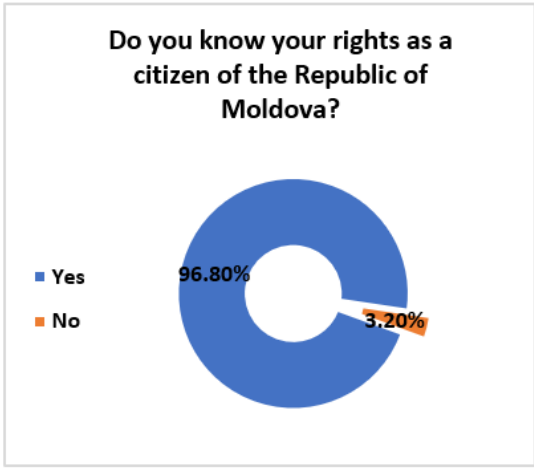

Figure 2. Answers to the question: Do you know your rights as a citizen of the Republic of Moldova?

It is considered that this "phenomenon" is deeply rooted in the consciousness of the citizens of the Republic of Moldova and a lot of hard work, patience and perseverance is needed to bring about a change in people's way of thinking. Especially in the perception of older people, who are often more stubborn and do not accept that time passes and many things change.

Based on the questionnaire, it appears that people find it very difficult to change their way of thinking and way of life. The biggest obstacle is the standard of living. 90.3% of people do not consider themselves to have a high standard of living. In the same vein, low salaries or pensions are not enough for the basics, let alone paying for the services of a lawyer. The largest proportion, 64.5%, say that money is the biggest obstacle to asking a lawyer for help. This factor is followed by people's distrust of lawyers - 19.4%. Finally, 16.1% do not know where they can turn and do not know how to find a lawyer (Figure 4).

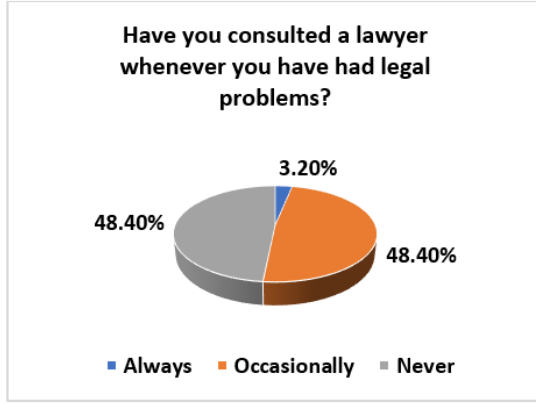

Figure 3. People's answers to the question: Have you consulted a lawyer whenever you have had legal problems?

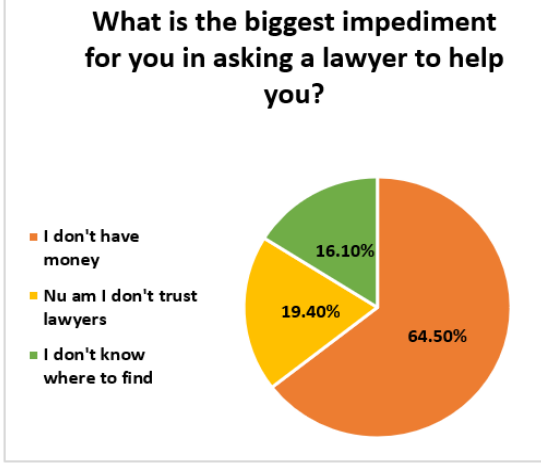

Figure 4. Answers to the question: What is the biggest impediment for you in asking a lawyer to help you?

It was found that the elderly know about state-guaranteed legal aid, (Figure 5) which is the provision of legal services provided for in the Law on State-Guaranteed Legal Aid [6]

from the funds intended for the provision of such services to persons who do not have sufficient financial means to pay for them and who meet the conditions stipulated in this Law.

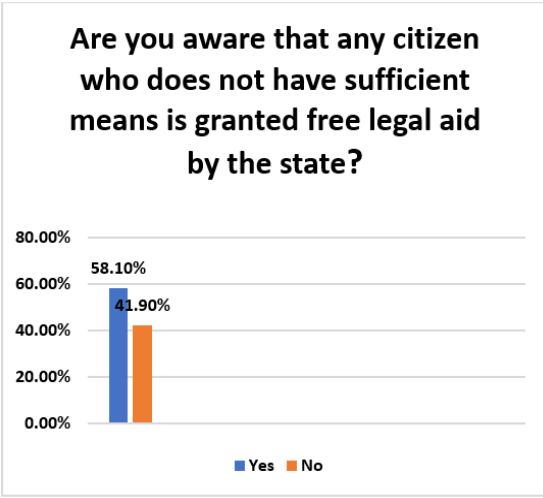

Figure 5. Answers to the question: Are you aware that any citizen who does not have sufficient means is granted free legal aid by the state?

State-guaranteed legal aid is granted through:

(a) providing information, through consultations and explanations in legal matters;

b) drafting legal documents;

c) representation before public administration authorities;

d) defending the interests of the suspect, accused or defendant in criminal proceedings;

e) defence and representation of the interests of the convicted person;

e1) defence and representation of the interests of child victims of crime and victims of domestic violence;

f) defence of the person's interests in proceedings in misdemeanour cases;

g) defence and representation of the interests of the person in civil proceedings;

h) defence and representation of the person's interests in administrative and administrative litigation proceedings.

Susleni also thinks that justice in our country is not working. Thus, 77.4% say that justice does not work and 22.6% say the opposite (Figure 6).

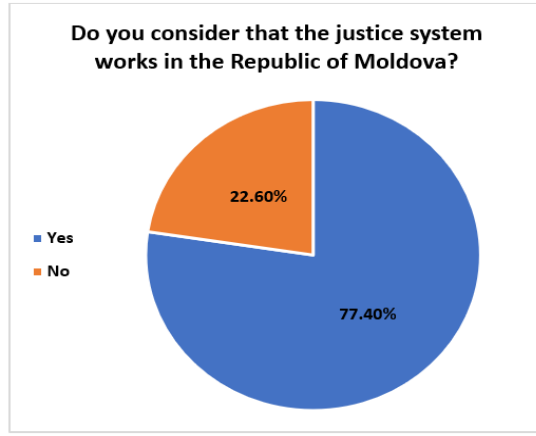

Figure 6. Responses to the question: Do you consider that the justice system works in the Republic of Moldova?

Thus, the proposed questionnaire reflects the opinion of 31 people who are old or about to reach this beautiful stage. As can be seen, the results are not the most expected. The elderly are disappointed and no longer trust the justice system, this state or the future. Money is at the top of the list. It is the source of security for our good people, but without it their standard of living is low, they cannot enjoy the pleasures of life and they cannot turn to specialists when they need them.

The current situation is borne out by research which says that nationally, as a state, we do not have a high level of legal literacy. This awareness and transformation of thinking,

conceptions, visions is a long process, but we believe that it is possible only through hard work and perseverance.

Conclusions and Recommen-Dations

In one of his publications, Gheorghe Avornic, PhD in law, university lecturer, mentioned the propagation of law as a way of raising legal culture, in order to intensify the legal activism of citizens in building the rule of law. I mention that this way is beneficial, because only by spreading knowledge in the field of law, people will know how to act, how to obtain and how to use information to their advantage.

However, if we are talking about the legal culture of older people, I believe that we can propagate law in the following ways:

1. Non-governmental organisations should pay special attention to providing legal services and legal advice to the elderly, especially those who are in an unfavourable situation.

2. Organise meetings with various specialists where the elderly will be made aware of all their rights, where they can go, what they can do to be protected.

3. We know that the elderly spend a lot of time listening to the radio or watching TV, so we recommend the creation of a programme or an information column on various legal topics.

4. Fill newspapers with useful information on how to get free legal advice.

In this context, it should be noted that legal culture, as a complex phenomenon, as a set of spiritual values in the sphere of law, exerts a strong influence on decisive political and social processes in society, such as the work of creating law, the implementation of laws, the functioning of the state mechanism, the principles and methods of action of the authorities. These aspects allow us to see the level of legal culture, the degree of its development determines the success of the modernization of the state and society. Even more, the stability and well-being of a nation depend on its level [7].

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Educational Needs of Adults and the Issues of Organizing Education in Ukraine

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Abstract.

This comprehensive study-based report presents the current state of awareness of the adult population of a territorial community in Ukraine, and specific social groups, on needing non-formal education. The analysis was based on a survey, expert individual interviews, focus group discussions, and consideration of regulations. Complex research resulted in a sufficiently complete multifaceted picture of the adult's educational needs and non-formal education situation in the Vinnytsia urban territorial community. The research tools provided different sections of the issue: public opinion, expert opinions from NGOs and city authorities, interests of various social groups.

Key words: adult learning, education, history, information warfare, NGOs, Ukraine

Classification codes: I21, I25, I26, I28, N3, N9

1. Introduction

Donetsk Institute of Social Research and Political Analysis, an NGO headed by Dr. V. Kipen of Vasyl' Stus Donetsk National University, has conducted a comprehensive study on educational needs and non-formal education in Vinnytsia territorial community in 2020. The study covered general and specific needs of various sectors of the adult population of Ukraine in educational services related to the non-formal education of adults, its related problems and optimal vectors of development. This paper represents a part of said research, while also noting further challenges for adult learning three years later, in wartime economy and information warfare.

2. Materials and methods

The research tools included: a quantitative questionnaire survey of the adult population, expert interviews, focus group discussions and content analysis of regulatory documents. The size of the representative sample for the population of the city for the survey was 300 people. The basic material was collected through 15 in-depth expert interviews. The researchers conducted and elaborated on 5 focus group discussions with 42 representatives of certain social groups.

3. Results and Discussion

3.1. Questionnaire results.

Per the survey, 56% of the adult population of the community found their last job did not

[1] DISRPA – Donetsk Institute of Social Research and Political Analysis

correspond to their formal education. The largest gap between education received and work performed is amongst 35–49 years olds [1, pp. 31–33].

74% of respondents claimed they had undergone non-formal education in the year prior to the study [1, p. 8]. Three quarters of Vinnytsia residents received additional education of varying intensity and quality during the year — indicating the need for non-formal education in the city. Most commonly used formats:

conferences, seminars, regular trainings (monthly or annually) — 25%;

professional retraining programs, advanced training in professions, courses for obtaining new professions — 24%;

one-time lectures, conferences, master classes — 22%.

The stated reasons for inactivity of a quarter of the respondents in any form of education were divided into three groups:

- personal circumstances;
- financial insolvency;
- unattainability of training for some people.

The survey refutes statements about unwillingness to pay for education — 73% expressed willingness. 27% favored free educational events [1, p. 9].

The residents' ways of obtaining new knowledge and skills were shown to be diverse, more than half engaged in both informal education and self-education. Online education is popular: learning through audio/video recordings found online (29%), online classes (23%), open master classes, webinars, online broadcasts (20%). 21% of respondents receive new knowledge through radio and TV [1, p. 8].

Self-education now actively competes with formal and non-formal education. Learning through direct attendance (in training centers, educational centers, libraries, clubs) is less common.

3.2. Expert interviews.

Expert interviews revealed a high level of awareness of the need for continuous education from civil society institutions and municipal authorities. When evaluating the effectiveness of providing the educational needs of adults in recent years, the evaluations ranged from neutral-critical to fairly positive. Positive trends are emphasized more by government representatives and communal institutions specializing in educational services. Some experts from businesses and NGOs agree. Others have caveats: they note restrictions on the access of adults to free educational activities; inadequacy and low activity in certain areas of the non-formal education, particularly on human rights and legal education; lack of information support for people with disabilities [1, p. 49–50].

Many of the offered training/seminars received criticism. The critics proposed to review the approach of the authorities in the management and coordination of the activities of both communal institutions and NGOs [1, pp. 51–55].

The position of the municipal employees focused on directions they specialize in. The bulk of adult residents — between 30 and 55 years old — are overlooked by the authorities. Their needs for educational services are mostly met by commercial structures [1, pp. 55–70].

On the question of who should invest in the sector (the government, local authorities, employers, donors, learners themselves) the

majority advocated for multiple sources of funding [1. pp. 73–74].

3.3. Focus group discussions.

These discussions recorded the representatives of five studied groups' attitudes and assessments. Target groups noticed more opportunities and offers in the last decade. However, there are differences in access to services between young, middle-aged, and elderly people. The last two categories are still waiting for more attention to their educational needs. The general results of working with focus groups include [1, pp. 13–18]:

Elders become more active, interested in developmental and educational services after retirement. They mostly seek computer literacy, health improvement training, workshop classes or hobbies.

Veterans of the recent war displayed post-traumatic syndromes, pessimistic moods, hidden aggression; requiring positive feedback from the community.

People with disabilities were less interested, particularly elder people (more interested came from 18–35 years olds).

The internally displaced persons have less interest in further education. Only 20–30% considered additional training.

The focus group with young mothers showed understanding of the importance of continuous education, with a preference for free learning.

3.4. Normative documents analysis

Of the 55 targeted programs from the Vinnytsia City Council website (responsible for the researched territorial community), only two were directly related to adult education. The documents barely contributed to the formation of the space of non-formal education of adults. A proposed urban development strategy "Vinnytsia 2030" also does not highlight the creation of a powerful integrated non-formal education space as one of the strategic projects [1, p. 18].

3.5. Further notes

While newer studies show that the idea of senior citizens being more susceptible to false information in media on a general basis is a misconception, there are still particularities related to the pensioners being targeted in information warfare [2]. Pensioner-targeted information attacks have been noted by Ukrainian government officials and local representatives throughout Kremlin's hybrid war against Ukraine. City councils reported pensioners asking about rumors they've heard online or from their neighbors regarding the refusal of state and municipal services if they don't cash out their pension accounts in 2020 [3]. 2022 saw a large number of cases, where pensioners complained to authorities regarding rumors about refusals of services they saw online, particularly in Moscow-affiliated media. Ukrainian media reported on authorities debunking rumors about refusal of state services to refugees [4], the UN support programs favoring younger people over the elders [5], deficits of goods [6], worrying political/historical narratives [7].

These reports correlate with certain critical statements from the in focus group discussions, complaining about "low capacity of municipal organizations and refusal of service", citing both personal experiences and anecdotes about "being lied to" [1. p. 14; 79–81]. The

pensioners' critical evaluation of services provided by NGOs and authorities may be connected to the aforementioned manipulation, clouding people's perception of services-providing agencies, including education.

4. Conclusions

All analysis tools record the existing urgent need for non-formal education and additional training and retraining of the community's adult population, covering existing weaknesses of Ukrainian formal education. Local authorities also get legitimacy for satisfying education needs of community members.

Among the positive points in the state and prospects of non-formal education for the adults in the researched community, the following can be named:

- a core of experienced organizations, knowledgeable in the socio-political situation, with ambitions to implement education projects, supporting vulnerable categories of the population;
- the interest amongst city authorities towards constructive interaction with NGOs;
- a large number of points of civic activity, capable of evolving into stable organizational structures for systematic non-formal adult education;
- a presence of communal institutions that provide social/educational services.

The sufficiently high level of involvement of the city residents in the acquisition of additional knowledge and competences stated in the survey indicates a positive trend in the involvement in continuous education. However, the views of experts and representatives of 5 focus groups do not correlate with the data. There is a need to raise awareness of non-formal education for many people. The weaknesses of the current situation:

- weakening of horizontal and vertical interaction within the sector and with respect to external platforms for non-formal adult education in Ukraine;
- weak institutional development, lack of necessary management skills for interactions with partners/contractors among some NGOs;
- insufficient inclusion of local businesses in the development of adult education, weakening the community's economic progress;
- no clear business strategies, high level of dependence on the current situation and economic environment. The pandemic and wartime events revealed little readiness to act in the changed conditions, except for the increase of online trainings.

Another remaining problem is the lack of a special Law of Ukraine "On Adult Education", which would be able to provide regulatory conditions and stimulating tools for the development of adult education spaces. Despite advice from researchers and experts, including the makers of this study, the law was not instituted back in 2020, discussions on the bill continued with slow progress for two years. Only in January 2023 did the parliament approve the bill project, which will require further discussion and voting by the MPs to proceed further [8].

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Lifelong Learning – An Important Objective In Cultivating The Emotional And Psychological Well-Being Of Adults

Maria Mancaş, Academy Of Economic Studies Of Moldova, Republic Of Moldova.

Abstract: *Lifelong learning* (LLL) is an essential factor in cultivating the self-confidence and intellectual and emotional potential that each adult can individualize, explore, and develop in a socio-professional partnership. The LLL involves certain roles that we assume with responsibility, the fulfillment of the obligations related to these roles, as well as the values and principles that we must be guided by in the LLL activities. The values and principles that we cultivate and promote within the SFC ASEM (School of Continuous Training of the Academy of Economic Studies of Moldova) - dignity, respect, tolerance, confidentiality, responsibility, professionalism, transparency, competitiveness, etc. – are meant to ensure, in the process of training, improvement, retraining, etc., both the emotional and psychological well-being of adults, as well as the increase of the competitiveness level of educational offers of LLL, but also the impact of these services on the training and personal and professional development of adult educational beneficiaries. The implemented opinion questionnaire gave us the opportunity to appreciate the degree of availability of the adult educational beneficiaries in adopting the decision and responsibility of continuous training as an important objective in cultivating emotional and psychological well-being.

Keywords: lifelong learning, emotional and psychological well-being of adult educational beneficiaries, culture of investment in training and professional development, PIES method.

Introduction

Motto: "The prosperity of the state and the well-being of the people depend invariably on the good of morality, and the good of morality invariably depends on education." (Nicolay Novikov, journalist, educator, collector of historical artifacts). [1]

It is rightly said that "lifelong learning is the key to success": success in overcoming challenges, obstacles and in creating a perspective that allows us to become the best version of ourselves.

Catherine II mentioned that "the most reliable, but also the most difficult way to make people better is to improve education".

Lifelong learning (LLL), according to the Ministry of Education and Research of the Republic of Moldova, is "early education, pre-university education, higher education, continuous professional training of adults", which is carried out in various contexts of "formal" learning (as organized learning, structured and based on an explicit didactic design), non-formal (integrated learning within planned activities, with learning objectives, which explicitly do not follow a curriculum and may differ in duration) and informal (the result of daily activities related to work, family environment, leisure time). [2]

Lifelong Learning consists of training and developing key competences (knowledge, skills and attitudes) that all individuals need for the

fulfillment, personal development, social inclusion, finding a job; is the training and development of acquired skills to improve career chances, etc. [1]

Lifelong Learning also means "somatic, physiological, intellectual, affective and, of course, behavioral health education". Or, if an educational institution or a company aims to cultivate (at the place of study / work, etc.) emotional and psychological well-being of adults to increase their quality of life (of studies / services provided, of the "personal life" - "professional life" balance, etc.), then this is only truly possible through a change in attitude and decision-making, through the adoption of behaviours and activities, through the implementation of a lifelong learning model.

Medical specialists themselves state that "well-being directly influences our actions and emotions." In other words, in order to succeed in cultivating our own emotional and psychological well-being, but also of those with whom we interact, communicate, collaborate, negotiate, both society as a whole and the adult, in particular, must approach Lifelong Learning as a necessary life model in the balanced management of various aspects of personal and professional life, thus avoiding workaholism, absenteeism in the workplace /in the studies, anxiety, depression, etc.

The role and importance of Lifelong Learning are reflected in the values that an entity promotes, whether public or private. And this can be explained by the fact that a higher education institution or a company with a sense of social responsibility wants a sustainable image in the education services market/labour market – all meaning social inclusion, competitiveness, proactive citizenship, personal and professional development.

But in order for the expectations to correspond to reality it is appropriate to ask ourselves: What is our career education (training and development) path for Today?

The path of professional education (training and development) is like a "travel subscription": it gives us the right to reach a "destination" (Pre-Graduate, Pre-Master, Master, Doctorate, Post-Doctorate, etc.), but it also motivates us to invest in this "subscription" (attitude, resources, knowledge, skills); is the route of identifying the specialization / the retraining / the requested improvement etc. Because Tomorrow belongs to those who learn throughout life; it is the strong motivation of today's graduate in relation to the tomorrow's success of the future specialist (adult).

Lifelong Learning also involves certain roles that we take on with responsibility, which, of course, also presupposes the proper honoring of the obligations related to these roles. In this regard, we welcome the example of SFC ASEM (School of Continuous Training of the Academy of Economic Studies of Moldova), which has as a major objective of coordination of all continuous education activities at the university level in cooperation with the specialized centers, the faculties of the ASEM and with other similar institutions in the country and abroad, in order to coordinate all the continuous education activities at the university level in cooperation with the specialized centers, the faculties of the ASEM and with other similar institutions in the country and abroad, in order to provide relevant training programmes from the perspective of the needs of both individuals as

well as of the legal entities to cope with the labour market and the information society of the third millennium.

What does Lifelong Learning mean at the ASEM School of Lifelong Learning?

SFC ASEM is actively involved in providing their competitive educational offers in the LLL field, the offers which are flexible to the needs of individual and corporate users; educational offers are adjusted to the individual needs of applicants within the limits of the legal framework in force; the development of various personal and professional development courses is ensured by highly qualified teachers, but also by field experts, these objectives being connected to the economic, cultural, psycho-social realities of the. Thus, dignity, respect, tolerance, confidentiality, responsibility, professionalism, transparency, competitiveness, etc. are the values and principles that SFC ASEM cultivates in the partnership with adult educational beneficiaries.

In order to increase the competitiveness of LLL educational offers and the impact of these services on the training and/or personal and professional development of adult education beneficiaries, the SFC ASEM applies the "Opinion Questionnaire", in order to identify the degree of availability of their adult educational beneficiaries on the adoption of the decision and responsibilities of continuous training, as an essential objective in the development of the society of knowledge and consciousness, in ensuring the emotional and psychological well-being of adult educational beneficiaries.

For this purpose, we considered acceptable the scaling method, with 21 items / investigation questions (closed and open).

However, the small number of responses we had, generated a low turnout rate – 23 respondents.

Nevertheless, the results of the questioning, largely reflect the intrinsic and extrinsic motivation of the academics to be continuously formed, thus demonstrating an openness, empathy and receptivity for the LLL.

Let's reflect on the predominant characteristics of the respondents who participated in the questionnaire:

Gender: female - 91.3%;

The predominant age of the respondents: 47-55 years;

The environment in which it operates: 100% urban;

The professional field I belong to: Education – 75%, Business, administration, law – 13%, Other fields (exact sciences, mathematics and statistics, engineering, processing and construction, health and social care) – 4%;

The sector in which the respondent works/studies: public sector – 87%; private sector – 13%.

The argument that comes to support the results of the questionnaire consists in the total agreement of the respondents to learn throughout their lives, in the intrinsic motivation, realizing that in an ever-changing society, people must be able to learn and adapt to this change, thus contributing to increasing confidence in one's own potential, raising morale in the workplace/studies, increasing income as a result of the performances obtained, etc.

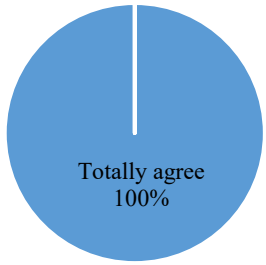


Figure 1. Confirm or deny the following statement: "In a constantly changing society, people must be able to learn and adapt to this world".

Certainly, for respondents, lifelong learning is also a goal to meet a need:

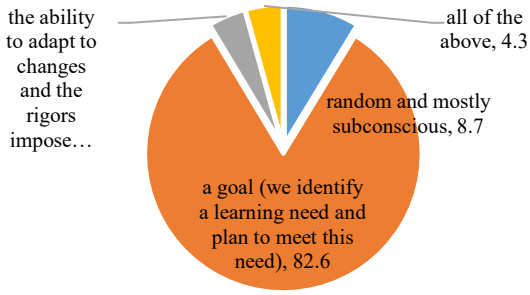


Figure 2. Lifelong learning according to respondents.

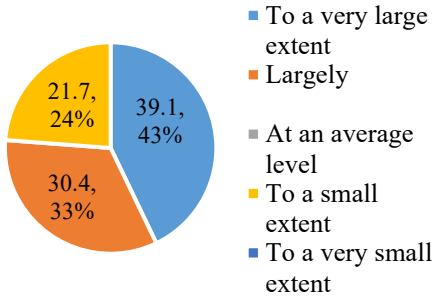


Figure 3. Formal education according to respondents' aspirations.

To the question: "To what extent the formal education (institutionalized, which is carried out in a clear organizational structure, represented by the education system) corresponds to your wishes and aspirations. ?" , respondents replied:

From the non-formal (complementary, optional, optional) and informal (non-systematic, unorganized, unsubordiated, unsubordinated to objectives, explicit goals) perspectives**,** respondents also showed an openness for this type of education (Figure 4 and Figure 5):

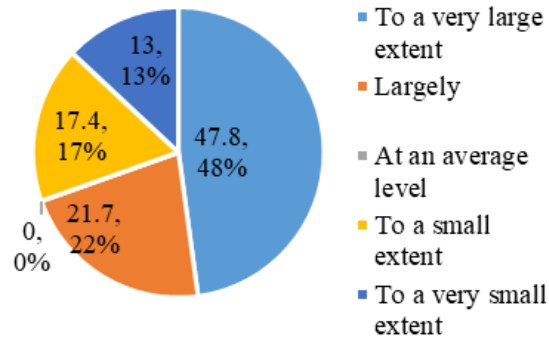


Figure 4. Non-formal education according to respondents' aspirations.

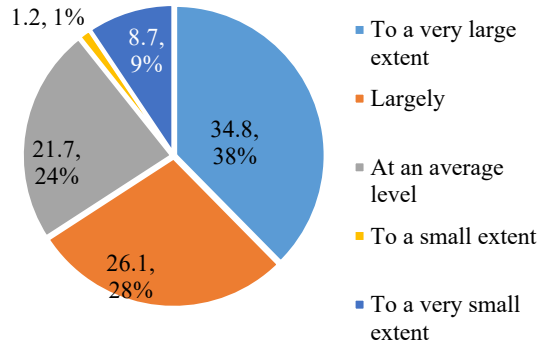


Figure 5. Non-formal education according to respondents' aspirations.

To the question: "Who should, in your opinion, be involved in the decision of trainers selection for continuous training programs?" some respondents saw appropriate the involvement of the director of the training university subdivision – 52%; 34.8% - the manager of the institution and only 13% - the trainer himself.

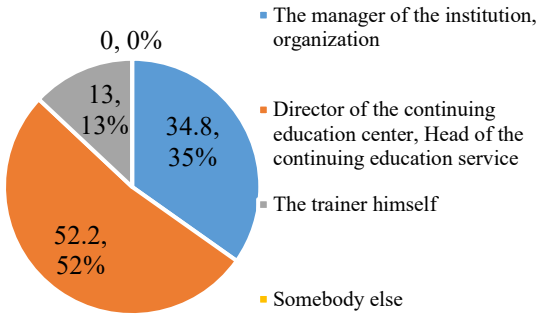


Figure 6. The decision-making factor in the selection of continuing education trainers.

From the point of view of the context in which they successfully completed and completed a training program / in-service training course, the respondents mentioned the workplace – with 69.6%, followed by the formal education area – with 56.5%, the center for continuous training – 43.5%, the other contexts being an alternative (in travel, abroad – 26,1%, through involvement in social, political, cultural activity – 21,7%, through volunteering activities – 13%, at home – 8,7%).

In the respondents' opinion, lifelong learning can be quantified. Thus, 60.9% of respondents have the firm belief that this type of education can be measured, and 39.1% are of the opposite opinion.

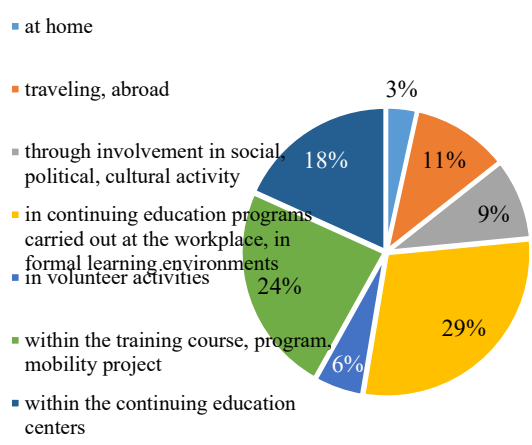


Figure 7. The continuing education context(s) chosen by the respondents.

To the question "How do you think lifelong learning must be coordinated, regulated and funded?" 82.6% were firm on this, and 17.4% of respondents did not see this as a stringency. However, to the question: "What is the source of funding for lifelong learning in your institution/organization? respondents surprised us with the following results:

- learner's contribution (private) – 52,2%;
- management and administrative structures of the institution/organization – 47,8%;
- non-reimbursable funds from European programs – 30,4%;
- financing and co-financing from employers – 30.4%;
- public and private funds based on public-private partnership – 21.7%;
- sponsorships, donations, external attracted sources – 21,7%;
- onon-governmental organizations that have contributed to the financing of this type of education - 13%;
- permanent educational accounts – 8,7%; of

the unemployment insurance budget – 8.7 percent.

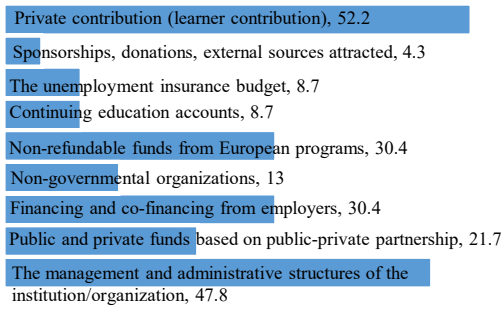


Figure 8. Source of lifelong learning funding indicated by respondents.

The research in question gave us the opportunity to notice that 87% of the respondents are not indifferent to their lifelong learning path. This aspect is also explained by the 34.8% of respondents, who mentioned that they systematically monitor the offers of continuous training. However, 13% of respondents made it clear that monitoring the bad offers of continuous training is not their priority, with 65.2% of respondents saying that they monitor continuous training offers only sporadically.

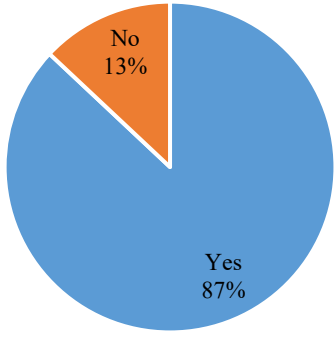


Figure 9. The degree of monitoring of continuous training offers by the respondents.

In this research, we set out to find out what lifelong learning programme (developed by the European Commission) our respondents turned to. The answers highlighted the high level of information of adult education beneficiaries about lifelong learning offers: Erasmus (higher education) – 52.2%; Jean Monnet Programme – 39.1% and other alternative options (Cross-cutting programme, with activities beyond the limits of sectoral programmes – 13%; Leonardo da Vinci – 13% etc.).

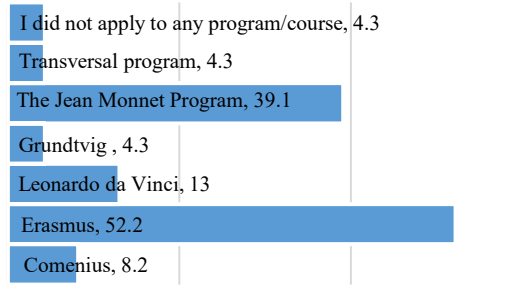


Figure 10. Lifelong Learning Program(s) attended by respondents.

To the question: "To what extent the continuous training offers provided contribute to the assurance of professional quality, to the satisfaction of your educational/professional?"

47.8% of respondents admitted that continuous training offers have an important impact in developing and capitalizing on their professional / educational skills and only 4.3% of respondents see this contribution as insignificant to meet their educational / professional needs.

Through this opinion questionnaire we had the opportunity to convince ourselves that, for the majority of respondents – 87%, lifelong learning is important, first of all, for psychological reasons. Thus, is an argument in

support of the need to cultivate emotional and psychological culture of adults (20-65 years) and, especially, of their adults in the age of involution (65-90 years).

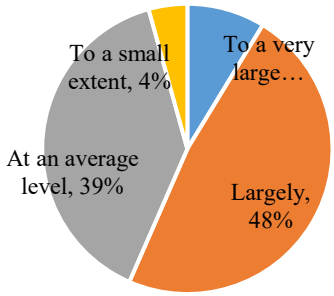


Figure 11. The quality of continuous training offers and their impact on ensuring professional quality, meeting the educational/professional needs of respondents.

Or, the psychological factor is the one that either favors you or disadvantages you in a world of knowledge and consciousness in case you give up on developing, re-inventing yourself, re-integrating yourself.

Social motivation - for 73.9% of respondents and economic motivation - for 65.2% is a vital vector for increasing the quality of their personal and professional life.

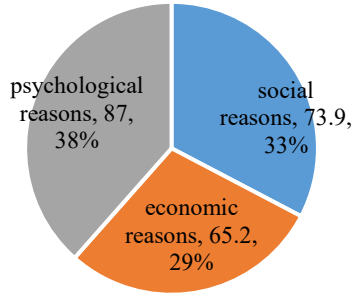
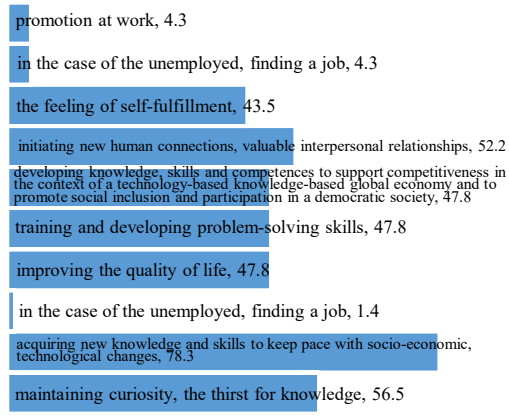


Figure 12. The motivation for lifelong learning.

The strengths enjoyed by the respondents (beneficiaries and adult education) in lifelong learning are multiple.



The IQ coefficient (reflected in the questionnaire by acquiring new knowledge and skills to be in step with the socio-economic, technological changes) is very important for most respondents – 78,3%. Maintaining curiosity, thirst for knowledge is another asset for respondents who are aware of the importance of entrepreneurship in their professional activity – 56.5%. However, the initiation of new human connections, valuable interpersonal relationships is seen by a good part of respondents, 43.5% - 47.8%, this being essential not only for the exchange of knowledge and experience between the parties, but also for strengthening self-esteem, a sense of self-fulfillment.

Promotion to the workplace or finding a job in the case of the unemployed are also among the strengths that can benefit some potential / current adult educational beneficiaries) within a training program / continuous training course.

Given that the continuous professional training path is not without certain obstacles, we set out to identify the barriers that respondents face in the process of lifelong learning.

Thus, situational barriers prevail according to the 73.9% of respondents, then institutional barriers – 26.1%, and psychological barriers – 21.7%. The linguistic, cultural, economic barriers faced by some respondents - 4.3%, among them being as well those who replied that they do not face / did not face certain barriers.

And since online education (training and development) reaches considerable levels both in the educational environment and on the labor market, we have sought to find out the respondents' choices about the order of importance they attach to online skills and the degree of utility that these skills have for them in the online format.

In respondents' opinion, online collaboration tools, webinars and mobile collaboration tools; multilingvism; numerical, scientific and engineering skills; digital and technological skills; interpersonal skills and the ability to adopt the need for and importance of soft skills in European adult education; inclusive ethnicity; developing an entrepreneurial mindset; development of specialneeds for people with special needs; competence assessment, learning offer, validation of competences - all reflect a high degree of importance and usefulness in developing analytical and creative thinking.

To the question: "What skills in your training? do you want to improve?" 65.2% of respondents opted for curricular skills, 52.2% - digital skills, communication and networking skills, 43.5% - managerial skills, 30.4% - willingness to organize and regulate their own learning, the spirit of initiative and entrepreneurship, 17.4% of respondents opted for cultural awareness and artistic expression, and 13% of respondents expressed their desire to improve their mathematical skills and basic skills in science and technology.

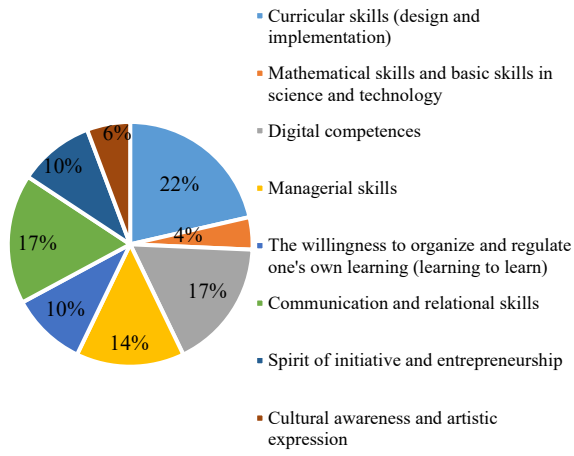


Figure 13. Competencies chosen for improvement.

Valuable as information are the roles and responsibilities that respondents have selected for a modern trainer.

87% of respondents say that a modern trainer is, first of all, a moderator (to stimulate the training of learners in the training process, to activate the exchange of experience), 69.6% - presenter (to inspire, to build bridges with those he trains, to use humor), 65.2% - team leader (to manage the group work and to act towards the management of the training objective), but also a good communicator (to possess oral, written and visual communication skills), 60,9% - designer (to adapt the training programs to the needs of the learners and to use the principles of learning adults), 43.5% - skillful user of distance learning tools, consultant and innovator (identify the problems studied and solve them in the training process), etc.

52.2% of respondents also pay attention to the role of ally of the students, this role being, at other times, decisive in creating the feeling of safety and in managing the counter carriage occurring in the training / improvement / retraining process, etc.

At the same time, 26.1% of respondents believe that a modern trainer is the one who assumes the role of organizer (he knows how to arrange the training room, to design the materials, training resources, etc.).

At the end of the opinion questionnaire, the respondents were invited to indicate, on a scale from 1 to 5, where 1 – means "to a very small extent", and 5 – "to a very large extent", their degree of availability with reference to the adoption of the "culture of investment in training and professional development".

The result was impressive: 43.5% of the 23 respondents demonstrated a proactive attitude towards LLL.

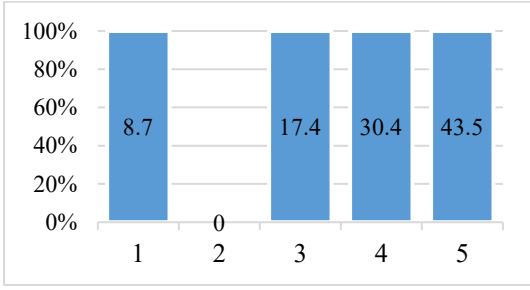


Figure 14. The degree of readiness to adopt the "culture of investment in professional training and development".

In the context of the approached, we conclude:

From the perspective of cultivating the emotional and psychological well-being of adult educational beneficiaries, it is important that each higher education institution in whose subdivision there is a Center for Continuous Training, to propose, in collaboration and coordination with organizations governmental and non-governmental, associations, etc., a stringent objective for the society of knowledge and social consciousness, namely: the implementation of resilience programs in different fields (training courses / seminars, workshops, etc.) for active adults (20-65 years) and for adults in the period of involution age (65-90 years).

Programs of resilience for older adults would foster conditions to cultivate a sense of control over their own lives and increase the chances of social re-integration, of re-orientation, especially at the retirement stage. In addition, we could prevent, at a societal level, the phenomenon of social disengagement, which highlights, most of the time, the pessimistic attitude towards retirement (perceived as a devaluation of social status, a state of boredom, etc.).

On the other hand, we can also observe elderly adults who denote a different kind of attitude towards retirement: the optimistic attitude (perceived as a benefit: the break deserved/ possibilities of carrying out some postponed projects, etc.) and the balanced attitude (this period being accepted as a calm, lucid life model, with its positive and negative aspects), without excluding the new perspectives of being useful further. [3]

This utility can be appreciated as the psychological well-being of adults, with a direct impact on somatic, physiological, intellectual, affective, and behavioral health. Albert Einstein himself pointed out, "Engage in lifelong learning. The most valuable asset you will ever have is your mind and what you put into it." Lifelong learning is possible not only

at the early stage of pre-university education and superior education, but also at the stage when the elderly adults (with the support of the local authorities, their social assistants, the organizations or volunteers, of the institutions accredited to provide in-service training services), would have the courage to assume new roles of interaction with the employer, with the society, thus optimizing the quality of their lives even after retirement.The results of this questionnaire motivated us to propose a model for cultivating the emotional and psychological culture of adults (20-65 years), a model that would guide adult educational beneficiaries towards an increase in emotional and psychological well-being, but also towards a more qualitative life: the PIES model, where:
PQ means exercises, nutrition, stress management.
IQ - mental skills, reading, visualizing, planning, writing;
EQ - emotional skills, empathy, synergy, intrinsic security;
SQ - spiritual values, commitment to oneself and others, knowledge of one's own self, meditation.

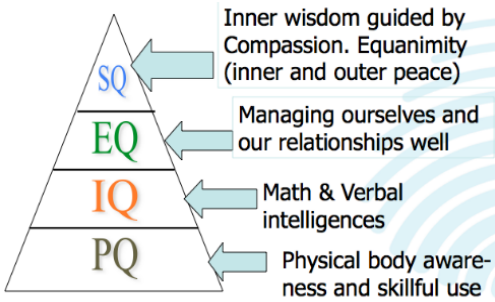


Figure 15. The PIES model.

In our opinion, in order for Lifelong Learning to become an important catalyst in cultivating the emotional and psychological well-being of adults, the PIES balanced model needs to be adopted precisely from the perspective of succeeding in ensuring competitiveness, in experiencing the feeling of self-fulfillment, of utility for fellows and society.

Therefore, let's opt for a "route" of continuous training that will favor our emotional and psychological well-being at different stages of adult life - the formula of a successful personality that the PIES model generates: PQ+IQ+EQ+SQ.

But without limiting ourselves to these intelligence coefficients. Otherwise, how would adults in the age of involution see themselves if they self-noticed with the eyes of active adults?

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Evidence on Incomes and Consumptions of the Elderly Population Based on National Transfer Accounts

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Abstract: The paper focuses to evaluate the characteristics of incomes and consumptions of the Moldavian population aged 60 and over, based on National Transfer Accounts (NTA) data frame for 2019, thus presenting an analysis of the Economic Life Cycle Deficit (ELCD) of individual age groups. Based on the study it is found that along with advancing age, the economic activity of the population inevitably decreases. The primary sources of livelihood for the elderly are not so much income from work but public transfers (payments for social programs, including pensions, healthcare and social services) – 37.8%. During the pre-retirement period, the self-employment labor income remains to have a special role in supplementing incomes and becoming the only source after age 75. Although in the total of public transfers to the old population, the share of the pension increases, constituting 3/4 of these transfers, this does not mean that the pension better covers the consumptions of the elderly, highlighting the insufficient support of the state for this vulnerable group. Practically 2/3 of the sources that make up the consumption of the population aged 60 and over is from their own account and that of their families, the activity on the labor market, transfers, and private reallocations. Low occupational indicators for the working-age population, emigration of young people, intensify the risk of economic losses in the future. In the last decade, the need to monitor the intergenerational balance of income and consumption, including for systematic forecasts of the public budget, is emphasized.
The paper is carried out within the State Program Project (2020-2023) 20.80009.0807.21 „Migration, demographic changes and situation stabilization policies."
Keywords: elderly population, National Transfer Accounts (NTA), life cycle deficit, active ageing

Introduction

In the Republic of Moldova, demographic developments no longer provide bonuses for economic dynamics. The changes in the age structure of the population, the increase in the number of elderly people causes a continuous increase in the dependency rate for the elderly, with a direct effect on living standards, the increase in the volume of transfers for the social fund, pensions, for the health system. Moreover, according to the demographic forecasts by 2040, for every 100 people of economically active age (20-64 years), there will be 42 elderly people aged 65 and over, double the value in relation to 2022, and 30 children (0-19 years) [4].

This article comes with an analysis of the particularities of the economic life cycle and its deficit for the population aged 60 years and over, taking as a basis the complex data framework of the NTA for the year 2019. According to

updated statistical data on the population with regular residence in Moldova (Figure 1), in the age structure practically every fourth person in the country is aged 60 and over (593 thousand people or 22.8% of the total population), and of these more than half (60.1%) are women.

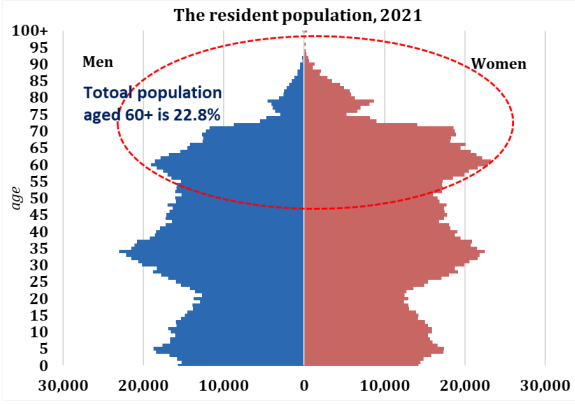

Figure 1. Distribution of the population with usual residence by sex and age, Moldova. *Source*: based on National Bureau of Statistics (NBS)

Methodology approach

The National Transfer Accounts (NTA) methodology is a modern system for estimating the intergenerational balance within the System of National Accounts (SNA), developed by - demographer Ronald Lee and economist Andrew Mason [6].

The National Transfer Accounts (NTA) enable a complex analysis of how much public money is spent on people at different stages of their lives, but also the massive resources that families themselves transfer between generations, in cash and overtime [9].

Currently, the National Transfer Accounts is an international research project which includes more than 60 countries [8]. Moldova joined the NTA project in 2016 and first analyses had been appeared in 2017. In terms of this paper, the analyses are based on the National Transfer Accounts methodology and the database performed and calculated by Valeriu Prohnițski. The data frame is for 2019, the last year available. The results are distributed by year and sex and are related to the national currency. To mention that according to the official exchange rate of the National Bank of Moldova in 2019 - 17.2 lei MDA was the equivalent of 1 USD ($).

Data sources for constructing the National Transfer Accounts (NTS) for Moldova are referring to (1) *macro indicators* extracted from:

System of national accounts (data available on the NBS website)

BOOST national budget data

Public expenses provided by the Ministry of Finance

Fiscal Service data

Data of the National Bank (balance of payments)

(2) *The age profile* of income and consumption is related to the data of the National Bureau of Statistics:

Household Budget Survey (HBS)

Labor Force Survey (LFS)

Research limitations. Some limitations relate to the lack of continuity of the statistical indicators needed to compare data longitudinally over the years, as well as the underestimation of the population's income, data extracted from the Household Budget Survey (NBS), as a result of the high rate of non-response to questions regarding sources of income.

Results and findings

On the life axis, at the beginning and towards the end of life, we experience a long period when we consume more than we produce through work. According to the NTA methodology, this is the period of the Economic Life Cycle Deficit (ELCD), when the total value of goods and services consumed by members of an age group exceeds the value of goods and services produced by its members.

The economic life cycle deficit increases significantly in older age groups (Figure 2), with incomes becoming lower and the post-retirement support system more problematic.

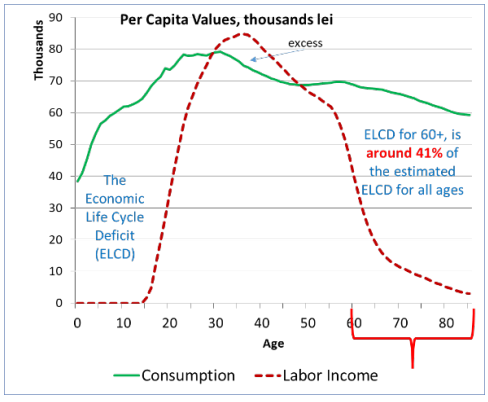

Figure 2. Distribution of the consumption and labor income of population by age, per capita, Moldova. *Source*: based on the National Transfer Accounts, 2019.

Associated with a long period of dependency this deficit is mostly determined, however, by low levels of population employment and low incomes. Based on the age profiles of the aggregated data of the NTA, it is confirmed that the ELCD of the population aged 60 and over constitutes around 41% of the estimated deficit for all ages, or over 27.5 million lei.

Individually, per inhabitant aged 60, the deficit of the economic life cycle is about 20 thousand lei annually (or 1630 lei monthly) in the case of men and almost 37 thousand lei annually (or 3054 lei monthly) in the case of women. As the age increases, the ELCD also increases – at the age of 70 it is already 51.3 thousand lei annually for men and 56.6 thousand lei for women. After the age of 75, the gender discrepancy between the nominal values (per capita) of the ELCD decreases, and the value of the deficit remains on average above 56.1 thousand lei/per capita annually (or 4675 lei/per capita monthly).

Women have a greater deficit compared to men, both during the period of economically active life, as a result of the dedication they have to family roles (birth, raising and caring for children), and after the age of 60, women remaining widowed in greater proportion, living alone and with greater longevity compared to men, but also with traditionally lower incomes. Aggregated values for all generations aged 60-70 years show a double ELCD in the case of women compared to the situation of men (Table 1).

Age	Total	Men	Women
Aged 60 +	27.506.517	9.805.911	17.700.606
By age groups			
60-64	7.285.688	2.467.086	4.818.602
65-69	8.566.447	3.284.375	5.282.071
70-74	4.642.969	1.703.241	2.939.728
75-79	3.491.801	1.217.338	2.274.462
80 +	3.519.613	1.133.870	2.385.742

Table 1. The Economic Life Cycle Deficit for the population aged 60 and over, millions of lei, aggregated values, Moldova, *Source*: based on the National Transfer Accounts, 2019.

Along with aging, the economic activity of the population inevitably declines. According to NTA data for 2019, at the (pre)retirement age (60-year-old), the annual work income is about 40 thousand lei, of which the wage income constitutes 32 thousand lei per person annually (2700 lei monthly) and about 8 thousand lei the income from self-employment (or 1/3 of total labor income among people aged 60 and over). After the age of 75, the salary income is insignificant, about 4400 lei per capita annually.

Self-employment has a special role in supplementing the incomes of the elderly population given that pensions are small. After the age of 75 it becomes practically the only source of active income. From a gender perspective, women both during life and after retirement have lower labor income, including from self-employment.

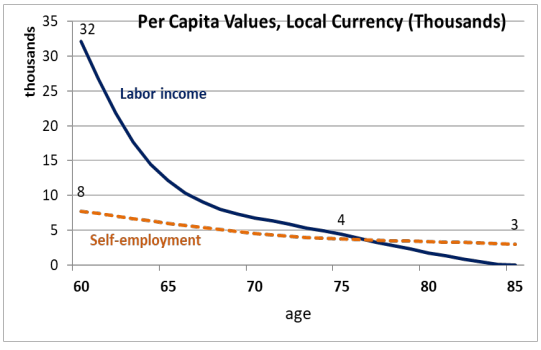

Figure 3. Labor income and self-employment of the population aged 60 years and over, in thousands of lei / per capita annually, Moldova. *Source*: based on the National Transfer Accounts, 2019.

Across generations (aggregated data) it is attested that even at very old ages (after the age of 80), women continue to earn sources of income through self-employment, however, these are very small, on average up to 3000 lei annually. This reality is also a factor in the poor material well-being of the elderly population, over 41% of people aged 65 and over being below the absolute poverty threshold [1], which is accentuated for those from rural areas, with a predominant activity agricultural, and very obviously for women.

Public transfers to the elderly population. The public sector plays an important role in transfers to the elderly population. The volume of total transfers to the elderly is almost twice as high as transfers to the youngest segment of the population (0-17 years). About 39% of public transfers (inflows) have as recipients people aged 60 years and over.

Most of the resources needed by them are provided through the pension and healthcare system. An important part of the various payments (other cash) is made for the social protection of the elderly population, including social assistance and various aids, for heating, the cold period, allowances, etc. The significant gender gap in life expectancy determines the length of the retirement period and the duration of receiving transfers – women are beneficiaries about 11 years longer than men [4].

In aggregate terms, total retirement benefits are considerably lower for men – public pension transfers being twice as high for elderly women (8073.4 million lei) compared to men (4411.3 million lei). But, in return per capita, annual old-age benefits for women are lower than for men. This reality is partially explained by the decrease in participation in the labor market because of the maternal role, the specifics of economic activities of women (usually less paid), lower incomes during this period, subsequently lower pensions.

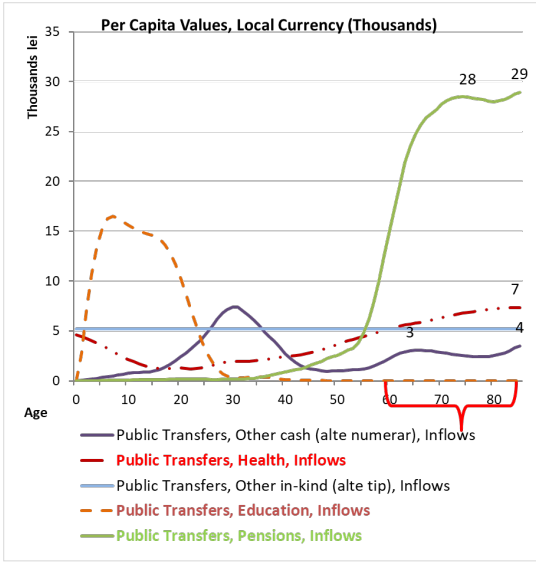

Figure 4. The particularities of public transfers, thousands of lei, per capita annually, Moldova. Source: based on the National Transfer Accounts, 2019.

Gender differences here are also driven by the bigger number of women in retirement age, including as a result of the longer survival and men's high rate of premature mortality. For example, according to the data of the National Social Insurance Agency, at the beginning of 2022, the total number of old-age pensioners was 520.9 thousand people, of which women constitute more than 69%. People aged 60 years and over had a share of about 98% in the total number of old-age pensioners, of whom 68.5% were women. The average size of the old-age pension in 2022 was 2960.6 lei for men, while 2432.2 lei for women [2].

About 40% of the total public consumption for *the health system* is for the elderly population, twice as much as for the 0-17-year-old population. Throughout life, considering the specific needs of motherhood, greater addressability, and healthier lifestyles, but also the larger number of generations of women aged 60 and over, the balance of health services consumption is feminized [3]. It is observed that at older ages (age 75 and over) the gender differences decrease, estimating on average over 7 thousand lei per capita annually.

It is certain that although older people are usually labeled only as beneficiaries and consumers of public transfers, the NTA data show that even after retirement, including at advanced ages, they continue to be donors of public transfers contributing to public fund (Figure 5). On average, per inhabitant aged 75 and over, these *"outflows" transfers* amount to ten thousand lei annually. By continuing their active life on the labor market, the elderly continue to pay taxes, but also other taxes (from property, agricultural land, etc.).

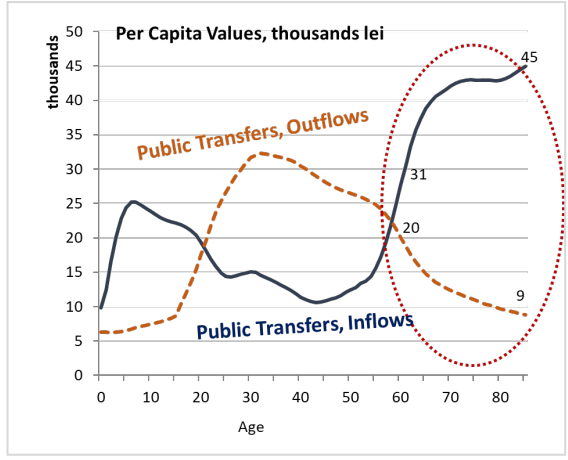

Figure 5. Public transfers (outflows and inflows) to population, thousands of lei, per capita annually, Moldova. *Source*: based on the National Transfer Accounts, 2019.

Transfers between households and private transfers. A common economic behavior in

Moldova is that the economically active population invests in their children, who, in turn, finance the care of their parents in their old age. *Intrahousehold* and *interhousehold transfers* also play an important role in covering the ELCD of the population. The NTA data show that within households *(intrahousehold transfers)* people aged 60 and over continue to be donors for their family members and only after the age of 77 do they become recipients from family members.

Remittances *(interhousehold transfers)* are an important help for the elderly throughout the rest of their lives. The total volume of transfers from remittances for the elderly, in aggregate values represents about 12% of the ELCD of the population aged 60 and over. In nominal terms, the values oscillate downward from 8500 lei per capita annually at the age of 60, to around 2200 lei per year for the elderly 80 and over. With age, transferred remittances become smaller, especially for men.

The spending of the population in old age depends only on the savings they have made during their economically active life. According to the NTA methodology, the accumulations assume various allocations at the household level that come from companies, agricultural land, the sale of goods, etc. but also the cost of own housing (as private property), although the person has no income from it as it is a place of living and not a rented property. For the specifics of the country, this is a methodological gap, as it refers to a hypothetical cost attributed to housing, which distorts the volume of real accumulations. At the same time, the HBS does not fully reflect the income from properties and capital of the population, as a result of the high proportion of non-responses and/or the underestimation of own incomes.

The NTA data shows that after the age of 60, the population does not have private savings, and the income from assets is very small. Sources that makeup Consumption among the elderly population. In Figure 6, according to NTA data, the main sources of livelihood for the elderly and covering their monthly consumption are presented. These are: *public transfers* (about 38%) which consist of various payments for social programs, including pensions, healthcare and social services, their intake increasing with age; *reallocations based on private assets* (30.7%) – refers to dividends from the bank, the cost of the house sold, the car and other properties, but here it should be noted that the value of these reallocations is assumed rather than objective (as a result of some methodological inaccuracies specific to the country in the calculation of some indicators of the NTA, but also of the incomplete data within the HBS); *income from work* (26.1%) including salary and self-employment; *private transfers* - 6.5%, including inter- and intra-households.

We find that although in the total of public transfers for the elderly population, the share of the pension is increasing, constituting 3/4 of these transfers, this does not mean that the pension better covers the expenses of the elderly, highlighting, in fact, the insufficient support of the state for this vulnerable group. Practically, 2/3 of the sources that make up the consumption of the population aged 60 and over is from own and family account, activity on the labor market, transfers and private reallocations.

In terms of gender gap, the share of public and private transfers is higher among women

(40.8%, respectively 9.5%) compared to men (33.2%, respectively 1.8%), a fact explained by the larger number of women over 60 and above, female longevity, but also of widows who live alone and receive family support. For men, a more important source in covering expenses is income from work (32.6% compared to 22% for women).

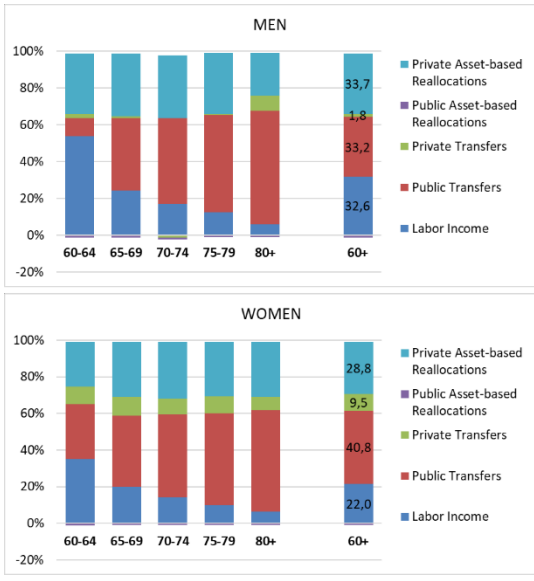

Figure 6. The share of sources that make up the consumption of the population aged 60 and over, by age group and gender, % of the aggregate values. *Source*: based on the National Transfer Accounts, 2019.

Conclusions

An aging population puts budgetary pressure on society as a whole, as the number of workers falls relative to the number of consumers. This phenomenon is quantified by the support ratio of the total number of workers to consumers (which includes everyone – child, youth, elderly).

Studies in the field indicate that as a result of the aging of the population, the decrease in the rate of fiscal support for the public budget is inevitable. For European countries, towards the year 2050, it is estimated that to compensate for the increased costs of population aging, and to balance fiscal revenues and expenditures in the public budget, either fiscal revenues will have to be higher by 14%- 28%, either lower spending by 14%-28%, or even a combination of the two [5] and not just on the social welfare component.

Restructuring public transfer programs is a politically difficult task for governments as it is being tackled by raising the retirement age and more closely linking the level of benefits to the availability of tax revenues.

In the case of Moldova, low occupational indicators for the working-age population, emigration of young people, intensify the risk of economic losses in the future. In the last decade, the need to monitor the intergenerational balance of income and consumption, including for systematic forecasts of the public budget, is emphasized. More vigorous policy efforts are required to improve productivity and increase the potential of the working-age population, including by ensuring active and healthy aging and social security for the elderly.

Acknowledgment:

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Achieving Energy Independence Through the Diversification of Sources: Solutions for the Present and Future

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Abstract Finding optimal solutions for replacing fossil fuels is the real necessity of the moment. This work aims to highlight the main renewable energy sources that could successfully replace fossil fuel energy sources. By making major investments in these renewable energy sources, every country could ensure its energy independence.
Identifying future solutions to reduce global warming and vulnerability to Russian gas imports is another objective of the present global situation in the EC, as well in Romania. In areas where electricity from fossil sources cannot reach.
Renewable energy sources have some extremely important characteristics: they are inexhaustible, they can ensure a sustainable supply and they can be implemented in hard-to-reach areas. Thanks to these two qualities, these electricity production systems lend themselves to be implemented in all areas where electricity and thermal energy are lacking.
The politicians and scientists are responsible for finding solutions both technically and applicable, at accessible costs. Civil society does not understand high tech but needs energy at accessible prices and constant supply.
Keywords: biogas, energy independence, energy security, renewable sources, hydropower, solar energy, wind power

1. Introduction

In the quest to reduce greenhouse gases caused by the use of fossil fuels, renewable energies have recently become increasingly present on the global market [1, 2]. Purpose-wise, renewable energy sources were essentially created in order to shape a decarbonized future [3] and achieve energy security [4]. In addition to the advantages brought to the environment (considered a clean energy) [5], the transition to green energy has provided the business environment and the entire society with numerous benefits [6]. What is more, the chances of power outages are visibly reduced by diversifying the sources of electrical energy [7]. Energy diversification also contributes to the enhancement of energy efficiency of a country [8]. At the same time, independence from imports can be reduced via resource diversification, ultimately removing the uncertainty related to energy prices [9]. The use of renewable energy sources can therefore be considered a good strategy in order to strengthen energy security [10]. Acutely aware of the importance of energy security and independence, many countries have initiated a

process of accelerating the diversification of energy sources [11, 12]. The support received from decision-makers have turned renewable energy sources into competitive counterparts against fossil fuels [13].

Unfortunately, energy independence insurance is not exclusively reliant on finding the resources for the diversification of electricity production, but also on creating new transport routes and the conditions for own energy storage [14]. Ensuring energy diversification contributes to the elimination of energy dependence on a certain energy source [11]. The primary sources of obtaining non-conventional energy oftentimes comprise the following: wind, solar [15], geothermal, hydropower, biogas.

Figure 1 shows the main sources of renewable energy.

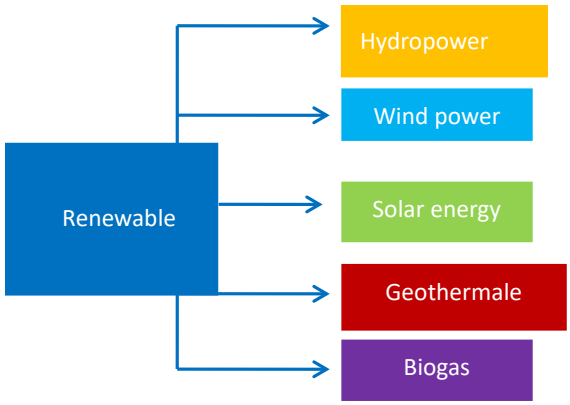

Figure 1. Renewable energy sources [15]

Hydropower

Hydropower constitutes one of the largest sources of energy worldwide [16], making up approximately one fifth of the total electricity production [17]. Unfortunately, the construction of hydropower plants is expensive and time-consuming [18], and their operation can have a negative impact on ecosystems [19]. Dams can affect the river flow, the quality of water [20], the movement of fish, they can damage the riparian vegetation and fish species [21, 18]. Unfortunately, the climate changes taking place recently have created serious disturbance to the production of energy obtained with the help of hydropower plants. This is due to the process of water evaporation [22], the increase in temperatures, but also to the rainfall shortage, which has led to a decrease in the level of water resources [23]. Unlike solar panels and wind turbines, however, hydropower plants are less affected by the weather [24]. In spite of the criticism centred on the negative impact it has on the ecosystem, hydropower still represents an important pillar in terms of global energy production [25]. As far as Romania is concerned, the largest amount of electricity obtained from various sources of renewable energies is represented by hydropower. According to the chart in Figure 2, the energy production resulting from hydropower represents 35.1% of the total energy produced, followed by coal (18.1%), and wind power (15.9%), respectively.

Figure 3 shows the breakdown of the amount of energy generated in Romania on April 18, 2023. Glancing through the chart (Figure 3), it is worth noting that hydropower occupies the first position with a production of 6641.94 MW, followed by coal with 3422.2 MW, and wind power with 3014.91 MW.

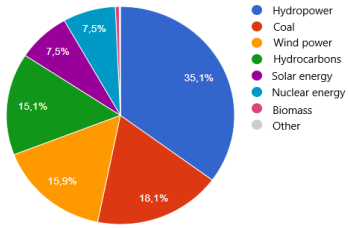

Figure 2. Graphic representation of the amount of energy obtained from various energy sources [26]

Production Type	Value
Hydropower	6641.94
Coal	3422.2
Wind power	3014.91
Hydrocarbons	2771.22
Solar energy	1413.33
Nuclear energy	1413
Biomass	106.266
Biogas	21.357
Waste	6.03
Waste heat	4.1
Geothermal energy	0.05
Total:	**18814.403 MW**

Figure 3. The amount of energy broken down by energy sources [26]

Geothermal energy

Geothermal energy represents thermal energy originating and preserved inside the Earth [27, 28]. It is obtained through the natural decomposition of radioactive isotopes of uranium, potassium and thorium [29]. Geothermal energy is oftentimes characterized by large reserves, low operating costs [30], and can be found at shallow depths [31]. Geothermal energy is not affected by weather conditions, having the ability to provide energy continuously [32], as well as to be used to produce electricity and heat [33]. Thus, geothermal energy can be considered a source of support for the energy system powered by fossil fuels [34]. Moreover, the geothermal energy generated has a low level of interruptions, being able to be used throughout the year for 24 hours [35]. As concerns geothermal energy, no problems with energy storage are signalled (as opposed to solar energy, for example) [36].

Solar energy

The production of electricity obtained from solar energy is influenced by three key factors: the season, the time of day, and the geographical area [37]. However, solar energy can contribute to alleviating climate change [38]. Solar power can unceasingly make use of the natural energy resources on Earth [39], exerting no negative impact on the environment. It is produced extremely easily by installing photovoltaic panels [40], and thanks to the constant solar radiation over a wider area, more energy can be obtained [41].

Through the photovoltaic system, green energy can be obtained at affordable prices [41]. A major advantage of photovoltaic panels lies in the fact that they can be installed on the surface of the water, which makes them suitable in densely populated areas lacking available land for conventional installations [42]. Since the state of the weather significantly influences the production of electricity obtained from photovoltaic and wind panels, the use of thermal generators is all the more needed in order to be able to compensate for the uncertainty and changeability [43]. Compared

to the energy obtained from biogas production, the energy obtained from solar and wind power is fluctuating, which causes imbalance between energy demand and supply [44].

Wind power

Wind power production is influenced by wind speed, which can sometimes cause fluctuations and implicitly result in problems concerning the efficient energy extraction [45]. At the same time, wind power is affected by climate change [46]. Wind power is a clean, cheap [47], feasible, and cost-effective source of energy [48]. It is further divided into two subtypes: onshore energy (it is used for limited spaces) and offshore energy [49]. The implementation of offshore energy projects in Japan has attracted heavy criticism from citizens. They argue that offshore energies can affect the landscape and marine ecosystems [50]. At the same time, wind power can affect birds through collision and displacement due to the movement [51]. Wind power and solar power are two renewable energy sources that complement each other (solar energy produces increases in flow fluctuations during the day, while wind power does so during the night) [52].

Biogas

Biogas can be obtained by treating organic waste (a process known as anaerobic digestion) [53]. In the process of anaerobic digestion, organic waste is decomposed with the help of bacteria, in the absence of oxygen [54]. The raw material needed in the biogas production process is represented by various organic substrates. For example: pig waste (consisting of faeces, urine, water and food waste) [55], food waste [56], crop straw [57], grass silos [58], municipal sewage [54]. This is beneficial to the environment, as the natural decomposition of organic waste can cause soil and water pollution [59].

Electricity, thermal energy, and green fuels (used for transport) can be obtained from biogas [60]. Following the biogas production process, biogas sludge results, which is an organic fertilizer rich in nutrients [61]. Unlike other sources of energy production, biogas production facilities can be built at various scales, ranging from small family facilities to industrial facilities [54]. Figure 4 depicts part of the advantages of renewable energy sources.

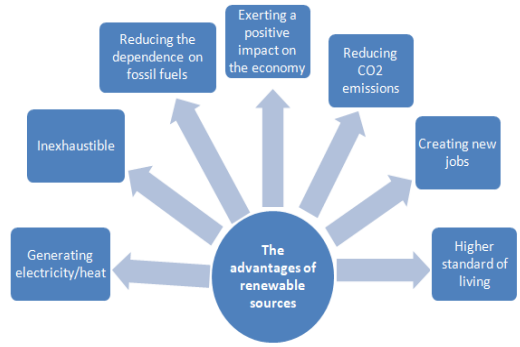

Figure 4. The advantages of renewable energy sources [3], [6], [11], [39], [60]

2. Responsible people and 'smart' buildings

Population growth has led to an "explosion" in the number of houses built. Thus, buildings make up for approximately 55% of the amount of electricity consumed worldwide [62]. The studies carried out have shown that the insulation of houses, heating-ventilation-air conditioning and lighting are critical factors when it comes to reducing CO2 [63]. Therefore, the construction sector is a

crucial field in terms of reaching the goals of net zero emissions by the middle of the century [64].

Aware of the fact that homes constitute high energy consumers, the EU established 2 directives: the directive on the energy performance of buildings 2013/31/EU, and the directive 2012/27/EU on energy efficiency. Based on these directives, the aim is to build energy efficient buildings by the year 2050 [65]. In countries like Switzerland, for example, the state has carried out promotion campaigns, implemented energy policy measures, and offered subsidies in order to support the construction of energy efficient buildings [66]. To reduce energy consumption, household consumers are advised to use energy-efficient appliances and tools [67].

Additional measures might point towards the insulation of buildings, as they have the ability to maintain the heat/ cold in the home. Replacing heating sources based on fossil fuels with air-water heat pumps offers the possibility of reducing CO2 emissions [69]. At the same time, photovoltaic and wind systems could be installed to ensure the energy independence of homes [70].

A ‘smart’ house improves the standard of living [71], ensures comfort [72] and provides information on energy costs [73]. At the same time, it has the ability to substantially reduce the amount of energy used [74] by automatically programming the components of the house, such as: fans, thermostats, lighting equipment [75]. The construction of a ‘smart’ house reduces the demand for electricity from the grid, relying to a larger extent on the use of renewable energy sources [76]. Aware of the many advantages that a ‘smart’ house can bring, many citizens are starting to favour this type of home [72]. This type of house is generally preferred by users with technical skills, since non-technical users face difficulties in understanding how they work [77]. As for the desire to build/purchase this type of house, studies have indicated that men are more receptive than women [78].

People's level of culture ‘weighs’ a lot when choosing the type of house. For example, the Japanese are more disciplined in terms of heating and lighting, with the durability of their home spanning up to 25 years. By contrast, the houses of English people are oftentimes indicative of an inefficient domestic heating system. This is due to their indifference towards modernization, but also to the desire to preserve old buildings [79].

Analyzing what has previously been discussed, we can say that the choice of the house type heavily depends on the technical training of the citizens, on the knowledge they have about renewable energy, as well as on the citizen's gender and culture.

3. Acceptable measures and solutions for the present and future

The first measure applicable to the near future could lie in the extraction of the Caragea deposit (estimated at approximately 30 billion cubic meters), as well as of the Neptun Deep perimeter (42-84 billion cubic meters) [80]. The development of the electric transport network between 2020 and 2029 [81].

Another measure is represented by massive investments, especially those aimed at environmental objectives. The use of coal for the transition to energy independence and green energy shall also be considered [82]. The ultimate

goal to be reached lies in protecting ordinary citizens and reducing energy poverty [83].

Civil society is expecting more and more energy prices reductions and availability at any moment. Nobody understands the high risks of no energy supply or the danger of lack of energy accessibility and supply. It is the role of the politicians and stakeholders to find bridges to communicate with the civilains and express rules and legislation for a safety availability at low prices. It is sure that technologies are developed and more and more offer solutions for the CO2 reduction in exhaust at the sources. But these technologies must reveal also a more simple and justified access and possibilities of implementation in real conditions. The delay between planning and implementation is a real gap that must be reduced.

4. Conclusions

Although renewable energy sources first emerged in the quest to replace fossil fuels and reduce CO2 emissions, they have ultimately become an option for ensuring energy security and independence. As a result, many countries have started making huge investments in these renewable energy sources. They were forced to invest in the development and creation of new transport routes, as well as in finding solutions to store energy from their own sources. At the same time, the studies have shown that the diversification of renewable energy sources strengthens security and energy independence, eliminates the uncertainty related to prices, reduces the risks of power outages and generates new jobs.

Among the most common sources of renewable energy, the following could be mentioned: wind power, solar energy, geothermal energy, hydropower and biogas. They bring many advantages such as generating electricity and heat (in the case of biogas, this also provides bio-compost), being inexhaustible, exerting a positive impact on the economy, and ensuring a high standard of living. Driven by the desire to ensure comfort and a higher standard of living, as well as to protect the environment, many people have modernized their old homes or purchased ‘smart’ homes.

Unfortunately, these investments are oftentimes made by wealthier people, with an above-average level of training, and who are familiar with new technologies. They also tend to respect and protect nature as much as they can, being aware that reducing CO2 emissions brings many benefits. As regards the future of renewable energy sources, it is worth noting that they are gaining more and more ground in front of fossil fuels. Notwithstanding, the transition from fossil fuels to renewable energies is to be undergone gradually.

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Mental Calculation as A Thinking Development Technique

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Abstract: Mental calculation has a special role in practical life. Its contribution to the development of children's mental faculties, attention, judgment, and discipline from a very early age is undeniable. At the same time, mental calculation develops the power to understand the spirit of initiative, insight. That is why it is said about mental calculation that it is the simplest form of the student's creative work. No less important is the fact that mental arithmetic develops concentration and reaction speed. Quick calculation procedures are special mental calculation procedures, which are based on particular arithmetical relationships that can be established between numbers. The following procedures are examined: rounding of numbers; the procedure based on commutativity and associativity properties of addition and multiplication; multiplication procedures by 5; division procedures by 5; the procedure of multiplying by 9; the method of multiplying by 11; the procedure of multiplying numbers ending in 5 by themselves, etc. These techniques develop cognitive and pragmatic learning skills, the participative, intercommunication spirit, getting children used to competitive situations, quick mental calculation, developing the ability to evaluate, self-evaluation, educating and training some physically and mentally healthy children. Mental computing develops cognitive abilities, especially memory, attention, judgment and speed of thought. From an educational point of view, mental calculation constitutes real gymnastics of the mind, of thinking. Mental calculation is one of the basic means of developing thinking. Making accurate and quick calculations, thinking, being subject to continuous effort, develops and disciplines itself. Also, through mental calculation insight is educated. Man is put in the position not only to perform calculations applying the learned procedures, but also to choose the most suitable calculation procedure for the given case, in order to find out the result more quickly and easily. It develops his power of understanding, initiative and keeps him in healthy mental shape.

Keywords: mathematical, method, mental, calculation, skill, trick
JEL classification: C020

1 Introduction

Mathematics is the discipline that, by its existence, has the purpose of forming research thinking. It is the most effective science, which has the most and most complex links of life. Therefore, a permanent preoccupation is required in the continuous improvement of the methods and means of education in order to achieve not a simple mathematical training, but mathematical education, with serious

implications in the development of the youth and his training as a useful person to the society of which he is a part during whole life.

Mental calculation has a special role in practical life. Its contribution to the development of children's and adults' mental faculties, attention, judgment, but also discipline from a fairly young age to old age is undeniable. At the same time, mental calculation develops the power to understand the spirit of initiative and insight. That is why mental calculation is said to be the simplest form of man's creative work. No less important is the fact that mental arithmetic develops concentration and reaction speed. Its use in the training process results in active students learning to focus on one thing, and passive students becoming more active and social.

Quick calculation procedures are special mental calculation procedures, which are based on particular arithmetical relationships that can be established between numbers. The famous Swiss psychologist J. Piaget proved one thing: mathematical thinking is nothing but a form of action [1]. "In some expression ($x^2+y=z-u$) each term indicates an action: the sign (=) expresses the possibility of a substitution, the sign (+) an addition, the sign (–) a separation, the square (x^2) the action of to reproduce the unit a certain number of times. Each of these symbols refers to an action that could be real, but which the mathematical language is content to demonstrate abstractly, in the form of internalized actions, that is, of thought operations".

Any action unfolds progressively over time. Mathematical thinking is subordinated to this lawfulness. However, there are cases of almost instantaneous, high precision solving of some extremely laborious mental calculations. History knows several documented cases of people who became professional calculators and who used specific techniques of rapid mental calculation [2].

Tom Fuller (1710-1790), an illiterate former slave, nicknamed "the Virginia calculator", at the age of 70 reduced a year and a half to seconds in about two minutes and 70 years, 17 days, 12 hours to seconds in about a minute and a half, correcting the result by his examiner, who disregarded leap years. Fuller was able to mentally multiply two numbers of 9 digits each.

Jedediah Buxton (1702-1772) remained illiterate all his life and was of below average intelligence, but he had a prodigious memory and could retain long numbers for days or even months, so that he performed enormous calculations, which in some cases occupied whole weeks. On one occasion he mentally squared a 39-digit number for 22 months. His methods were original, but very clumsy, more based on counting than multiplication [2].

Zerah Colburn (1804-1840), the son of a Vermont farmer, is considered one of the first professional calculators. In the spring of 1812, Zerah was taken by his father to London. Here, among other facts, he mentally found, by successive multiplication, the 16th power of 8 (= 281474 976710656) and the 10th powers of other single-digit numbers. Also, although with more difficulty, the 6th, 7th, and 8th powers of several 2-digit numbers. The square root of 106929 (= 327) and the cube root of 268336125 (= 645) were found "Before the original numbers could be written down". He immediately identified 36083 as a prime number and found "by the mere operation of his

mind" the factors, 641 and 6700417 of 4294967297 (=2^{82}+ 1) [2].

Henri Mondeux (1826-1862) was the son of a woodcutter near Tours. Sent to look after sheep at the age of 7, he amused himself by playing with pebbles and thus learned mental arithmetic. In 1840 Mondeux's mental calculation capabilities were exposed in a report to the Paris Academy of Sciences. In the commission's report of him we are told that he continues in his head not only the various arithmetical operations, but also, in many cases, the numerical solution of the equation. More precisely, he finds powers of numbers by rules of his own discovery which are equivalent to special cases of the binomial theorem; he worked out formulas for the sum of the squares, cubes, etc., of the natural numbers, and for arithmetical progression and other series; he solves simultaneous linear equations by a method of his own, and sometimes higher degree equations, especially where the root is a positive integer; and he solves such problems of indeterminate analysis as finding two squares whose difference is a given number. He knows almost by heart the squares of all integers under 100. Learning a 24-digit number divided into four 6-digit periods takes 5 minutes. He can solve a problem while attending to other things [2].

Closer to the present day, Maurice Dogbert mentally performed cube root extractions of the 5th or 7th order with astonishing speed, surpassing the electronic calculator. Chinese mathematician Shi Fengshou, in public demonstrations, correctly multiplied two numbers by 10 digits faster than an electronic calculator. Shi Fengshou mentally performed exercises of the type: 48 241 · 35 482 = 1 7111 687 162 or 569 773: 832 = 684.77524 [3].

Another Chinese national, Shen Kegon, mentally calculated the square number 1455 in 0.6 seconds; in 3.4 seconds he found out the exact result of the exercise 639·33 + radical 884 736. In 20 seconds, he calculated that 625 to the power of 9 makes 14 551 915 228 366 851 806 604 625. Out of a total of 600 calculation problems, Shen Kegon solved 400 exercises faster than an electronic calculator [3].

2 Fast mental calculation methods

Such cases aroused not only the curiosity of the public, but also the interest of scientists who, studying the thinking of people with exceptional abilities of mental calculation, hoped to find out new ways of raising the performance of human thinking. The following tricks will make math easier.

2.1 The percentage of a number

To calculate the percentage of a number, divide each of the numbers by 10, then multiply the results between them. For example – 60% of 500, each is divided by 10, obtaining 6 and 50, after which the obtained numbers are multiplied and 300 is obtained.

2.2 Multiplying by 5

The given number is divided by 2. If the result is an integer, 0 is added to the tail. If the result is with a decimal point, the decimals are ignored and 5 is just added to the tail.

That is, when multiplying 5887·5, 5887/2 will be calculated and 0 or 5 will be added.

2.3 Multiplying by 9

The result of multiplying by 9 consists of two digits. The first column is in ascending order from 0 to 9, and the second is in reverse from 9 to 0.

Product	Result
9x1	9
9x2	18
9x3	27
9x4	36
9x5	45
9x6	54
9x7	63
9x8	72
9x9	81
9x10	90

Table 1. Multiplying by 9

2.4 Multiplying by 11

Let's examine an example of multiplication: 45·11. In this case, the digits 4 and 5 of the number 45 can be separated spatially, and the sum of these digits will be entered in the space formed, i.e., 9 (4+5). The final result will be 495, i.e., 45·11=495.

This rule works if the sum of the two digits is up to and including 9.

Another method of calculation: the number is multiplied by 10 and the given number is added to the obtained result once more. For example, 45·11=45·10+45=450+45=495

2.5 Multiplying by 4

The trick is to multiply the number by 2, then again by 2. For example, 53·4 will be calculated as

53·4= (53·2)+(53·2)=116+116 = 232

2.6 Dividing by 5

In this case, all you have to do is multiply the number by 2, and then move the decimal point to the left.

Example: we need to divide the number 123 by 5. First the number 123 is multiplied by 2 and 246 is obtained, and in the second step the point after the decimal point is moved to the left and the final result is 24.6. Keep in mind, however, that there may be exceptions to the rule where the tricks above don't apply.

2.7 Rise to power

Using simple shorthand formulas, we can perform quick mental calculations. Applying this quick calculation method, here is how one might mentally calculate, for example, the square of the number 988:

$$988^2 - 12^2 + 12^2 = (988 + 12)(988 - 12) + 144 = 1000 \cdot 976 + 144 = 976000 + 144 = 976144$$

Similar:

$$27^2 - 3^2 + 3^2 = (27 + 3)(27 - 3) + 9 = 30 \cdot 24 + 9 = 720 + 9 = 729$$

Or:

$$104^2 - 4^2 + 4^2 = (104 + 4)(104 - 4) + 16 = 108 \cdot 100 + 16 = 10800 + 16 = 10816$$

Applying this quick calculation method, here is how one might mentally calculate, for example, the product of the numbers 986 and 997:

$$986 \cdot 997 = (1000 - 14)(1000 - 3) = 1000 \cdot 1000 - 3 \cdot 1000 - 14 \cdot 1000 + 14 \cdot 3 = 1000(1000 - 3 - 14) + 14 \cdot 3 = 1000 \cdot 983 + 42 = 983042$$

There is a simple and automatic method to get the square of a two-digit number whose last digit is 5. Here's how:

• the last two digits of such a square are 25;

• the first digit(s) of this square is obtained by performing the product of the first digit of the number that is squared and the number that

follows it in the set of natural numbers.

For example, the square of 65 is a number whose last two digits are 25 and whose first digits are obtained by performing the product of 6 and 7:

$$6 \cdot 7 = 42, \quad \text{mean} \quad 65^2 = 4225$$

Similar:

$$35^2 = \overline{(3 \cdot 4)25} = 1225$$

Or:

$$95^2 = \overline{(9 \cdot 10)25} = 9025$$

The method can be extended to larger numbers (of 3, 4 or more digits), provided that the product of the number formed by the first digits of the number (less than 5) and its successor is easy to calculate in the mind.

E.g.:

$$105^2 = \overline{(10 \cdot 11)25} = 11025$$

$$115^2 = \overline{(11 \cdot 12)25} = 13225$$

The table below shows the squares of two-digit numbers with the last digit equal to 5 and of some three-digit numbers with the last digit equal to 5, for which the above trick can be easily applied:

Number	Trick	Square of number
15	(1·2)25	225
25	(2·3)25	625
35	(3·4)25	1225
45	(4·5)25	2025
55	(5·6)25	3025
65	(6·7)25	4225
75	(7·8)25	5625
85	(8·9)25	7225
95	(9·10)25	9025
105	(10·11)25	11025
115	(11·12)25	13225
195	(19·20)25	38025
1005	(100·101)25	1010025

Table 2. Squares of numbers with the last digit 5

Application models for calculating the square root:

$$\sqrt{5625} = 75 \text{ or } \sqrt{42{,}25} = 6{,}5$$

When removing the factor from under the radical

$$\sqrt{675} = \sqrt{225 \cdot 3} = \sqrt{225} \cdot \sqrt{3} = 15\sqrt{3}$$

Another example of fast calculation is that of Gauss. It refers to the addition of numbers from one to one hundred. The calculation formula for the sum of the first N natural numbers is:

$$1 + 2 + 3 + 4 + \cdots + N = \frac{N(N+1)}{2} \qquad (1)$$

If there are exercises of the type:

2 + 4 + 6 + 8 + … + 100 – common factor 2 is given and formula (1) is applied.

If there are exercises of the type:

3 + 6 + 9 + 12 + … + 2022 – common factor 3 is given and formula (1) is applied again.

2.8 Other math tricks

$$9 \cdot 9 + 7 = 88$$
$$98 \cdot 9 + 6 = 888$$
$$987 \cdot 9 + 5 = 8888$$
$$9876 \cdot 9 + 4 = 88888$$
$$98765 \cdot 9 + 3 = 888888$$
$$987654 \cdot 9 + 2 = 8888888$$
$$9876543 \cdot 9 + 1 = 88888888$$
$$98765432 \cdot 9 + 0 = 888888888$$

$$1 \cdot 8 + 1 = 9$$

$$12 \cdot 8 + 2 = 98$$
$$123 \cdot 8 + 3 = 987$$
$$1234 \cdot 8 + 4 = 9876$$
$$12345 \cdot 8 + 5 = 98765$$
$$123456 \cdot 8 + 6 = 987654$$
$$1234567 \cdot 8 + 7 = 9876543$$
$$12345678 \cdot 8 + 8 = 98765432$$
$$123456789 \cdot 8 + 9 = 987654321$$

$$1 \cdot 9 + 2 = 11$$
$$12 \cdot 9 + 3 = 111$$
$$123 \cdot 9 + 4 = 1111$$
$$1234 \cdot 9 + 5 = 11111$$
$$12345 \cdot 9 + 6 = 111111$$
$$123456 \cdot 9 + 7 = 1111111$$
$$1234567 \cdot 9 + 8 = 11111111$$
$$12345678 \cdot 9 + 9 = 111111111$$
$$123456789 \cdot 9 + 10 = 1111111111$$

$$1 \cdot 1 = 1$$
$$11 \cdot 11 = 121$$
$$111 \cdot 111 = 12321$$
$$1111 \cdot 1111 = 1234321$$
$$11111 \cdot 11111 = 123454321$$
$$111111 \cdot 111111 = 12345654321$$
$$1111111 \cdot 1111111 = 1234567654321$$
$$11111111 \cdot 11111111 = 123456787654321$$
$$111111111 \cdot 111111111 = 12345678987654321$$

3 Conclusion

Armed with the techniques of rapid mathematical calculation, the student at the lessons of mathematics, physics or chemistry has the satisfaction that his activity is important, in this way he also has an increased motivation for self-training.

At the same time, fast calculation techniques are applied to school competitions. These techniques develop cognitive and pragmatic skills of learning, the spirit of participation, intercommunication, the habituation of students to competitive situations, rapid mental calculation, the development of the ability to evaluate, self-evaluation, the education and training of physically and mentally healthy people (*mens sana in corpore sano*).

At the same time, it should be noted that daily mental calculation exercises bring benefits throughout a person's entire life. Mental computing develops human cognitive capacities, especially memory, attention, judgment and speed of thought throughout life. From an educational point of view, mental calculation constitutes real gymnastics of the mind, of thinking. Mental calculation is one of the basic means of developing thinking. Performing accurate and rapid calculations, human thinking, being subjected to continuous effort, develops and disciplines itself. Also, through mental calculation insight is educated. Man is put in the position not only to perform calculations applying the learned procedures, but also to choose the most suitable calculation procedure for the given case, in order to find out the result more quickly and easily. This develops his power of understanding, the spirit of initiative.

In 2019, an international team of researchers published a relevant study in this regard in *The Journal of the American Medical Association* [4]. The research included 196,383 participants over the age of 60 who were not diagnosed with dementia at the time. They

followed for eight years. During this time, data related to their health, physical activity, diet and alcohol consumption were collected. Following the study, the researchers found that a healthy lifestyle was associated with a lower risk of dementia among the participants, regardless of whether or not there was a genetic predisposition to Alzheimer's disease, dementias and other related diseases. Logical games, which put your mind to work, such as chess, puzzles or strategy games, are extremely beneficial for the brain.

In addition to adopting a healthy lifestyle, which includes, among other things, a balanced diet and regular exercise, one can keep the mind sharp with exercises that train the brain. Experts recommend that brain training involves activities anchored in the real world. Exercises to strengthen cognitive function should represent, every time, a novelty and a challenge for the mind.

Try to do simple calculations in your mind. Avoid using a computer or pencil and paper. You can practice multiplication or division, you can calculate the remainder you need to receive at the store from the purchases you made, or the percentage of blue clothes in your wardrobe. Anything that surrounds you can turn into a simple and effective calculation. You can add multiplication, division and subtraction.

Solve crosswords, puzzles, logic problems, read books. These methods, at first glance, do not contribute to the development of memory, but you will be surprised at how quickly your mental activity is activated.

Can't remember an actor's name? Don't know where a particular mountain peak is? Indeed, Google can give you the answer in an instant. It also fuels a modern condition called digital amnesia, which is forgetting information because you trust a device that has the ability to remember it. This is also why most of us cannot call our children, friends or colleagues without using our phone's contact list.

Learning helps keep the brain in good shape and reduces the risk of developing Alzheimer's disease. It is not necessary to learn foreign languages or obtain other higher education. The process itself is important: read professional literature to develop skills. Go to cooking classes. Read non-fiction and fiction books. Learn new knitting patterns or make original crafts. The main rule is to strive for the new.

The brain's ability to resist neurological damage caused by aging and other factors can be maintained or even improved through physical and cognitive exercise. Just as weight training is practiced to increase muscle mass, regular, brain-directed exercise can increase cognitive reserve.

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Innovative, Psychological and Energetic Medicine in Consciousness Society

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Abstract: The aim of this work is to establish the influence of various methods of modern psychological therapy on the process of integrating the elderly population into modern society, developing strategies or applying various medical practices to maintain the psycho-emotional state of the elderly population, as well as stimulating the younger generation to a more responsible attitude to the problems of the demographic gap among the population.
This article discusses the advantages and disadvantages of various strategies for maintaining a stable psycho-emotional state of older people and ensuring their full integration into the rhythm of the life of modern society, as well as the consequences and detrimental effects on psychophysical health of isolation from civil and social life of a certain category of the older population.
On the basis of information and analysis, we can conclude that with the help of certain methods of traditional and non-traditional medical therapy, it is possible to maintain a stable psycho-emotional state of the elderly population - this is a problem that has been actively covered and studied by specialists in recent years.
Keywords: modern psychological therapy, education of older people, demographic gap, light medicine, yoga, acupuncture, breathing exercises.

1 Introduction

It is generally agreed that older people, defined as those aged 65 years and above, can exhibit a wide range of characteristics that may be influenced by a number of factors, including genetics, environment, lifestyle, and medical history. Some of the common characteristics of older people include:

Decline in physical abilities: Many older people may experience a decline in physical abilities, such as reduced strength, flexibility, and balance, which can affect their ability to perform everyday tasks. Increased risk of chronic health conditions: older people are more likely to develop chronic health conditions, such as diabetes, arthritis, and heart disease, which can affect their quality of life and increase their healthcare needs.

Cognitive changes: Some older people may experience cognitive changes, such as slower processing speed, difficulty with memory, and decreased attention span, although these changes are not necessarily indicative of dementia or other cognitive disorders.

Increased emotional resilience: Many older people have developed emotional resilience over their lifetime, which can help them cope with stressful situations and maintain a positive outlook on life. Increased wisdom and life experience: older people often have a wealth of

life experience and knowledge that can be invaluable to their families, communities, and society as a whole.

Social isolation: Many older people may experience social isolation or loneliness, especially if they have lost friends or family members or have limited mobility.

Diverse needs and interests: older people are a diverse group with a wide range of needs, interests, and preferences, and it is important to recognize and respect these differences when providing care or support.

2 The main characteristics of the old age period

If we can agree with the cultural, political and other aspects of the social development of people, as well as the development of compensatory mechanisms in them up to a very old age, then in relation to the development of most physiological, psychophysiological and many mental functions, there are age restrictions associated with periods of maturity and especially aging [1]. Overall, while older people may experience some physical and cognitive changes, they are also likely to have developed emotional resilience and wisdom over their lifetime, and they continue to have diverse needs, interests, and contributions to make to society.

A feature of the experiences of older people is the approach of death, which, despite its inevitability, most people are afraid of and seek to push back the date of its onset. [2] That is why the experience of aging depends not only on the individual, but also on the people around them. It is important to highlight that older people may experience more negative than positive aspects of life and may have an unstable mood and feelings of anxiety and anger if they don't receive enough attention. Moreover, any disrespect or lack of attention can lead to psychological trauma for older people.

Furthermore, the different age groups have different values, and suggests that relatives and friends should be aware of these differences when interacting with older people. This can help to avoid misunderstandings and promote better communication and relationships between different generations.

So, it is important to treat older people with respect and attention and recognize the unique needs and values of this demographic group. By providing appropriate support and understanding, it is possible to improve the quality of life for older people and promote positive aging.

The fast changes in the character of an elderly person can be attributed to a lack of control over their own reactions. As a result, emotions that were previously managed to be masked can suddenly come to the surface. Additionally, this age is characterized by egocentrism, intolerance, and impatience towards anyone who does not show proper attention. Furthermore, the characteristics of this age can be divided into three areas: intellectual, emotional, and moral. In the intellectual sphere, there may be difficulties in acquiring new knowledge and ideas and adapting to unforeseen circumstances. In the emotional sphere, there may be a tendency towards unreasonable sadness and easily appearing tearfulness. In the moral sphere, older people may refuse to adapt to new norms of morality and manners of behavior and may even criticize widely accepted norms and

manners. The duty of others is to help the elderly person feel like a fully integrated member of society, and to prevent them from feeling useless and lonely. By providing support and attention to older people, it is possible to help them navigate the challenges of aging and maintain their overall well-being.

3 Social innovations to support the well-being of the elderly

Let's mention some tips that help the older generations in maintaining their psychological health and to stronger their connections with the social life.

In addition to the universities of the third age, social tourism can also be a great way to increase socialization and decrease stress for older generations. Social tourism involves organizing trips and vacations specifically for older people, often with the aim of promoting socialization and community building. These trips can include cultural and educational activities, as well as opportunities for physical activity and relaxation.

Computer literacy training is another important tool for older generations to maintain their psychological health and stay connected with the world. With the increasing importance of technology in our daily lives, being able to use computers and other digital devices is essential for staying connected with loved ones, accessing information, and participating in society. Many organizations offer computer literacy courses specifically tailored to older learners, often at low or no cost.

The Active Longevity Center is another resource that can be helpful for older generations. This type of center is designed to promote healthy aging and provide support for older people. Services provided can include exercise programs, health screenings, counseling, and social events. The goal of these centers is to help older people maintain their physical and mental health, stay connected with their communities, and enjoy their later years to the fullest.

Overall, there are many different resources and strategies that can be helpful for older generations to maintain their psychological health and stay connected with their communities. By taking advantage of these opportunities, older people can lead fulfilling and meaningful lives as they age.

For example, French "universities" are based on the fact that teaching is conducted by professors and the best students of scientific and educational institutions. In the UK, the same form of organizing "universities" is radically different: teaching is conducted in a relaxed, club atmosphere, teachers are among the most competent, active and educated representatives of the "third age", who share their life experience with others. In fact, this is self-organization and self-learning. The British model has been adopted in Australia, the Dominican Republic, New Zealand, and South Africa. And in France, Spain and Italy they are guided by the exchange of experience between specialists.

This is a great overview of the goals and structure of Universities of the Third Age. It's important to note that these universities are not traditional academic institutions, but rather they provide a space for older individuals to continue learning and growing, while also fostering social connections and preventing isolation. The fact that the education is structured around the interests of the students

and taught by qualified professionals is an excellent approach to adult learning. It allows the students to pursue their passions and develop new skills that they can apply to their daily lives. The emphasis on application and practical use of the knowledge gained is also important, as it reinforces the value of the learning experience and encourages continued engagement in the program.

The main criteria for the success of teaching older people are the interest shown in the classes and the application of the acquired knowledge, skills and abilities in life. As it is shown in the graph [3] the main part of older people does not have enough confidence to use modern technologies.

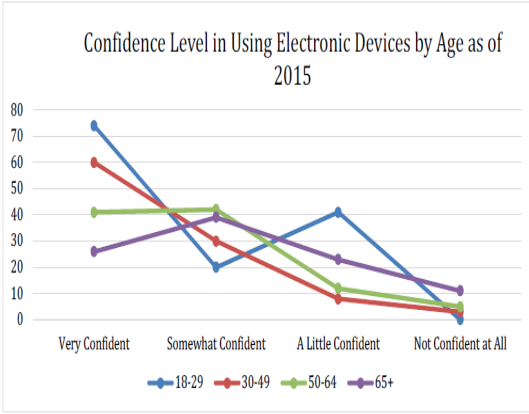

Figure 1. Older adults' education level and adoption and use of technologies. Source: [3]

The results of social work with the elderly and disabled within the framework of the university's activities are any successes of "students": cases of employment as a result of obtaining the knowledge necessary for a new job; well-formed computer skills, the ability to use digital technology; observed progress in the physical and emotional state of older people (a more active lifestyle, improved well-being, mood, etc.). Special training allows you to form the skills and abilities necessary for new activities, even in old age. This training is based on the concept of lifelong education, based on the fact that learning is a normal and necessary activity for a person in all periods of his life.

4 The impact of body energetic practices for older generation

Another utterly effective way of maintaining psych emotional health of older generations are psycho energetics practices as a separate branch of science. These systems were a unique way of transforming the body, creating physical and psychological opportunities for the harmonious development of the individual, in particular in old age.

These are, for example, such well-known Eastern systems as yoga, Chan Buddhism, meditations, acupuncture etc. Analysis of the most ancient concepts shows that most of the techniques divide the human body on:

The physical body is the tangible, material aspect of the human body that can be studied using various traditional methods such as anatomy, physiology, and medicine.

The concept of the "energy body" or "etheric body" is often associated with various forms of alternative medicine and spirituality. According to this concept, the human body is not just a physical entity, but also has an energetic component that is closely related to the physical body. This energy body is believed to have its own structure, including energy centers known as chakras and energy channels or meridians, which are said to be responsible for the flow of vital energy, or "prana", throughout the body.

Proponents of this concept believe that disruptions or blockages in the energy flow can lead to physical or emotional problems and that various techniques such as acupuncture, Reiki, or qigong can help to restore balance and harmony in the energy body, thus promoting overall health and well-being. However, the existence and nature of the energy body is still a subject of debate and skepticism in mainstream scientific circles, as there is no scientific evidence to support its existence or its role in health and disease.

The concept of the "astral" or "emotional" body is commonly associated with certain belief systems and spiritual practices. It is said to be a subtle body that is composed of more refined energies than the physical and energy bodies. Some people believe that this body is responsible for our emotions, feelings, and desires, and that it exists beyond the physical body. There are different theories about the extent and properties of the astral body. Some suggest that it extends beyond the physical body by a distance of 30 to 60 cm, while others propose that it can expand to cover a wider range. It is believed to contain various energy centers or chakras, which correspond to different emotions and functions in the body.

The idea of a "mental" or "spiritual" body is often associated with spiritual or esoteric traditions, such as yoga, qigong, and various forms of meditation. According to these traditions, the mental body is the most subtle and refined aspect of the human being and is sometimes referred to as the "causal body" or the "soul". It is said to be the source of consciousness, thought, and intention, and to exist beyond the limitations of time and space. What is more, group classes, communication with colleagues helps older people tune in to a positive attitude and prepare for a new period in their lives.

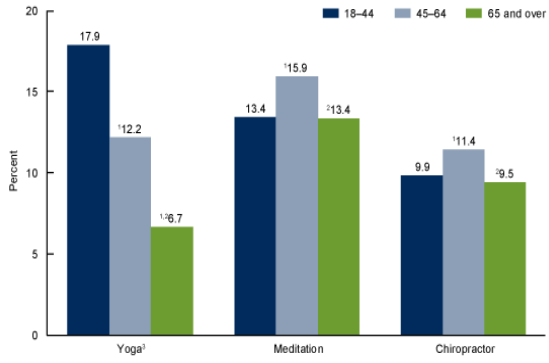

Figure 2. Percentage of adults who used yoga, meditation, or a chiropractor during the past 12 months, by age: United States, 2017. Source: [4]

Yoga can be very beneficial for older people as it can help improve their physical and mental well-being, but unfortunately, the graph [4] illustrates that the percentage of older people practicing this type of oriental practices is relatively small despite all the positive effects that will be described below.

Here are some ways that yoga can be helpful:

- Improving flexibility and balance: As we age, our flexibility and balance can decline, which can increase the risk of falls and injuries. Yoga can help improve flexibility and balance, which can help older people maintain their independence and reduce the risk of falls.
- Reducing stress and anxiety: Yoga can be a great way to reduce stress and anxiety, which can be especially important for older people who may be dealing with health issues or other life stressors. Improving cardiovascular health: Some types of yoga, such as vinyasa or power yoga, can be quite vigorous and can help

improve cardiovascular health, which can be important for older people who want to maintain their overall health and fitness.

- Enhancing cognitive function: There is some evidence to suggest that yoga may help improve cognitive function in older adults, including memory and attention span.
- Managing chronic conditions: Yoga can be helpful for managing a variety of chronic conditions, including arthritis, osteoporosis, and chronic pain. It can also help improve the overall quality of life for older people with these conditions.

Overall, yoga can be a safe and effective way for older people to improve their physical and mental well-being. As with any exercise program, it's important to consult with a healthcare professional before starting yoga practice to ensure that it's safe and appropriate for your individual needs and abilities.

Speaking about breathing exercises helps to cope with stress, as proper even breathing allows you to focus on yourself and your feelings, counting the time, controlling your breaths, a person moves away from external damages and negative thoughts. As a result, the body relaxes, the emotional background of a person becomes stable.

This is especially beneficial for older people with diseases of the respiratory system, such as bronchial asthma. With regular exercise, the elderly can more easily cope with coughing fits. It is also beneficial in the fight against insomnia, since in the process of doing exercises, the body receives more oxygen and brain cells begin to function better. After the first practice, you can feel relaxation and a fall asleep faster. If you perform exercises before going to bed, then breathing will become correct, the body will relax and tune in to rest.

Breathing exercises restore oxygen balance, strengthen the muscles of the abdominal cavity and have a beneficial effect on the entire body.

Acupuncture (acupuncture, acupuncture, reflexology) is a method based on the impact on the body by pricking with needles, heating, pressing (acupressure) on special zones, points. It affects the functioning of organs, improves their functions, harmonizes neuropsychiatric disorders, has an analgesic, balances the hormonal and immune status.

Under the influence of acupuncture, inflammatory diseases, pain syndromes, organ dysfunctions are perfectly treated, the body is harmonized at all levels from the psyche to the organ system. Thus, a very wide range of diseases can be treated with acupuncture. A method that does not damage the body but is designed to restore and heal. Allows you to treat a patient without the use of chemicals, safe from the point of view of allergic reactions - in the elderly. Often the method is effective where official medicine is powerless.

5 Conclusions

To sum up, unfortunately, aging is a natural process occurring in the human body. It's important for older people to consult with their healthcare provider before beginning any new exercise routine to ensure it's safe and appropriate for their individual needs. Thanks to timely treatment, the use of psychological and physiological methods of maintaining health, a person can remain healthy and lead a full life even in old age.

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Patient And Public Involvement in Research: Implementation Project

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Abstract: Purpose: Citizen-centered care is a best practice that should form the basis of health disciplines. As a dynamic and complex process, health research and innovation should address citizens' needs using the patient and public involvement (PPI) approach. Researchers should have the necessary research skills and ecosystems to implement PPI at different stages of the research cycle. This project aims to support the implementation of PPI in the Health Sciences Research Unit: Nursing (UICISA: E) based at the Nursing School of Coimbra, Portugal.
Design/methodology/approach: It is divided into three pillars. Pillar 1 involves identifying the needs, including training needs for researchers and citizens, and structural conditions to develop research at UICISA: E. Pillar 2 involves co-creating and co-implementing training and change-facilitating solutions, identifying obstacles that hinder change, identifying and implementing strategies to overcome them, fostering awareness, and engaging stakeholders. Finally, Pillar 3 involves monitoring the impact of change and implementing solutions to ensure sustainability.
Findings: This project is making progress towards promoting PPI at UICISA: E through the interaction of different stakeholders, including managers, researchers, senior technicians, and citizens. We have identified the needs of all stakeholders, including training needs, and the structural conditions necessary to develop research. Several initiatives have been launched to increase awareness among citizens and researchers and bring them together, such as social science festivals and public events. We are currently co-defining methodological protocols for PPI in primary and secondary research and creating a pool of volunteer citizens to participate in projects. We are also co-writing and co-validating publications to disseminate evidence.
Research limitations/implications: We have identified some obstacles to change and are overcoming them with the engagement of all stakeholders through communication strategies and constructive feedback.
Practical implications: This project has contributed to expanding PPI best practices for the development of research at UICISA: E.
Originality/Value: PPI in research is essential for innovative and citizen-centered care.
Keywords: Citizen-centered care; Nursing research Patient and public involvement.

Introduction

Scientific research and technological development (R&D) activities should generate knowledge and products that are relevant to society. In health research, patient and public involvement (PPI) at different stages of the research cycle is a crucial approach for creating citizen-centered products and services that meet citizens' needs. On the other hand, well-defined communication and dissemination strategies are essential to the success of citizen science projects.

Several terminologies have been used in the literature for PPI, such as *participatory research*, *collaborative research*, *citizen engagement*, *citizen participation*, *community engagement*, *consumer involvement*, *public adviser*, *public involvement*, and *volunteered geographic information* (Aristeidou, Scanlon, & Sharples, 2017; Haklay, 2013; South et al., 2016), which is a major barrier to its implementation. Despite these different terminologies, PPI is broadly understood as the direct involvement of citizens in at least one stage of the R&D project life cycle (South et al., 2016).

In health research, PPI is defined as research carried out 'with' or 'by' citizens rather than 'about' or 'for' citizens. Therefore, it is a key action for the development of responsible research and innovation, bringing together multiple actors (citizens and other stakeholders) who do not usually interact with each other. These stakeholders are individuals, organizations, or communities with a direct or indirect interest in the project outcomes, namely researchers, citizens, policymakers, civil society and industry organizations, non-governmental organizations, and political influencers (Boaz, Hanney, Borst, O'Shea, & Kok, 2018; Deverka et al., 2012; European Commission Directorate-General for & Innovation, 2008).

Thus, involvement in the design and development of R&D projects promotes dialogue and enables participatory exchanges, leading to the co-design, co-production, and co-validation of research results.

Universities and research units also have the social responsibility to produce relevant knowledge, make it available in a readily consumable and user-friendly format, and transfer it to the community (Silva, Cardoso, Cardoso, Sá, & Apóstolo, 2021). By providing the best knowledge and products to end-users (citizens and health professionals) and policymakers, universities and research units enhance evidence-informed decision-making in health at individual, collective, or political levels. Therefore, the methods for disseminating knowledge to the community should be better planned and monitored. Outreach to Society is a complementary phase to the production of knowledge, products, or services that aims to increase citizen empowerment, literacy, and capacity building. Outreach activities should be assessed regarding their impact on the community, the methodologies used, the science communication strategies, and the best products/knowledge made available to society (Perkmann, Salandra, Tartari, McKelvey, & Hughes, 2021; Tembo et al., 2021).

Several international initiatives have been undertaken to increase researchers' awareness of citizen science and citizens' potential to develop research to meet their needs and those of their communities. These initiatives have

created a widespread consensus that PPI is a crucial element in scientific research in any area of knowledge, such as the exact, natural, or social sciences, within universities or research units, and even in the business sector (Bonney et al., 2009; Vale, Thompson, Murphy, Forcat, & Hanley, 2012). These initiatives have been developed, for example by the Health Research Authority (HRA), National Institute for Health Research (NIHR), in the United Kingdom, as well as other international entities such as the National Institutes of Health Director's Council of Public Representatives in the United States of America and the Cochrane Consumer Network (Ahmed & Palermo, 2010; Hanley, Associates, Humphreys, & Stewart, 2017).

Studies indicate that citizens should be involved in the research cycle from priority setting to the dissemination of results, maximizing their contributions. To this end, researchers' work methods in their universities or research units should be restructured and reorganized to enable citizens and researchers to establish a close partnership as they are part of the same work team. Consequently, these citizens will also require training and capacity building for these processes (South et al., 2016; Ward et al., 2020).

PPI is believed to be the next step towards more citizen-centered and meaningful research for societies. There are many arguments supporting citizen involvement in research units/universities, namely the quality of the research produced; the increased likelihood of research success/product creation; and the sense of responsibility and democracy, especially in research conducted with public funding (Bonney et al., 2009; European Commission Directorate-General for & Innovation, 2008; Lakomý et al., 2020; Marschalek, 2017; South et al., 2016). For these reasons, funding bodies are increasingly encouraging PPI in research. However, the literature also mentions challenges related to the feasibility of citizen science, such as a possible collision of values due to clinical and economic vs. social and political issues. If, on the one hand, a range of arguments foster citizen science and PPI, other data warns of possible challenges that should be further explored (Abelson et al., 2016). In addition, the plurality of terms and concepts make it difficult to implement PPI and, consequently, extend or transfer knowledge to society (Pizzo, Doyle, Matthews, & Barlow, 2015).

Given the insufficient knowledge about this topic, the best strategies for implementing PPI should be explored in quantitative, qualitative, and secondary research, such as systematic reviews. Therefore, we expect to extend to society the best knowledge/products produced by the Health Sciences Research Unit (UICISA: E) based at the Nursing School of Coimbra through the implementation of PPI strategies, the training of researchers and citizens, and the creation of specific procedures and structures.

Aware of these challenges, the strategic axis of PPI and Outreach to Society of UICISA: E has developed a set of initiatives, including participation and organization of events, publication of articles, awareness-raising activities for researchers, and dissemination of the best knowledge to citizens. However, research on citizen science, namely on PPI and Outreach to Society, is necessary to gain a deeper understanding of these topics and

explore how to implement, monitor, develop, and innovate this type of science.

Thus, the major purpose of this project is to produce sufficient knowledge to establish a Citizens and End-Users Center at UICISA: E. As specific objectives, this project aims:

1) To conduct research on citizen science;

2) To establish processes and protocols to create a Citizen and End-Users Center at UICISA: E (e.g., establishing inclusion criteria for a citizen/end-user pool, defining recruitment processes, workflows, etc.);

3) To design and implement a protocol for PPI in research projects;

4) To assess the impact of PPI in the processes and outcomes of UICISA: E projects;

5) To implement protocols for the dissemination of the best knowledge, products, and services to society;

6) To assess the impact of the dissemination of knowledge, products, and services produced at UICISA: E on its processes and outcomes;

7) To explore the ethical and legal issues of citizen science.

Design:

This project for the implementation of PPI at UICISA: E is divided into three pillars. Each pillar includes several tasks: some have already been completed, others are underway, and others have not yet been initiated. Figure 1 shows a synthesis of the three pillars.

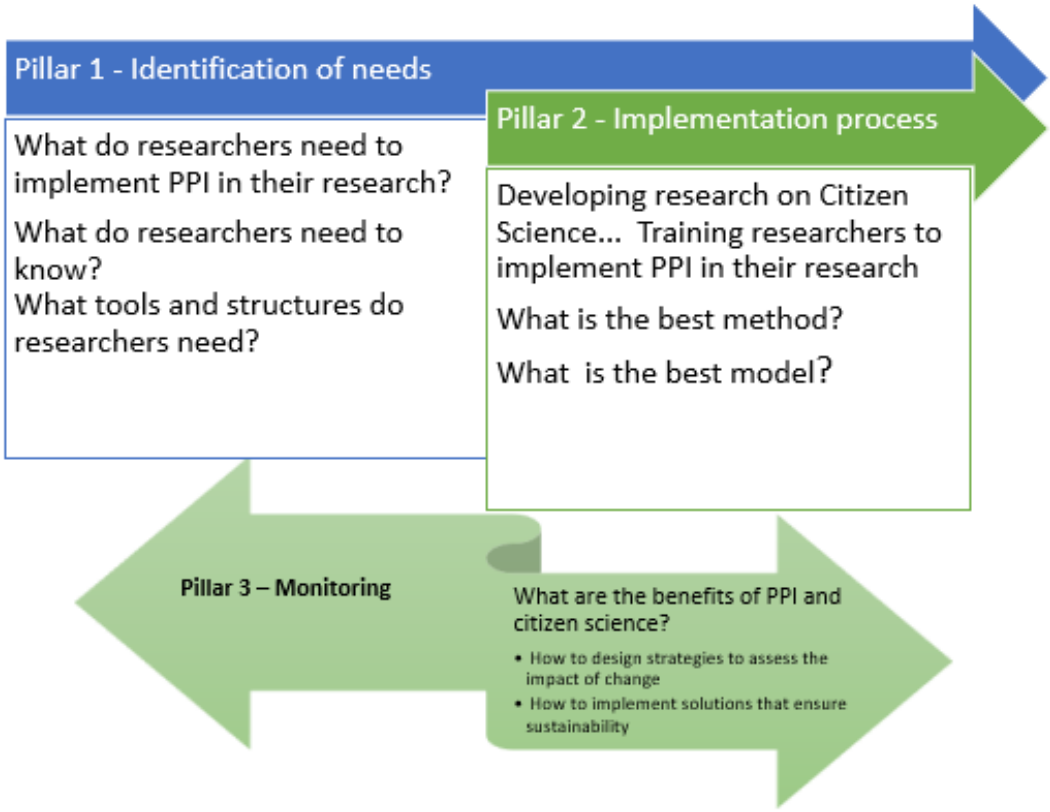

Figure 1 - Synthesis of Pillars 1, 2, and 3.

Pillar 1 involves identifying needs, including training needs for researchers and citizens, and structural conditions. Pillar 2 involves co-creating and co-implementing training and change-facilitating solutions, identifying obstacles that hinder change, identifying and implementing strategies to overcome them, fostering awareness, and engaging stakeholders. Finally, Pillar 2 involves monitoring the impact of change and implementing solutions to ensure sustainability.

Pillar 1: Identification of needs

Identifying communication needs and disseminating scientific knowledge are essential aspects of the research cycle. Communicating scientific information to lay citizens is crucial to disseminate knowledge and increase their scientific literacy. This step, for example, aims to identify strategies to communicate science to lay citizens used by international research organizations engaged in citizen science activities.

An exploratory-descriptive study was conducted to identify strategies to communicate science to lay citizens used by international research organizations engaged in citizen science activities. The sample includes the websites of international scientific organizations with relevant work in citizen science, namely activities, initiatives, or research projects to communicate science to lay citizens.

We obtained data from these websites and compiled a text corpus. We used Bardin's content analysis technique, consisting of three phases: pre-analysis, exploration of the material and treatment of the results, and inference and interpretation. We built word clouds to represent each category using the Tagul Cloud online word cloud generator, facilitating the analysis and presentation of results.

Another task is the identification of tools and strategies, such as frameworks (e.g., citizen scholarships, restructuring of the axis website, creating networks with patient associations/representatives) to implement PPI in primary and secondary research processes. We are conducting an exploratory-descriptive study with a qualitative approach and snowball sampling. Participants are lay citizens who expressed their interest in participating in the project.

Initially, we contacted senior universities, patient associations, and community care units in Coimbra, Portugal, to present the project and invite them to participate. The first participants invited other citizens from their network of friends and relatives within or outside the institutions. Interviews are being conducted with participants to explore their perceptions of and involvement in research processes, using questions such as: What is a research project? What is science? What is the role of researchers, and what do they do? What is a citizen researcher? What is their contribution/role in knowledge production? How can citizens have an active involvement in research processes? What are their needs as consumers of scientific knowledge? How are results communicated to lay citizens?

In addition, we are using the Free Word Association Technique. Research team members are asking citizens to write down five words that come to their mind when they hear the word 'science'. Citizens should respect word order rules. We are repeating this process

with the following words ‘scientist’ and ‘citizen involvement’.

We also carried out a survey to identify researchers’ needs and difficulties in implementing PPI and promoting citizen science. Focus groups and interviews are using, as well as webinars and workshops for both citizens and researchers.

We plan to conduct a scoping review to map the methods, strategies, and instruments available for promoting active PPI in primary and secondary research. This scoping review will follow the guidelines set out by the Joanna Briggs Institute to ensure high quality and comprehensive results. This task aims to identify effective approaches for PPI in the research process and provide recommendations for future research in this area. By analyzing and synthesizing the available literature on this topic, we hope to gain insights into best practices and generate knowledge that can be used to improve PPI in research.

Pillar 2: Implementation process

In Pillar 2, UICISA: E researchers, citizens, and experts have co-created evidence summaries. These summaries have been published in plain, easy-to-read language and in an attractive format, making them easily accessible to citizens. A process flow was first established to facilitate this co-creation process, and summary design guidelines were defined.

This strategic axis assists with applications for competitive funding programs, such as Horizon Europe. We are currently focused on co-defining methodological protocols for involving citizens in primary and secondary research. We are also creating a pool of volunteer citizens to participate in projects and evidence-based publications. These tasks involve different approaches, from systematic reviews to design thinking.

Pillar 3: Project monitoring

This Pillar involves designing strategies to assess the impact of change and implementing solutions that ensure sustainability.

We will conduct a review to determine the impact of PPI and citizen science and identify the strategies and instruments used to implement it.

The design thinking methodology will also be used to explore the potential challenges of this paradigm shift at UICISA: E, including the legal and ethical issues about copyright, intellectual property, data sharing, and confidentiality.

Findings

This project promotes the interaction and alignment of ideas about PPI among the different stakeholders (managers, researchers, senior technicians, and citizens) of UICISA: E.

In Pillar 1, we have identified the needs of all stakeholders, including the training needs in different areas, and the structural conditions necessary to develop research. In addition, we are designing protocols for PPI in primary and secondary research and creating a pool of volunteer citizens who will receive training to participate in R&D projects.

Several initiatives have been created to increase awareness among citizens and researchers, such as social science festivals, public events, webinars, lectures, conferences, and news in local newspapers and on social media. These activities aim to bring citizens and researchers closer together (Figure 2).

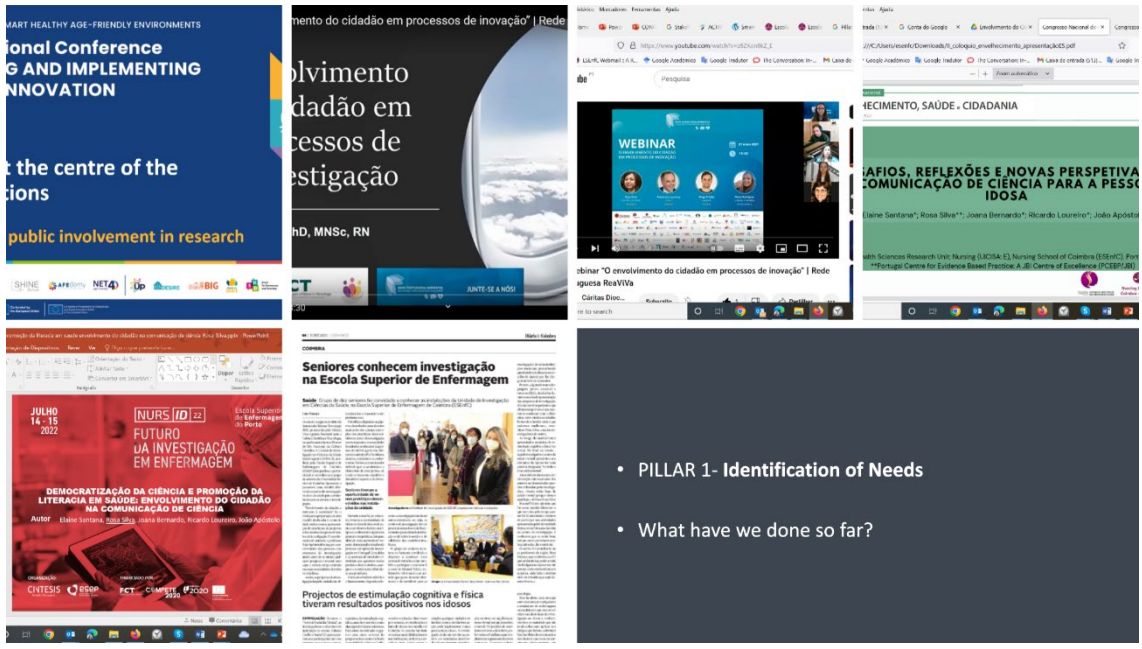

Figure 2 – Examples of news in local newspapers, social science festivals, and public events.

We have already developed several scientific products, such as a review paper on Citizen Involvement and Outreach to Society in research processes and outcomes based on a theoretical analysis supported by relevant scientific evidence on the central concepts (Silva et al., 2021); two editorials, one on Citizen and open science in pandemic times (Apóstolo & da Silva, 2021) and the other on Citizen Science (Silva & Santana, 2023); an opinion text[2]; several original papers on science communication needs and strategies, such as Science communication for citizens: speeches in use (Santana, Cardoso, et al., 2022) and Science Communication and Citizen Science: Strategies for the Ordinary Citizen (Santana, Silva, Cardoso, Ventura, & Bernardo, 2022)(Figure 3).

In Pillar 2, one of the most significant activities is co-creating and co-validating publications to disseminate evidence and improve health literacy.

These summaries are made freely available to citizens once or twice a month on UICISA: E's social media channels. Of the 27 co-created summaries, some aim at empowering citizens to make better decisions about COVID-19 by providing information on topics such as "Transmission of COVID-19," "Community masks," "Use of face shields in the community," and "COVID-19 vs flu

[2] https://caritascoimbra.pt/2021/rede-portuguesa/artigo-de-opiniao-no1-o-envolvimento-do-cidadao-nas-icdt-rede-reaviva/

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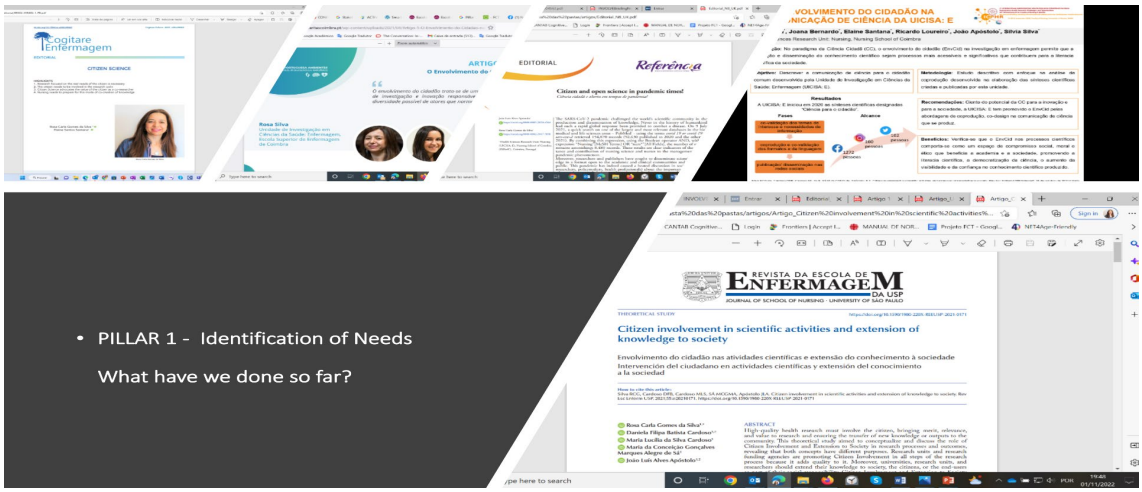

Figure 3 – Examples of publications.

Other summaries focus on emerging topics such as dementia, cancer, mental health, and lifestyle. The remaining summaries cover topics suggested by citizens and health professionals (Figure 4).

The involvement of citizens as active research team members in creating these evidence summaries is an excellent strategy to improve the quality of the product developed and disseminated.

Additionally, we are creating a pool of volunteer citizens to participate in projects, and co-creating and co-validating publications to disseminate evidence, with the ultimate goal of creating a Citizens and End-Users Center.

This axis has also played an active role in assisting with applications for competitive funding programs.

In Pillar 3, the tasks are already underway and future outcomes will contribute to increase this project's effectiveness, efficiency, and relevance for both citizens and researchers.

Conclusion

PPI and Outreach to Society is a strategic axis for carrying out research that produces knowledge, products, and services that respond to citizens' needs. UICISA: E has developed research activities around this strategic axis to better understand how to engage citizens and transfer knowledge to society. These activities also analyze the implementation, monitoring, and innovation processes that lead to a more citizen-centered science.

Research limitations/implications: We have identified some obstacles to change and are overcoming them with the engagement of all stakeholders through communication strategies and constructive feedback.

Practical implications: This project has contributed to expanding PPI best practices for the development of research at UICISA: E.

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Nursing School of Coimbra, Portugal, as well to the COST Action 19136 International Interdisciplinary Network on Smart Healthy Age-friendly Environments, due to the connection/network it promotes.

PPI is promoted by research centers and funding entities, which integrate it into the several stages of the research cycle to increase its quality. Universities, research units, and researchers have a social duty to extend their knowledge to society.

Figure 4 – Examples of lay summaries.

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ArcGIS Online as a digital tool for inclusiveness and healthy aging: a case study from a northern suburb of Athens

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Abstract: GIS is a technology used to keep track of the location of an object or a user to store and manipulate the data utilized for multiple applications. Wireless identification of IoT in combination with the capacity to proceed with spatial data expression and analysis offered by GIS can give rise to evolutionary applications, characterized by interoperability and agility, such as citizen science sensor platforms for several purposes. In this case, we developed a mobile application delivered by the open-source GIS software, ArcGIS Online for tracking elements of sustainable mobility, such as elements supporting the mobility needs of different users in the area of Melissia, a northern suburb of Athens. Our main goal is to place emphasis on everyday activities of people with reduced mobility in order to maintain their mobility, safety and independence, thus promoting their quality of life and social equity.

Keywords: GIS, AI, IoT, inclusiveness, healthy aging

1 Introduction

Geospatial data is being used to predict natural hazards, manage waste as well as for many other urban planning applications addressing issues of accessibility. With rising rates of aging population, the United Nations estimate 2.1 billion individuals will be living with a disability by 2050. According to the Higher Council for the Rights of persons with disabilities (HCD) in Jordan, disabled people constitute 13% of the community [1].

In 2015, the US Federal Highway Administration set a priority of reforming sidewalks attaining the standards of the Americans with Disabilities Act (ADA) [2]. Local governments should make an inventory of accessibility barriers and a description of accessible renovations to enhance accessibility [3]. In a recent study of 401 municipalities, however, only seven met the minimum ADA criteria [4].

Open source, geospatial web-based tools have shown a remarkable increase in recent years. These new data sources rely on the contributions of non-professional volunteers that collaboratively collect geodata, also referred to as Volunteered Geographic Information (VGI). These tools are used by volunteers in major cities to collect information about sidewalks, road surfaces, road incline, pedestrian crossings and tactile paving so as to create a suitable routing graph for disabled people, such as wheelchair users or elderly people [5, 6].

Accessibility through transportation, such as paved highways and public transportation

for reaching school facilities, health and goods facilities are particularly important. As education is especially fundamental for sustainable development, the location of schools and the route from home to school and back should conform to the basic European Pillar: safe and inclusive cities encompassing walking safely on sidewalks in order to increase accessibility for the city's inhabitants [7]. Globally, accessibility to public services is tied to social and economic equality [8]. According to a study, accessible public facilities can decrease the inequality by approximately 20% in OECD and Latin American countries [9].

2 Geographic Information Systems (GIS) and Artificial Intelligence (AI)

The accessibility, mainly measured by travel distance or travel time, from a residence to social infrastructure facilities, such as elementary schools, parks, childcare facilities, kindergartens, sports facilities and libraries, was investigated through the use of ArcGIS as GIS software and a navigation application programming interface (API), in Namdong-gu, Incheon, South Korea [10, 11].

Another research provides insight into accessibility of the disabled through GIS, Analytical Hierarchy Process (AHP) and Multi-criteria Decision Analysis (MCDA) for improving accessibility and location of services and facilities according to multiple factors. The final product of the research was the development of an accessibility map and a decision support tool that assists in effective decision making by stakeholders in order to achieve sustainable urban development [12].

Computer vision (CV) models and specifically deep learning models set the ground for the detection and analysis of the potential progress made over time concerning the technical requirements and infrastructure of urban sidewalks through the development of new spatio-temporal tracking tools [13]. Future research should emphasize the level of accessibility related to crosswalks [14], pedestrian signals [15] and street/sidewalk surfaces [16].

In order to determine the accessibility rate from students' homes to the nearest school in Kenya, several attributes were taken into consideration, such as school's location, capacity, amenities, number of students by gender as well as number of teachers. In the long run, any attempt to rehabilitate, expand or construct new schools should be supported by additional information, such as population dynamics and geospatial data, such as road networks and topography within a geospatial information system (GIS) enhanced by crowdsourcing methods. All information and data can be transcribed into functions and furthermore they can be transformed into machine learning models [17]. Therefore, decision-makers and stakeholders can proceed effectively with designing, organizing and conducting performance management in regard to schools in their administrative areas [18, 19].

Open Street Map (OSM) data is a valuable source of data in the case of Object-based Urban Analysis and Geospatial Optimisation for defining the optimal location of key public services/facilities. However, the accuracy level of Open Street Map data differs in different regions on account of the development level of the region [20]. The developed GIS-based model encompassing both Frequency Ratio

(FR) and the Analytical Hierarchy Process (AHP) model predicted the association of environmental factors with active school transportation, such as walking, cycling and active component of active transport journeys of university students in combination with public transport accessibility. Influential factors were found to be intersection density, land use, travel time as well as public transport network service area [21].

3 Geographic Information Systems (GIS) and Internet of Things (IoT)

Accessible and Inclusive Design (AID) aims to allow developers to add accessibility features to their systems as well as to provide transparency regarding lack of accessibility by people who lack certain abilities. More specifically, the current research explains how to apply accessibility and inclusiveness in physical and virtual worlds, like the metaverse, in combination with describing how ambient intelligence, accessibility maps and virtual worlds can contribute to building accessible and inclusive geospatial applications and wearables [22].

GIS integrated with IoT-based systems are already used in applications related to infrastructure, transportation and smart cities, in general [23-26]. More specifically, the proliferation of internet infrastructure, such as WebGIS, cloud computing or big data systems in combination with sensor-oriented technologies, network services and energy-related technologies can enable a parking navigation system [27] or enhance public transportation [28] as well as develop intelligent transportation systems. For example, by correlating Global Positioning System (GPS) data and local GIS information, latency and limitations of bandwidth when transmitting the location of vehicles in Intelligent Transportation Systems, are reduced. Furthermore, GIS, Radio-Frequency Identification (RFID) and cloud computing technologies can be used to build a parking navigation system, which informs users through their smart mobile devices whether there is an empty parking lot, its exact location and relevant image along with navigation toward it.

4 Geographic Information Systems (GIS) and inclusiveness

Specific features of the surroundings determine access to essential public goods and services in addition to facilitating a person's self-actualization via offering a quality of life. Equal access to educational, professional, social and economic opportunities entails enhancing the autonomy of persons with disabilities and fostering their integration into society. Therefore, under this perspective, stakeholders can use GIS to enable the implementation of evidence-based public policies to support social equality as well as inclusive cities [29].

GIS has the capacity to geocode several variables and address planning and management needs of a city so as to be able to adhere to Inclusive Sustainable Development Goals of 2030 Agenda of the United Nations. Moreover, governments should pay special attention to rapid urbanization of already marginalized communities, such as persons with reduced mobility. Goal 11: "Sustainable Cities & Communities" aims to protect individual rights in relevance to universal

access to basic urban services and transport-tation. Furthermore, GIS technologies allow for decentralized and bottom-up decision-making processes to build accessibility and mobility, thus improving urban resilience and sustainability. The attributes that should be taken into consideration in terms of developing urban amenities are bus stops, waste containers, schools and education services, health centers as well as public administration offices and public service facilities [30, 31].

5 Geographic Information Systems (GIS) and healthy aging

Accessibility to green space in urban areas and its relevance to individuals' health encompasses certain indices, such as levels of physical activity, levels of obesity, mental health as well as other health conditions [32].

Active School Travel (AST) decrease has brought the rise in childhood obesity as well as earlier onset of other chronic diseases due to increased sedentary activity and unhealthy diets. Daily physical activity and social contact are tied to better school performance and higher degree of activation (i.e. alertness and activity) during school. On the contrary, children who go to school on foot accumulate more physical activity and they attain lifelong fitness and wellness. Finally, establishing an active lifestyle in childhood could influence physical activity into adulthood [33-44].

6 Originality/value

Current research stems from the 2nd Panhellenic Student Competition “Mapping accessibility for disabled students” organized by Spotlight on Innovation (Spotin), a non-profit organization. First, we gained access to a powerful digital tool, ArcGIS Online, based on GIS technology to make a field study on accessibility, courtesy of Esri and Marathon Data Systems. We used this open-source program as an active learning technique and a cross curricular activity into our school. Third, we suggested merging GIS with emerging technologies, such as Artificial Intelligence, Internet of Things, 5G and Augmented Reality/ Virtual Reality to produce smart navigation systems and mobility enablers to the benefit of disabled persons. Finally, we endorsed the role of Citizen Science in using location intelligence to plan optimal locations for handicapped parking, bus stops and accessible entrances.

7 Conclusions

Education and training are critical for the evolution in the field of geospatial data as participants get initiated into the use of GIS. GIS, AI and IoT are interrelated in several fields, such as urban infrastructure, environmental monitoring, managing and controlling utility systems, disaster management, agriculture, transportation and healthcare. In that sense, users integrate applications such as collaborative tools, data mining, visualization applications, communication tools (social network) as well as documentation, accounting and reporting tools to innovate without the complexity of building something from scratch [45].

In general, GIS, AI and IoT offer a comparative advantage to geography, urban planning, spatial planning and architecture: real-time information from the sensors without the need of human intervention [46, 47].

Geospatial data are also related to inclusiveness and healthy aging as European

pillars. More specifically, GIS in conjunction with emerging technologies, such as Artificial Intelligence and IoT can be used to improve citizens' quality of life as well as promote social inclusion via universal accessibility and navigation.

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Evoluția rețelelor de calculatoare

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Abstract: In modern society, computer networks are used in all areas of activity: at home, at work, on roads, during vacations, etc. A computer network includes various types of computing systems: desktop or laptop personal computer, mobile phone, tablet, servers, which can be a minicomputer or a supercomputer with productivity up to several tens or hundreds of Pflops (top500.org). It also includes network equipment (routers, switches, etc.) and implemented services. Computer networks have experienced the greatest growth in modern society. If, at the beginning, in 1969, 4 universities were connected to the Arpanet network, in 2013 about 2.8 million users were using computer network services. And in 2020, due to the use of Internet of Things technology about 50 billion devices were connected to the Internet. Hundreds of billions of dollars are spent annually on the maintenance and development of computer networks. The efficient utilization of these resources becomes very important. Because every year new users are connected, new networks are built, new types of network standards and network protocols are developed and because of the use in more and more fields of activity, the importance of efficient use of networks, of allocated resources becomes and more acute. This paper describes and researches the types of computer networks, starting with the old ones. What type of network in which domain is used, what types of networks can be used to connect to the Internet? Knowing the characteristics of each network, their pros and cons, we can make an optimal choice.
Keywords: computer networks, Internet, classification of computer networks, local networks, global networks.
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1. Introducere

În societatea modernă rețelele informatice sunt utilizate în toate domeniile de activitate: acasă, la lucru, pe drum, în timpul vacanței, etc. O rețea informatică include diverse n tipuri de sisteme de calcul: calculator personal de tip desktop sau laptop, telefonul mobil, tabletă, servere. Serverele, la rândul lor, pot fi de tip minicalculator până la supercalculatoare cu productivitatea până la câteva zeci sau sute de Pflops (top500.org). La fel include echipamentele de rețea (rutere, commutatoare, etc) și serviciile implementate. Rețelele informatice au cunoscut cea mai mare creștere în societatea modernă. Daca, la început, în 1969 la rețea Arpanet erau conectate 4 universități, în 2013 de serviciile rețelelor informatice se foloseau circa 2,8 miliarde de utilizatori. Deja, în 2020 la Internet erau conectate circa 50 miliarde de echipamente, fapt ce se datorează utilizării tehnologiei Internet of Things.

Astăzi chiar un utilizator casnic poate fi conectat prin cablu optic, cu viteza de la câteva sute de Mbps până la câțiva Gpbs. Primele

metode de conectare au fost rețelele X.25 și Frame Relay. Pe urmă au apărut rețelele SONET, SDH, ISDN, ATM, FDDI, Metro Ethernet, WiMax etc. [1, 3].

În dependență de tipul clientului, evoluția rețelelor informatice a cunoscut mai multe tipuri de conectări. Clienții, în general, pot fi clasificați ca: utilizator casnic (persoană fizică) sau o întreprindere (persoană juridică). Deoarece la întreprindere lucrează mai multe persoane, avem nevoie de legături de viteza mai mare, față de utilizatorii casnici.

Pentru persoane fizice pot fi folosite următoarele tipuri de conectare:

- Cablul optic
- Legătura DSL
- Cablul coaxial
- Telefonia mobilă
- Prin satelit
- Legătura Dial-Up

Pentru persoane juridice pot fi folosite următoarele tipuri de conectare:

- Linie dedicată
- Metro Ethernet
- Legătura DSL
- Satelit.

Legătura Dial-Up este prima legătură folosită în rețeaua ARPANET, care utiliza canale telefonice analogice cu viteza de 56 Kbps. La început a fost unica metodă de conexiune. Dar, cu creșterea popularității Internetului, operatorii de rețele informatice au creat propriile rețele, infrastructura proprie de viteză mare.

Legătura DSL a permis de a transmite prin linii de telefonie analogică cu o viteză până la câțiva zeci Mbps, o creștere substanțială [2].

Văzând creșterea numărului de cereri de conexiune la Internet, și dorința de a avea mai mulți clienți, operatorii de televiziune au început a oferi conectarea prin cablul coaxial (televiziune). În zilele noastre toți operatorii (Internet, telefonie, televiziune) preferă utilizarea cablului optic, deoarece oferă viteza cea mai mare la distantă mare.

Din 2014 traficul rețelelor fără fir a depășit traficul rețelelor prin cablu, chiar dacă lățimea de bandă a cablului optic este cea mai mare. Aceasta se explică prin comoditatea folosirii legăturii fără fir. Nu are importanță unde se află utilizatorul: acasă, la lucru, pe drum are acces la rețea. Astăzi folosind telefoanele mobile cu conexiune 5G se pot obține viteze peste un 1 Gbps.

Legătura prin satelit este mai costisitoare, dar în unele cazuri este unica soluție. De exemplu, dacă suntem departe de civilizație, în junglă, pustiu unde nu prinde nici telefonul mobil. De asemenea, marinarii, militarii folosesc pe larg legătura prin satelit. Un alt exemplu este Indonezia, care are peste 13000 de insule, pentru sistemul telefonic folosește legătura prin satelit. Fiindcă, este foarte scump și incomod că tragi calul telefonic pe fundul oceanului ca să conectezi utilizatorii. Unii autori spun că pe viitor o să dispară toate celelalte legături și va rămâne doar cea prin satelit. Ca exemplu, se poate lua Elon Musk, care oferă conexiunea la Internet prin rețeaua StarLink. În Moldova pentru aceasta trebuie de procurat echipament de circa 17000 lei, iar abonamentul lunar costă 2300 lei.

Operatorii de Internet conectează oficiile sale cu magistrale de mare viteză, mai mare ca buclele locale a clienților. În felul acesta datele a mai multor utilizatori se pot transmite printr-un cablu comun. Pentru a asigura o viteză mai

mare, stabilă și o securitate mai bună, clienții pot alege linii dedicate.

Tabelul 1. Tipuri de conexiuni la Internet, din 16.03.2021 [4].

Internet type	Max speed	Price	Availa-bility
Fiber	10 Gbps	$25.00–$299.95/mo.	39%
Cable	1.2 Gbps	$19.99–$109.99/mo.	89%
DSL	140 Mbps	$27.99–$69.99/mo.	88%
5G	1.1 Gbps	$50.00–$90.00/mo.	N/A
4G LTE	9–50 Mbps	$40.00–$100.00/mo.	N/A
Fixed wireless	100 Mbps	$39.95–$99.00/mo.	46%
Satellite	100 Mbps	$30.00–$150.00/mo.	100%

Sau schimbat și tehnologiile folosite în rețele locale. Dacă la început printre cele mai populare erau Ethernet, Token Ring, Token Bus. Dar, cu timpul tehnologia de bază a devenit Ethernet, deoarece este mai simplă, mai ieftină, este compatibilă cu versiunile precedente. Astăzi cea mai utilizată este Gigabit Ethernet, dar și versiuni de viteză mult mai mare. Popularitatea și simplitatea acestea a dus la aceea că tehnologia dată se utilizează și în rețele MAN (Metropolitan Aria Network). Care deja se numește Metro Ethernet.

Este interesant ce tip de conexiune se folosește în țările cele mai dezvoltate și costul lor. Printre lideri se află SUA, pentru a vedea metodele de conectare vezi tabelul 1. Ofertele și disponibilitatea pot varia în funcție de locație.

2. Specificații

Mai sus, am vorbit despre evoluția și importanța rețelelor. Să vedem acum caracteristicile de bază a unor rețele.

În primul rând să vorbim despre operatorii de Internet. ISP (Internet Service Provider) sunt divizați în 3 nivele. Operatorii de primul nivel administrează magistralele principale a Internetului (Internet backbone). Ei investesc sume colosale în întreținerea și dezvoltarea acestor legături. Anume ei realizează conexiune dintre continente, trăgând cablul optic pe fundul oceanului. Printre operatorii de tipul dat se pot evidenția Amazon, Facebook, Google or Microsoft. Google și SubCom au finalizat primul cablu SDM submarin pe distanță lungă, cunoscut sub numele de Dunant, în 2021. Acesta conține 12 perechi de fibră și poate livra o viteză record de 250 Tb/s peste Oceanul Atlantic [5].

Operatorii de nivelul doi sunt companii mari sau companii naționale care reglementează utilizarea Internetului la ei in țară. Ei procură viteză la Internet de la operatorii de primul nivel, deja au canale de viteză mai mică, dar au și cheltuieli mai mici. La ei se pot conecta clienți importanți care au nevoie de viteză mare. Majoritatea clienților (mai ales mici și medii) se conectează la operatori de nivelul 3. Unde primesc viteză și mai mică, dar și la un preț corespunzător.

La selectarea operatorului pentru conectare clientul alege după preț și viteză. Atunci este important ce viteză maximă oferă diferite tipuri de conectare. După cum se vede din tabelul 2, cele mai mari viteze se pot obține folosind cablul optic și telefonia mobilă.

Tehnologia de bază, pentru conectarea clienților prin fibra optică, este FTTH (Fiber to

the Home). În acest caz prin cablul optic se obține viteza cea mai mare, deoarece cablul optic vine pană la client. Cablul optic vine până la echipamentul clientului (router), iar mai departe se poate folosi cablul torsadat (UTP), cablul optic sau conexiunea prin wi-fi.

Tabelul 2. Viteze maxime de Internet în funcție de tipul de conexiune [6].

Connection type	**Max download speed**
Dial-up	Up to 56 Kbps
DSL	64 Kbps to 100 Mbps
Satellite	Up to 500 Mbps
Fixed wireless	Up to 50 Mbps
Cable	25 Mbps to 1 Gbps
Fiber	Up to 5 Gbps
Cellular LTE & 5G	LTE: 20 Mbps to 30 Mbps 5G: Up to 10 Gbps

FTTH este un caz aparte din tehnologia FTTx, în dependență până unde vine cablul optic poate fi: FTTN (Fiber to the Node), FTTC / FTTK (Fiber to the Curb / Fiber to the kerb), FTTDP (Fiber To The Distribution Point), FTTB (Fiber to the Building), FTTD / FTTS (Fiber to the desktop, Fiber to the Subscriber), FTTE / FTTZ (Fiber to the telecom enclosure, fiber to the zone), etc. Diferența dintre ele se poate vedea din figura 1.

În rețea FTTN cablul optic vine pană la nodul de rețea. În rețea FTTC cablul optic vine până la un grup de clădiri. În FTTB cablul optic vine până la o clădire. Popularitatea utilizării Internetului prin telefonia mobilă se explică prin comoditatea utilizării și viteze mari. Prima generație de telefonie mobilă oferea, doar, comunicare prin voce, folosind transmiterea analogică. A doua deja transmitea vocea în format digital, ceia ce a permis la folosirea unei lățimi de banda îngustă conectarea a mai multor utilizatori. Începând cu generația a treia datele și vocea se transmit în format digital.

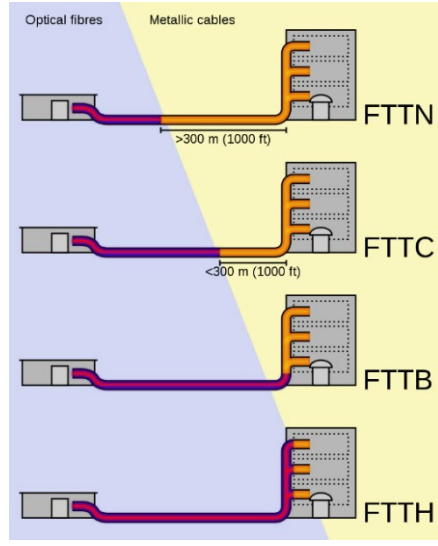

Figura 1. Schema conectărilor prin FTTX (Node, Curb, Building, Home) [7].

La moment, cel mai utilizate sunt rețele 4G. În multe țări deja este accesibil și 5G. Dar, deja se lucrează și asupra tehnologiei 6G. Folosind 4G se pot atinge viteze de circa 100 Mbps pentru utilizatorii cu mobilitate înaltă și viteze până la 1 Gbps pentru utilizatorii cu mobilitate joasă. Deja, folosind 5G se pot obține viteze până la 10 Gbps.

3. Constatări

a) Anual pentru întreținerea și dezvoltarea rețelelor informatice se cheltuie sute de miliarde de dolari. Devine importantă valorificarea

eficientă a acestor resurse. Ținând cont de faptul că în fiecare an se conectează noi utilizatori, se construiesc noi rețele, se elaborează noi tipuri de standarde de rețele și protocoale de rețea, utilizarea în tot mai multe domenii de activitate, importanța utilizării eficiente a rețelelor, a resurselor alocate devine și mai acută.

4. Oportunități și limitări

b) În această lucrare se descriu și se cercetează tipurile de rețele informatice, începând cu cele vechi. Ce tip de rețea în ce domeniu se utilizează, ce tipuri de rețele pot fi folosite la conectarea la Internet. Cunoscând caracteristicile fiecărei rețele, plusurile și minusurile fiecărei, putem face o alegere optimă.

c) Concluzii

Valoarea practică constă în faptul că având descrierea a mai multor tipuri de rețele, a metodelor de conectare, a plusurilor și minusurilor fiecărui tip, clientul poate face o alegere cât mai corectă. Astfel încât să nu fim dezamăgiți de alegerea făcută, astfel încât să putem utiliza comod serviciul necesar și să avem cheltuieli minime pentru furnizor de servicii și client. Ținând cont de faptul că rețelele informatice, în societatea modernă, se utilizează tot mai mult, crește volumul de date transmis, apare necesitatea de a avea o conexiune de viteză tot mai mare. Pentru client este important de a avea o conexiune la Internet eficientă: preț minim, viteză mare. Pentru furnizor este important de a avea viteză cât mare, ceia ce presupune elaborarea de noi rețele, standarde ce permit de a primi viteze mai mari decât cele existente. Ca exemplu, la început, în rețeaua Arpanet calculatoarele se conectau prin linii telefonice analogice cu viteza 56 kbps. Astăzi, legătura dintre continente este realizată cu ajutorul fibrei optice, cu viteza de circa 250 Tb/s.

d) Acknowledgment:

Această lucrare se bazează pe manuale din domeniul rețelelor de calculatoare expuse în referințe și pe paginile web corespunzătoare.

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AI Machines - Increased Potential or Risk?

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Abstract. ***Purpose of the work****:* To highlight the importance of the ability to handle the AI's advancement rationally in order to optimize processes from different industries. By presenting and exploring the latest innovations with their best features, this work aims to spread awareness about the benefits of using AI powered machines, but also reflects the major value of managing machine learning very consciously and carefully.
Approach: This paper analyzes the dynamic of AI by investigating meticulously selected statistics. Also, another subject evaluated in this work is the increased risk of huge job losses caused by the explosive growth of AI systems.
Findings: During the analysis of statistical data and the evolution of AI, it was discovered that more companies should invest in developing AI systems since the advantages outweigh the costs of this decision. Top technology companies are in a race to implement artificial intelligence in our day to day lives, which will lead us to a fantastic and exciting future. AI will be a game-changer in promoting better experiences in all fields.
Limitations/suggestions for research: This paper leads to the debate on the potential risk of replacing human work with AI, since elevated productivity is a key factor that can determine companies opting for machines.
Applied value: The results of the work are supported by the value of findings, conclusions, and recommendations, which can be useful for companies that want to have a precise outlook on the concept, evolution, advantages, and disadvantages of AI in order to make a decision regarding its use in their working environment.

Introduction

Digital innovations have the potential to enhance our daily lives in countless ways, from making our homes and workplaces more efficient and comfortable to improving our health and safety. For example, AI-powered virtual assistants can help us manage our schedules, make recommendations, and automate routine tasks. AI systems can also analyze large amounts of data to help doctors diagnose diseases and develop personalized treatment plans. AI research has the potential to lead to breakthroughs in different science areas, help us better understand complex systems and find more effective solutions to some of the world's most pressing problems. AI is also considered the power engine that drives innovation and creativity. It may seem weird, since AI is usually trained to only reproduce existent data in a certain way, but it can help companies gain new insights and create leading-edge products and services, by identifying patterns and trends in data that humans may not be able to see, leading to new discoveries and ideas.

Purpose

For me, as a marketing student, it is crucial to understand and spread awareness about the overwhelming impact of AI, since I recently read that 64% of B2B marketers consider AI to be valuable in their marketing strategy. After visiting an event where different machine learning specialists spoke about their experience of exploring the AI field, I became particularly interested in the use of ChatGPT and its role in revolutionizing the evolution of marketing jobs. AI could help content creators create better and more engaging content, dramatically reduce the time needed to create content, and automate content creation. AI-generated content could help creators reach more people by helping them efficiently create content tailored to their target audience. ChatGPT can do much more than just blogging and copywriting. It can generate images, ideas, answer questions, correct your copy, devise business plans, write poetry, provide sentiment analysis, and much more. In theory, companies can now use technology to create copy for advertising, marketing emails, social media posts, long-form content marketing pieces, and website copy.

Impact and dynamic of AI

AI can be a critical source of business value when done right. It has long been regarded as a potential source of business innovation. With the enablers now in place, organizations are starting to see how AI can multiply value for them. Automation cuts costs and brings new levels of consistency, speed and scalability to business processes; in fact, some Accenture clients are seeing time savings of 70%. Even more compelling, however, is the ability of AI to drive growth. [7]

How will AI change healthcare?

By using AI, researchers will be able to assess vast amounts of patient outcome data to identify substances that are more likely to be effective against certain diseases. At the same time, they can also screen compounds that are safe for human consumption and cheap and easy to make. With increased computing capability, AI will also be able to analyze large amounts of data from clinical trials and patient records, which will help providers identify which patients might be most likely to respond to a specific treatment. It can then help researchers prioritize which compounds to test in the lab, as well as design more effective clinical trials. This can speed up the development process and see new medicine brought to market more quickly.

Artificial intelligence is a powerful tool for healthcare and hospitals, with the ability to improve patient outcomes and patient satisfaction. It has already made significant headway in drug discovery, data analytics, robot-assisted surgery, and virtual nursing assistants. There are still many challenges ahead, such as ensuring AI systems are appropriately trained so that they don't make errors. [1]

Robot-Assisted Surgery

Robot-assisted surgery is the use of surgical robots in the operating room to assist in performing a medical procedure. The most widely used system today involves a camera and very small surgical tools attached to robotic arms that surgeons can control by viewing a screen that displays real-time magnified images. These systems enable doctors to perform many types of complex procedures

with more precision, flexibility, and control than with conventional techniques.

How can AI improve robot-assisted surgery?

First, AI algorithms can analyze images such as CT scans and MRIs to create 3D models of a patient's anatomy. Doctors and surgeons can use this information to guide them around important structures in a patient's body, minimizing the risk of complications. As AI and robotics become more common in the operating room, doctors will benefit from a collaborative relationship with this technology. For example, it will someday be possible to use machines to track the position of surgical instruments in real time and for AI to make recommendations to surgeons, ensuring they perform the necessary steps in each procedure. Therefore, as AI gathers and analyzes ever more data, develops 3D models of the human anatomy, and is better able to manipulate robot instruments, AI-controlled robots may eventually perform surgeries with minimal or no human intervention.[1]

Virtual Nursing Assistants

Virtual nursing assistants are one of the most popular ways healthcare organizations are using AI. While there are many apps that you can use to monitor your health and various apps that use chatbots to support mental health, AI-powered virtual assistants are slightly more sophisticated. They can interact with patients remotely, providing them with information about their health conditions, answering questions, and scheduling appointments. This can be particularly useful for patients in remote or underserved areas. Virtual nurses are also used to help patients identify and assess the severity of their symptoms and provide them with personalized advice for understanding and managing their health.

Care Angel is an example of a virtual nursing assistant that conversationally interacts with patients through a simple phone call or text message. It claims to extend clinical capacity by 600%. Using an AI-powered voice assistant, which features personalized, conversational health monitoring and management, Care Angel helps close care gaps for patients with chronic conditions. It improves preventative care, ensures people take their medicine, helps people deal with addiction, and even offers remote patient monitoring. As AI-powered virtual nurses become more integrated with advanced medical devices, doctors will be able to use AI to monitor a greater number of vital signs and other health data, such as blood pressure and blood sugar levels. They'll be able to alert patients as well as healthcare professionals of any changes that require immediate attention. New innovations are likely to continue changing how patients interact with doctors and nurses by providing better care at lower costs. [1]

Improving Diagnostics

Analyzing Symptoms, Suggesting Personalized Treatments, and Predicting Risk

Many healthcare providers and health care organizations are already using intelligent symptom checkers. This machine learning technology asks patients a series of questions about their symptoms and, based on their answers, informs them of appropriate next steps for seeking care. Buoy Health offers a

web-based, AI-powered health assistant that healthcare organizations are using to triage patients who have symptoms of COVID-19. It offers personalized information and recommendations based on the latest guidance from the Centers for Disease Control and Prevention (CDC).

Additionally, AI technology can take precision medicine to the next level by synthesizing information and drawing conclusions, allowing for more informed and personalized treatment. Deep learning models have the ability to analyze massive amounts of data, including information about a patient's genetic content, other molecular/cellular analysis, and lifestyle factors—and find relevant research that can help doctors select treatments.[2]

Supporting Operational Workflow

AI can improve administrative and operational workflow in the healthcare system by automating some of the processes. Recording notes and reviewing medical records in electronic health records takes up 34% to 55% of physicians' time, making it one of the leading causes of lost productivity for physicians. Clinical documentation tools that use natural language processing can help reduce the time providers spend on documentation time for clinicians and give them more time to focus on delivering top-quality care.

Health insurance companies can also benefit from AI technology. The current process of evaluating claims is quite time-consuming, since 80% of healthcare claims are flagged by insurers as incorrect or fraudulent. Natural language processing tools can help insurers detect issues in seconds, rather than days or months.[2]

How could AI impact the justice system?

How do you envisage AI impacting the legal profession and the role of lawyers in the next five years? There is little doubt that advancements with computer systems will play an essential role within the legal profession, and that this could transform it for the better. Automated document management is already becoming commonplace, saving lawyers a lot of dull work hours, but we are still a long way from harnessing the full potential of the data now available. Everything hangs on exactly how we harness that potential, whether we allow an instrumentalist logic to take over or whether the aims that preside over such data mining reflect what we want law for. [3]

AI and Criminal Justice

AI can assist us in many aspects of criminal justice such as preventing crime and prosecuting criminals using evidence that was obtained by AI. It can help with sentencing criminals based on their past crimes and it can help with parole or bail hearings by using algorithms that predict whether an individual will commit another crime if released now or later.

Artificial intelligence is increasingly being used to sort through the sea of data that police, prosecutors, and judges are drowning in. For example, AI can help detect patterns in data that humans might not be able to find on their own. And it can help find patterns in data that humans might not even realize exist like when an unknown suspect has committed crimes before, or a suspect's DNA matches up with evidence found at crime scenes.

While this kind of information isn't necessarily new, it has been possible for years to use software programs for these tasks. What is different about artificial intelligence (AI) is its ability to learn from its mistakes and adjust itself accordingly as it works through cases. This means that over time, AI will get better at its job than other approaches have been able to do so far; it won't require manual input from human experts every step of the way.[3]

Artificial Intelligence and Bail

Bail is designed to prevent people accused of crimes from fleeing, but it has a problem: people who are accused of crimes may not be guilty or may have a low probability of fleeing, but they might not be able to pay the bail amount and so they have to stay in jail until their trial, even if they could promise to return for their court date.

This means that innocent people are spending time in jail because they don't have access to money, which is obviously not good for the person or for society. It also means that people who are guilty could get out of jail before their trial if they can find enough money to pay their bail amount. AI can also be used to help determine whether someone should be released on bail or detained as a flight risk. If you've ever been involved in the criminal justice system, you've likely had your bail set based on certain criteria: whether you pose a threat to the community and/or have ties to that community, whether there's reason to believe you'll flee prosecution, etc.

But while these criteria work well with humans making bail decisions, they're not overly scientific. In fact, they're often considered subjective, relying more on intuition than any real science. And why? Because it's hard for humans to keep track of all the relevant information about each case without making mistakes along the way.

Using AI instead of humans in this context could solve many problems at once: The technology would be able to make faster decisions (which means less time spent behind bars), it would keep better records for future cases that could arise from its previous ones (and thus improve outcomes), and it wouldn't get tired from having worked all night long as some human judges do.[3]

Artificial Intelligence and House Arrest

The criminal justice system is designed to protect society from criminals, but it also provides a means of rehabilitation and reintegration. One method of punishment that serves this goal is house arrest, which can be used as an alternative to prison time.

House arrest requires offenders to live at home or in a halfway house for up to two years at a time, depending on their offenses and other factors. The conditions imposed on them during house arrest vary depending on the situation. Some people may be restricted from leaving their homes except for work or school purposes while others may choose to stay indoors most of the time but are allowed visitors between certain hours each day.

House arrest isn't intended as just another punishment. It is meant as an opportunity for offenders to adjust back into society after committing a crime without being locked away from family members who depend on them financially or emotionally. Many times, people placed on house arrest are required to wear an ankle monitor. These tracking devices use

GPS, cellular or other tracking methods to always monitor the location of the individual. If the person leaves the assigned perimeter during the assigned hours a law enforcement official can be notified. GPS ankle monitors have become a common, and sometimes controversial, part of house arrest.

While ankle monitors can allow some participants to avoid time in prison, instead working and caring for their family, some believe the stigma associated with the ankle bracelet version of GPS monitoring is difficult on self-esteem and can hamper job opportunities.

Thankfully the team at Talitrix has developed a house arrest solution that offers accurate GPS monitoring in a wristband version that looks just like a smart watch. And because the Talitrix band uses the latest technology they can send tracking data every 15 seconds, giving law enforcement renewed confidence in GPS monitoring. Most of the traditional ankle monitors have much longer lag times. Talitrix is compiling behavior data and using AI to help criminal justice professionals make better case management decisions. [3]

Possible risks in relying too much on AI-generated predictions.

There are some dangers in relying too much on AI-generated predictions. AI can be biased and there have been past examples when AI reflected the biases of its creators. This is especially true if those creators are law enforcement officers or judges who use machine learning to predict whether someone has committed a crime before they've been convicted by a jury (or even charged with one).

Another concern is that AI systems might make mistakes such as misclassifying an innocent person as guilty. This can be based on slightly similar patterns between their behavior and those of known criminals because the underlying data sets used to train them aren't accurate enough. Criminal justice professionals need to be careful not to disassociate behavior across any group of individuals, especially those that have been historically marginalized. It's important that we gather as much data as possible to inform every decision and that we make sure that data is not biased by the creators of the system or the collectors. [3]

Statistics on Artificial Intelligence Industrial Usage

Nine out of ten leading businesses have investments in AI technologies, but only 14.6% deployed AI capabilities in their work. [4]

Due to confusion over the optimal strategy for effective implementation of AI, business leaders and CEOs are in many cases ineffectively integrating this technology into their services. PwC found only 4% of executives have successfully adopted AI into their business. Business leaders' lack of knowledge is affecting AI implementation. And when AI doesn't deliver against the metrics used to measure its success, there is a knock-on effect on return on investment. But these don't happen because AI is incompetent or insufficient, but due to false expectations. When used effectively, AI can be highly beneficial for businesses. Microsoft found that businesses already implementing AI were outperforming those that aren't by 5%, on factors such as productivity, performance, and business outcomes. Additionally, businesses

which then established a strategic approach to AI, such as developing underlying values, ethics, and processes, outperformed those which weren't by 9%. It's persuasive evidence that successful applications of AI can have a great positive effect on a business.

To gain the advantages of AI, enterprises need to use this technology effectively. Through education on AI, business leaders will be able to understand which subcategory is most useful to their business. A company with strong customer focus should aim efforts toward NLP utilized for chatbots; while businesses which use big data should focus on machine learning to enhance data mining and analytics practices.[5]

Increased Job Loss Risks

As technology advances rapidly, the fear of job loss due to automation has become a reality for many workers across industries. While some jobs are more susceptible to being replaced by AI than others, it's important to understand which roles are most at risk and how workers can adapt.

Multiple jobs have already started to see the impact of AI, such as writing, social media management, and graphic design. By examining these roles, we hope to shed light on the current state of AI in the workforce.

The rise of AI will eliminate 85 million jobs and create 97 million new ones by 2025.
The 3 Types of Jobs Most at Risk from AI are:

1. Graphic Designing

AI has come a long way in recent years, making significant strides in various industries, including graphic design. AI-powered tools can create designs in real-time that are aesthetically pleasing.

This technology analyzes user preferences, brand guidelines, and design trends, providing designers with an efficient way to get their work done quickly. AI-powered tools like Adobe Spark and Canva create stunning graphics with minimal effort. The algorithms also analyze designs and recommend changes to create something aligned with industry standards.

You can also use AI text-to-art generators to create multiple images within seconds. Companies can save costs by hiring fewer designers and getting faster outputs. It is also a cost-effective alternative for smaller businesses that may not have the resources to hire a team of designers.

2. Writing, Editing, and Proofreading

Different AI writing tools, such as automated content generators and language translation software, use algorithms and machine learning to create written content. These tools can produce articles, blog posts, and even books with remarkable speed and accuracy.

The technology behind these tools is constantly improving and creating complex and nuanced writing. While some believe AI can never replace human writing, its content can be highly informative and well-structured. This makes it a useful tool for organizations requiring a large amount of written content that is otherwise difficult to manage with several writers and editors.

3. Research Analysis

AI processes vast amounts of information much faster than humans, making it ideal for research and analysis. However, this does not necessarily mean that AI will replace all

research and analysis jobs. Some tasks still require human interpretation, creativity & critical thinking.[6]

Creating Jobs due to AI

While AI could streamline tasks people used to complete, it is also creating a new field for workers to manage and direct the technology. When you think of artificial intelligence, you might conclude that AI handles everything in a project from start to finish, but that's generally not the case. Most applications of AI involve some level of human direction. As everyday applications abound, so do the AI employment opportunities. Here are some jobs that will be created due to the development of AI: [8]

Ethical sourcing officer

A tech-saturated world will make a lot of grunt work disappear, but it won't eliminate ethical quandaries. In fact, it might create more of them. An ethical sourcing officer is a sort of sheriff, ensuring that the priorities and ethical commitments of a big company are practiced.

Data Protection Manager

With the increasing use of AI, there will be a growing need for individuals who are experts in data protection and privacy. Data Protection Managers will help ensure that organizations are complying with data protection regulations and that individuals' personal data is being used appropriately.

AI Trainer

As AI systems become more advanced, they need to be trained on larger and more diverse datasets. AI Trainers will work to create and curate these datasets, ensuring that they're representative of different populations and free from bias.

Conclusion

After doing the research required for writing this article, we concluded that AI is both as powerful as weak compared to humans, and my argument for that is that despite its explosively rapid spreading success it still remains a tool created by humans, its main task is to only simulate human behavior. In my opinion, there is still a long way until the similarity of the AI and human actions will be equaled, to be honest I am still not convinced that would be even possible, but I don't exclude the chance for this to happen.

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Particulate Matter Concentrations in a Residential Area, Near a Round-about with High Vehicular Traffic

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Abstract: The primary objective of this research endeavor is to disseminate the outcomes and comprehensive examination of particulate matter quantification conducted in the urban area of Timisoara, Romania. Specifically, this investigation was focused on a locality characterized by a pronounced vehicular traffic load, situated in close proximity to a roundabout intersection renowned for its substantial diameter, denoted as the "Cardinal Points Fountain". It is imperative to emphasize that this locale encompasses residential homes in close proximity to the aforementioned traffic-intensive area. The instrumentation employed possesses the capability to quantify concentrations of particles of varying sizes, including PM1, PM2.5, and PM10, signifying particle diameters of 1 μm, 2.5 μm, and 10 μm, respectively. This cutting-edge technology relies on dynamic light scattering spectrometry, which evaluates alterations in the intensity of light diffused by a suspension or solution. In accordance with particle size, the apparatus possesses the capacity to discern concentrations of particles categorized as inhalable, thoracic, and alveolar, thereby affording valuable insights into their impact on human health. Diverse particle sizes possess the ability to traverse unimpeded through the protective mechanisms of the human respiratory system: inhalable particles navigate through nasal hair, thoracic particles penetrate the mucus lining the throat, and alveolar particles proceed beyond the alveoli in the lungs, gaining access to the bloodstream. Such infiltration can generate severe maladies and adverse health ramifications.
Keywords: Engineering; PM concentrations; Dynamic Light Scattering measurement; inhalable-, thoracic, and alveolar-sized particles.

Introduction

The main scope was to measure the concentrations of Particulate Matter (PM), of different sizes, and measured in two different points in an area with high vehicular traffic and frequent traffic congestion.

The pollution caused by particulate matter has been recognized as a longstanding threat to human health. It remains a significant factor in the development of several diseases, of which cardiovascular and pulmonary are of significance [1], resulting in a significant number of untimely fatalities annually. As a result, it serves as a major worldwide contributor to mortality [2].

The inherent defenses of the body can partially restrict the entry of these particles. The nasal hair and throat phlegm affectively trap bigger sized particles, whereas smaller sized particles bypass these initial defenses, reaching the lungs and even entering the bloodstream by reaching the [3].

PM2.5 enters the lungs, triggering oxidative stress on lung tissues. The abundance of free radicals that this causes surpasses antioxidants, causing harm to lung cells, DNA, and repair mechanisms, thereby elevating the risk of lung cancer [4]. Human exposure to vehicle-emitted

particulate matter includes a mix of metals from tires, brakes, wear parts, and road dust [5].
Governments, by introducing effective measures, are focusing on reducing human-made sources of PM, resulting in a planned decrease of exposure levels in human population by up to 75% in 2040 [6].
Human activities stand out as the primary contributors to air pollutant emissions, supplementing existing sources of natural emissions like soil dust, sea salt, and vegetation [7]. The World Health Organization (WHO) currently estimates that approximately 90% of urban residents are exposed to PM2.5 levels exceeding the WHO guideline value of 10 $\mu g/m^3$ [8].

Measurement method

This study centered on an area marked by high vehicular traffic, situated near a large roundabout known as the "Cardinal Points Fountain." It is crucial to highlight that this location includes residential homes in close proximity to the busy traffic area.
The study sought to determine concentration level variations at different heights by situating measurement equipment on the ground and fourth floors of a residential apartment building, as depicted in Figure 1. Measurements were conducted during both weekday rush hours and weekends.

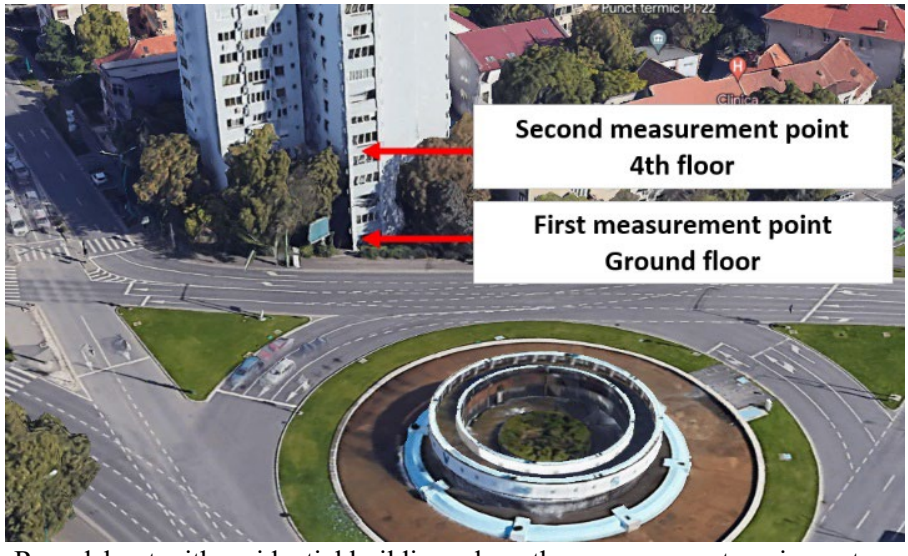

Figure 1. Roundabout with residential building where the measurement equipment was placed.

The utilized instrumentation can measure concentrations of particles across different sizes, encompassing PM1, PM2.5, and PM10, repre-sentting particle diameters of 1 µm, 2.5 µm, and 10 µm, respectively. This advanced technology employs dynamic light scattering (DLS) spectrometry, assessing changes in the intensity of light diffused by a suspension or solution. Analyzing the intensity fluctuations, attributed to the Brownian motion of macromolecules in a solution, allows for the determination of the diffusion coefficient ($D\tau$). This coefficient is closely linked to the hydrodynamic size of the macromolecules [9, 10].
The measurement equipment is produced by GRIMM Aerosol Technik, Durag Group, with

headquarters in Hamburg, Germany. By using DLS technology, it can perform a measurement of PM sizes each 6 seconds, resulting in a more accurate measurement result than with conventional measurement methods (e.g., gravimetric impactors, which utilize air suction and depositing PM particles on fiber glass filter).

First measurement was performed during a weekday, on Tuesday 10 October 2023, for approximately 1h between 16:40 and 17:50 at ground floor (GMT+2 time zone), and approximately 1h between 18:00-19:10 at 4th floor (GMT+2 time zone). Meteorological data as recorded, are: Outside temperature measured at 17°C, wind speeds around 6 km/h, wind direction towards NE (directly towards the measurement equipment), air pressure 1009 hPA [11].

Second measurement was performed during weekends, on Sunday 17 September 2023, for approximately 1h between 14:00 and 15:10 at ground floor (GMT+2 time zone), and approximately 1h between 12:50 and 14:00 at 4th floor (GMT+2 time zone). Outside temperature recorded at 22°C, wind speeds around 2 km/h, wind direction towards W (opposite direction of the placement of the measurement equipment), air pressure 1009 hPA [12].

Results and discussions

Measurement of PM concentrations during weekday

Table 1. Recorded concentrations (min., max., and mean) for PM on Tuesday 10 October 2023 and at each floor.

	PM1 [µg/m3]		PM2.5 [µg/m3]		PM10 [µg/m3]	
Variable	G floor	4th floor	G floor	4th floor	G floor	4th floor
Min	11.8	10.6	12.7	11.3	13.8	13.3
Max	17.2	18.9	22.6	28.8	57.9	61
Mean	13.9	14.9	16.3	17.9	28.4	32.2

Table 1 represents the minimum, maximum and mean concentration of PM1, PM2.5, and PM10, recorded during Tuesday 10 October 2023 at each floor (G floor = Ground floor).

Figure 2 is a graphical representation of the concentration levels of PM1, PM2.5, and PM10 at ground floor, with Figure 3 showing the same measurement details, but recorded at the 4th floor.

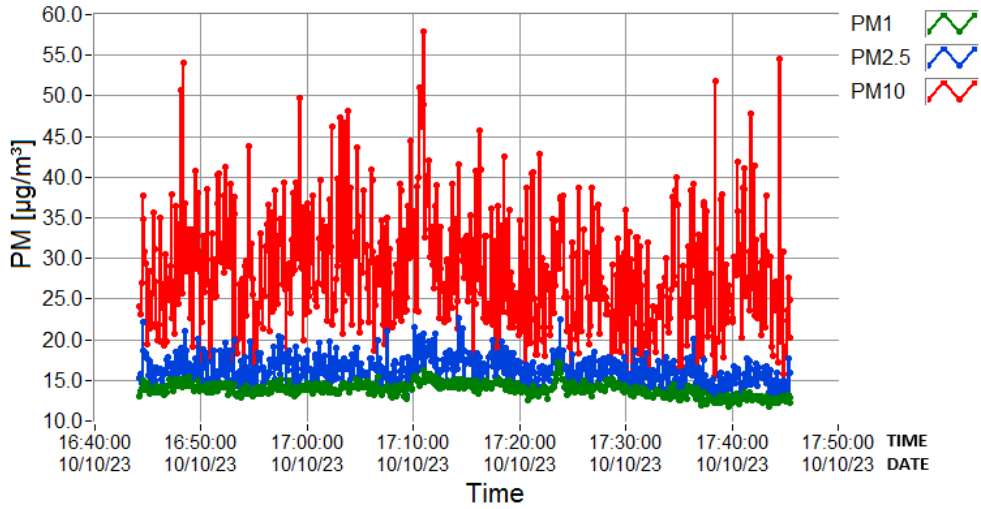

Figure 2. PM concentrations measured on Tuesday 10 October 2023 at ground floor.

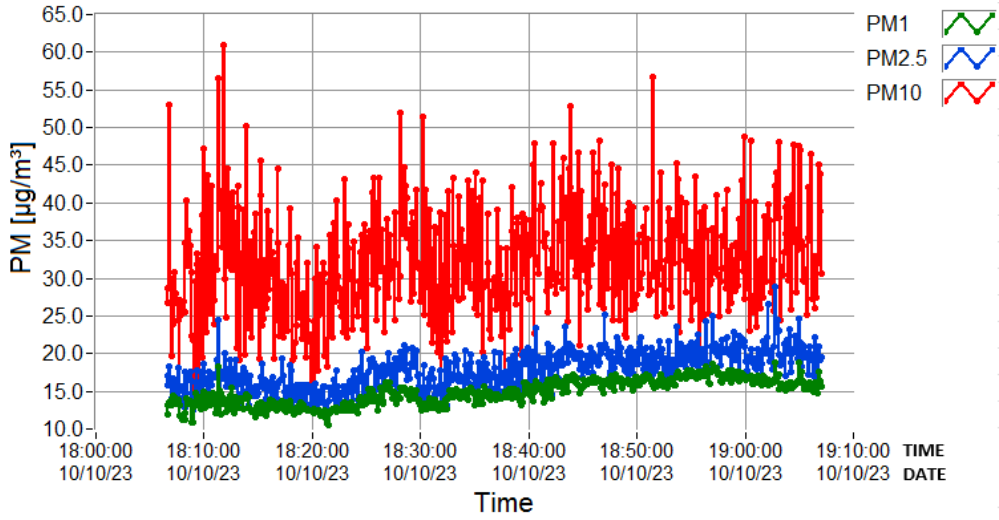

Figure 3. PM concentrations measured on Tuesday 10 October 2023 at 4th floor.

Based on the results measured, it can be recognized that the concentration levels of PM are mostly within the same ranges, with an increase at the 4th floor. This can be explained by the time range when the measurement where performed, 4th floor measurement performed later, allowing wind gusts to raise PM in the atmosphere.

Figure 4 and Figure 5 are graphical representations of concentration of PM transposed to inhalable-, thoracic-, and alveolar-sized particle concentrations.

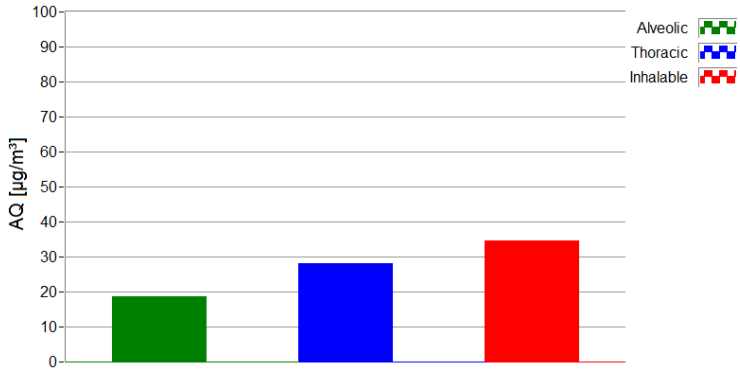

Figure 4. Inhalable-, thoracic-, and alveolar-sized particle concentrations measured on Tuesday 10 October 2023 at ground floor.

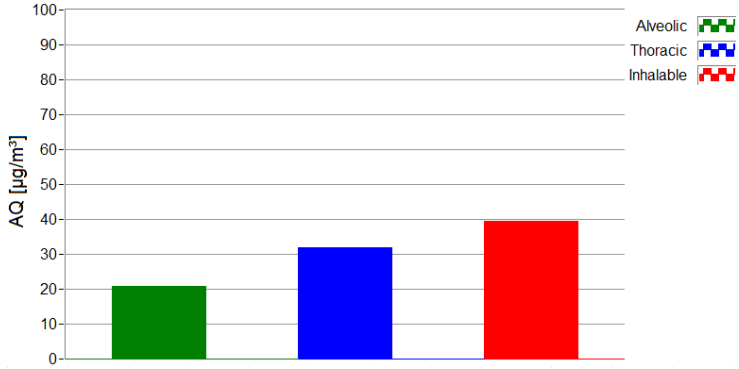

Figure 5. Inhalable-, thoracic-, and alveolar-sized particle concentrations measured on Tuesday 10 October 2023 at 4th floor.

Measurement of PM concentrations during weekend

Table 2. Recorded concentrations (min., max., and mean) for PM during Sunday 17 September 2023 at each floor.

	PM1 [µg/m3]		PM2.5 [µg/m3]		PM10 [µg/m3]	
Variable	G floor	4th floor	G floor	4th floor	G floor	4th floor
Min	7.1	4.5	7.3	4.5	7.3	4.5
Max	25	9.3	27.5	10.6	35.7	29.2
Mean	14	6.6	15.1	7.3	17.7	8.9

Table 2 represents the minimum, maximum and mean concentration of PM1, PM2.5, and PM10, recorded during Sunday 17 September 2023 at each floor (G floor = Ground floor).

Figure 6 is a graphical representation of the concentration levels of PM1, PM2.5, and PM10 at ground floor, with Figure 7 showing the same measurement details, but recorded at the 4th floor.

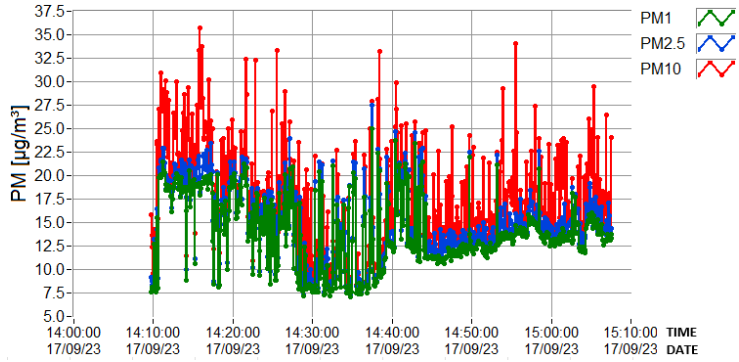

Figure 6. PM concentrations measured on Sunday 17 September 2023 at ground floor.

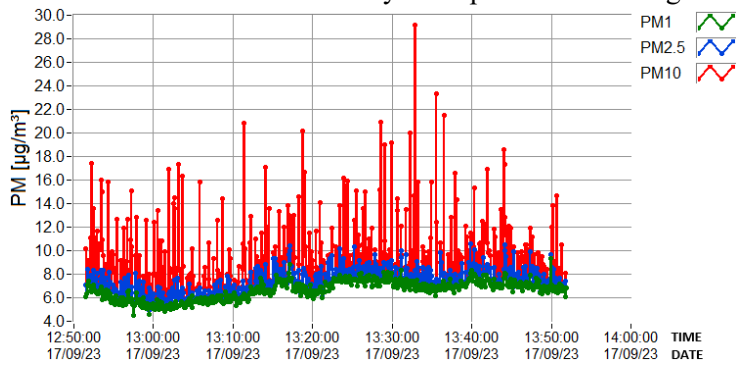

Figure 7. PM concentrations measured on Sunday 17 September 2023 at 4th floor.

Analyzing the measured results, it seems that on the 4th floor, values are slightly lower than on the ground floor, exactly the opposite to the measurement performed during the weekday. This can be attributed to lower wind speeds, which kept the PM particles more on the ground floor level, and also due to wind direction which was exactly opposite to the measurement device sensors. Figure 8 and Figure 9 are graphical representations of concentration of PM transposed to inhalable-, thoracic-, and alveolar-sized particle concentrations.

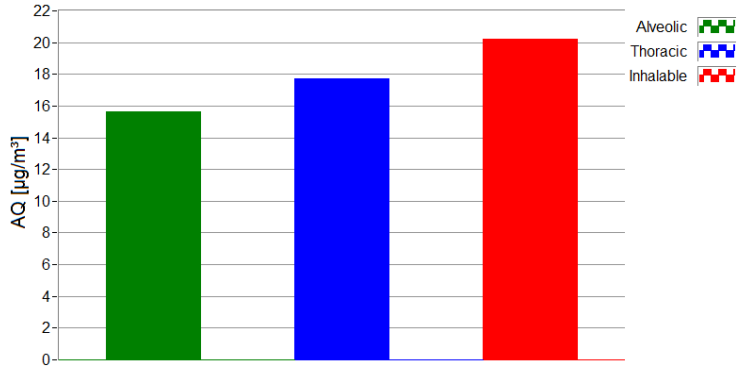

Figure 8. Inhalable-, thoracic-, and alveolar-sized particle concentrations measured on Sunday 17 September 2023 on the ground floor.

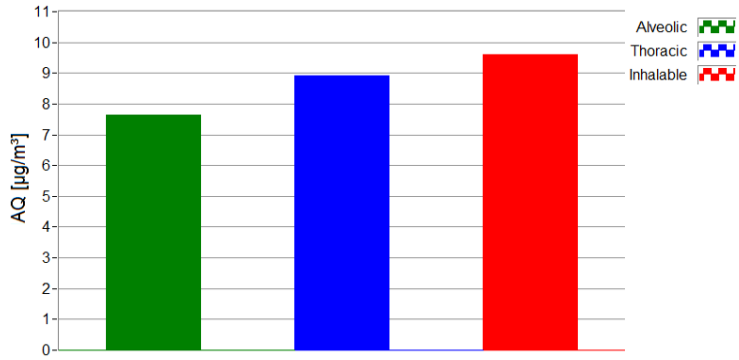

Figure 9. Inhalable-, thoracic-, and alveolar-sized particle concentrations measured on Sunday 17 September 2023 at 4th floor.

Conclusions

This research aims to share the findings and in-depth analysis of particulate matter quantification carried out in the urban area of Timisoara, Romania. The focus is on an area marked by heavy vehicular traffic, located near a notable roundabout intersection known for its substantial diameter. It's crucial to highlight that this locale includes residential homes in close proximity to the traffic-intensive area, where near such a residential building, the measurement equipment has been placed.

Based on the presented results and discussion, there are several factors which influence the spread of PM concentrations lower or higher in the atmosphere, with wind speed and direction showing the most senseful explanation for the presented differences in concentrations, comparing ground floor to 4th floor.

Even if PM1 is unregulated by any legislation of any country or governing body, PM2.5 is stated, according to European Directives, as allowing a maximum annual concentration limit of 20 µg/m^3 [13]. This value, during the approximately 4h total measurement time, exceeded 32 times, and only during the Sunday measurement.

PM10 is regulated by Romanian Law, with an annual allowed limit of 40 µg/m^3 [14]. Instances of PM10 concentrations exceeding the imposed limits are during the Tuesday measurements, whey they represent the majority of values recorded, with high vehicular traffic explaining this aspect.

Acknowledgment

The authors wish to extend their heartfelt gratitude to Diana-Raluca STREINU (M.D.) for providing invaluable medical insights pertaining to the impact of particulate matter on human health.

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Implementation of Recycling Technologies for Used Engine Oil at European Scale: a Comprehensive Analysis

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Abstract: Amid increasing apprehensions regarding the deterioration of the environment and the escalating demand for sustainable solutions, the recycling of used engine oil has emerged as a critical area of interest. One of the key driving forces behind the growing interest in used engine oil recycling is the pressing need to address the environmental concerns associated with its improper disposal. Used engine oil contains hazardous substances that, if not managed effectively, can contaminate soil and water resources, endangering ecosystems and public health. The primary purpose of this article is to comprehensively investigate the current state of used engine oil recycling technologies at European level. It seeks to shed light on the role of these technologies in promoting the circular economy, reducing environmental pollution, and conserving valuable resources.

Furthermore, this article emphasizes the economic and environmental benefits of used engine oil recycling. Recycling technologies not only reduce the demand for virgin oil but also mitigate greenhouse gas emissions associated with oil production. In the context of sustainable development, the recycling of used engine oil aligns with the principles of the circular economy, which aim to decouple economic growth from resource consumption and promote the efficient use of materials. By recycling used engine oil, Europe can recover valuable base oil and other by-products, reducing its reliance on imported resources and minimizing waste generation [2]. This study on the application of used engine oil recycling technologies on European level provides valuable insights into the current state of recycling technologies and their potential to contribute to a circular economy.

Keywords: engineering, used engine oil, internal combustion engine, recycling technologies, sustainable development, circular economy

1 Introduction

Used engine oil poses a hazard to both ecological systems and human well-being. Resulting from the degradation of the oil that ensures the lubrication of the engine components, this type of waste presents a serious degree of risk, due to the high content of pollutants.

The most dangerous compounds that degrade used engine oil are:

- Polycyclic aromatic hydrocarbons (benzanthracene, benzopyrene, naphthalene, etc.): they appear as a result of incomplete combustion of the fuel and present a carcinogenic risk [1];
- Polychlorinated biphenyls: consisting of organic compounds that have been used in

the past as additives for lubricants. They are particularly dangerous due to their carcinogenic risk and high toxicity [2].

- Heavy metals (Fe, Cr, Ni, Pb, Cu, Zn): attributed to the wear and tear of metallic engine components during the operational process [3];

Due to these contaminants, used engine oil falls into the category of hazardous waste and must be managed with great care. That is why a number of recycling technologies have been implemented at European level, adopted by countries interested in moving to a circular economy. The purpose of this article is to provide an overview of these technologies, highlighting the different recycling methods adopted at European level, as well as the advantages of using them, both ecologically and economically.

2 Recycling technologies applied in Europe

It is obvious that the recycling process of used engine oil is preferable to other methods of its management, such as energy recovery by incineration or storage in landfills. This is also underlined by the European norms for hazardous waste management (and not only), which can be summarized in the pyramid of available choices for the management of used engine oil (Figure 1).

2.1 HyLube technology – PURAGLOBE (Germany)

The underlying technical principle of HyLube technology involves the application of Direct Contact Hydrogenation (DCH). Illustrated in Figure 2, the process encompasses a series of sequential steps commencing with mixing the used engine oil with heated hydrogen. Subsequently, this mixture is introduced into a separating flash, wherein a fraction of the contaminants, including metals, solid impurities, and a minor quantity of hydrocarbons, undergo separation. The oil, now separated from impurities, is directed to a catalytic reactor designed to eliminate any remaining soluble metals. Following this, the oil undergoes hydroprocessing (HPS) in both hot and cold stages, facilitating reactions essential for the purification of used oil. Key reactions involved in this stage include desulfurization, dechlorination, oxygenate conversion, denitrification, aromatic saturation, and mild hydrocracking [5].

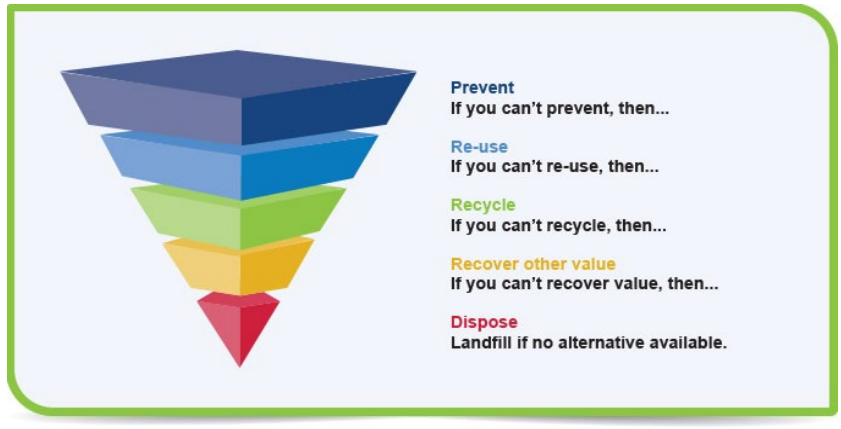

Figure 1. The ranking of available choices for the management of used engine oil [1]

The concluding phase involves isolating water and gases from the oil fraction, after which the separated oil is gathered and directed to the additive section for enhancement of its

properties, facilitating its reintroduction into the automotive circuit.

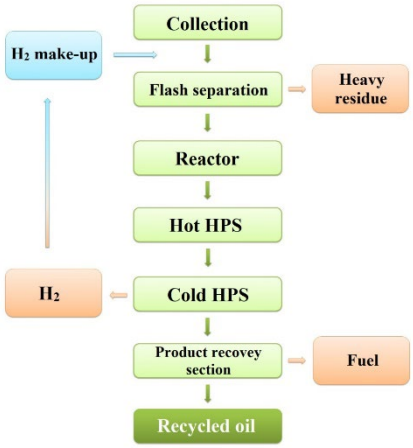

Figure 2. Block diagram of the HyLube process [6]

The HyLube technology represents the pioneering recycling method wherein the used engine undergoes processing within a pressurized hydrogen environment, without the need for any pre-treatment. The process is applied, at European level, by the company PURAGLOBE Holding GmbH, based in Chemical and Industrial Park Zeitz, Germany [7].

2.2 VAXON technology – Avista Oil (Denmark)

The Vaxon process (depicted in Figure 3) comprises chemical treatment, vacuum distillation, and solvent refining units. The distinctive feature of this method lies in its specialized vacuum distillation unit, known as the Vacuum Cyclon Flash Evaporator, which significantly reduces the cracking of oil.

In the initial phase of the procedure, chemical treatment is conducted using alkali-hydroxides (sodium- and potassium-hydroxide) to eliminate chlorides, metals, additives, and acidic compounds. Insoluble alkali hydroxides undergo a transformation into alkoxides on the catalyst surface, rendering them soluble in oil. These reactants form bonds with impurities, such as chlorides, metals, additives, and acidic compounds, associating them with asphaltene molecules. Consequently, these impurities can be readily separated from the oil. [5].

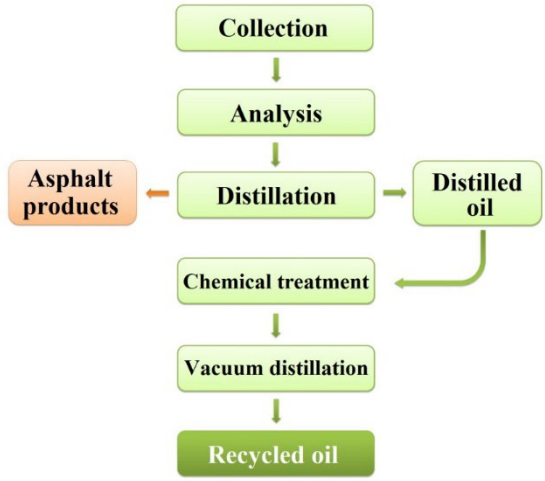

Figure 3. Block diagram of the Vaxon process [5]

Following the chemical treatment, the feed undergoes separation into light products, catalysts, base oils, and residue. A cyclonic column is employed to distill the feed into two parts, facilitated by the formation of a tangentially flowed thin film, ensuring the rapid and efficient distillation of light hydrocarbons. Polycyclic aromatic hydrocarbons are isolated through solvent refining utilizing polar solvents such as dimethyl-formamide and n-methyl-2-pyrrolidone. This process occurs within a multistage extractor, with subsequent solvent recovery from both phases. The raffinate, containing a broad boiling range of base oil, can be fractionated through vacuum distillation to obtain base oils with different viscosity grades. The concentrated polycyclic aromatic hydrocarbons in the extract find application in

heat energy production or serve as a component in bitumen blending [8].

This technology is attributed to Avista Oil, a prominent European producer of rerefined base oils and a key player in the industry. The recycling plant is based in Kalundborg, Denmark, and it has the capacity to generate 40 000 tons/year of recycled oil [9].

2.3 REVIVOIL technology – Viscolube (Italy)

The Revivoil technology, illustrated in Figure 4, relies on two primary processes: thermal de-asphalting (TDA) and hydrofinishing (HDF).

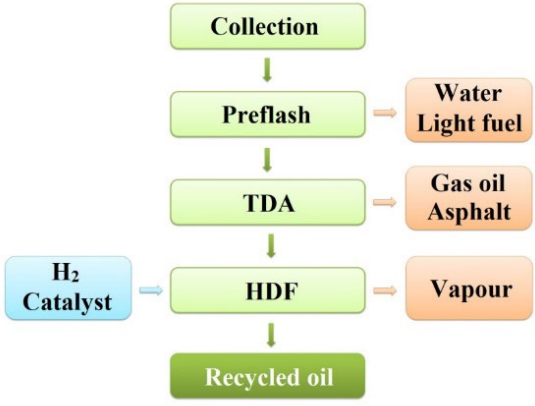

Figure 4. Block diagram of the Revivoil process [6]

Filtered used oil retrieved from storage tanks undergoes pre-heating and blending with additives aimed at reducing fouling. Once heated to a temperature of 140 ºC, the resulting mixture is directed to a preflash column. The mixture, consisting of water and light hydrocarbons, is then extracted from the top of the separation column and subsequently condensed to separate its components.

The dehydrated oil from the preflash unit is routed to the Thermal De-Asphalting unit (TDA). Within the TDA unit, the oil is isolated from substances that could induce fouling in an intermediate tank. The oil, now heated to 350 °C, undergoes fractionation in the TDA distillation column under vacuum conditions (15 Torr). This process results in the separation of the diesel fraction from the top of the column and the asphalt fraction from the bottom. Concurrently, the oil is fractionated into three distinct lubricant cuts with varying viscosity grades. These cuts are then subjected to stripping in a dedicated column and subsequently cooled. To enhance product quality, the oil cuts post-TDA are refined through contact with hydrogen over a catalyst. This catalytic process enables the removal of metals and metalloids, organic acids, sulfur- and nitrogen-containing compounds, thereby improving the color and thermal stability of the oil [6].

This technology is applied in Europe in Viscolube's facilities. Established in 1963, Viscolube manufactures a lubricating base oil with properties deemed superior to those of the virgin base oils presently available in the market. With two production facilities in Italy, Viscolube has the capability to process over 190,000 tons/year of waste oil, resulting in the production of more than 110,000 tons/year of re-refined base oil and 20,000 tons/year of bitumen [10].

2.4 Sotolub technology – Eco Huile (France)

The Sotulub process (figure 5) is based on treatment of the used oil with an alkali additive called Antipoll and high vacuum distillation.

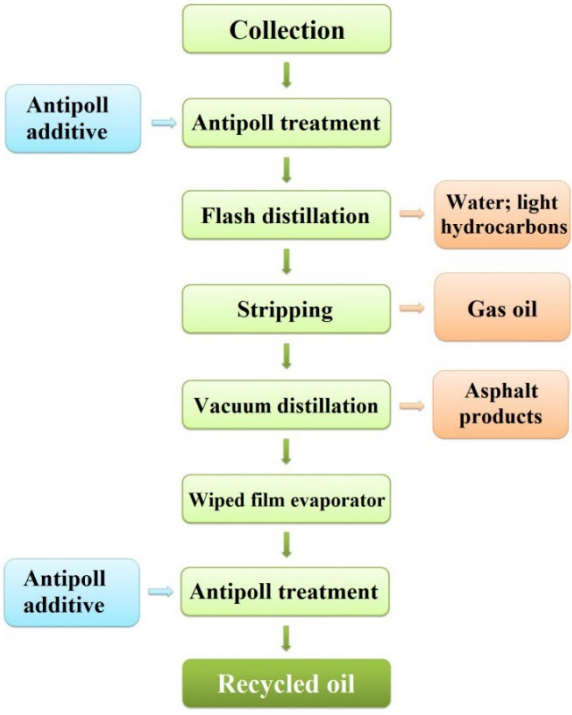

Figure 5. Block diagram of the Sotolub process [8]

The used engine oil undergoes pre-heating to approximately 160 ºC and is combined with a minimal quantity of Antipoll-additive, effectively mitigating equipment fouling. Subsequently, the oil is introduced into the flash-drum, where the separation of water and light hydrocarbons from the lubricating base occurs. The dehydrated oil undergoes an additional heating process, reaching 280 ºC, and is subjected to vacuum conditions to eliminate the gas-oil fraction. Following this, the oil undergoes high-vacuum distillation in a thin-film evaporator. Within this procedure, asphaltic residue, containing heavy metals, additives, polymers, and degraded products, is segregated from the column's bottom. The distilled oil is then condensed and treated once more with a small quantity of Antipoll to eradicate any residual undesirable compounds thoroughly. This methodology enables the attainment of a final product of acceptable quality without necessitating supplementary finishing stages. Optionally, the oil can be further fractionated to obtain diverse base oil cuts [8].

2.5 Cyclon technology - Cyclon Hellas (Greece)

The Cyclon process (figure 6) includes three technologies: vacuum distillation, propane de-asphalting (PDA) and hydrofinishing.

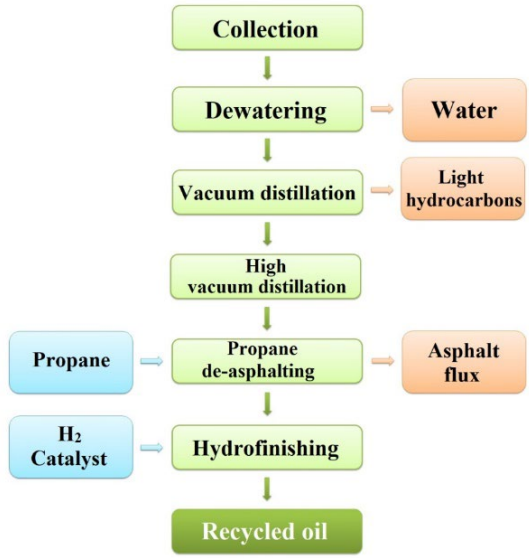

Figure 6. Block diagram of the Cyclon process [6]

Used oil is withdrawn from storage tanks, subjected to dewatering, and undergoes distillation to remove light hydrocarbons. The resulting heavier fraction is directed to high vacuum distillation, where the majority of base oil components evaporate from the residual heavy fraction. Propane is employed in the de-asphalting unit to extract oils from the residues, which are then processed in the hydro-

processing unit. Subsequently, the oils undergo treatment with hydrogen and are fractionated based on the desired base oil features [6].

The rerefined base oil products exhibit high quality owing to the hydrogenation process. This method is currently employed in Greece, where Cyclon Hellas Company utilizes the technology with an annual capacity of 40,000 tons. [8].

3 Concluding about advantages and opportunities of recycling used engine oil

Beyond the status of hazardous waste, engine oil is a by-product with a high economic value. By recycling it, therefore, both ecological advantages and economic opportunities can be highlighted [11].

3.1 Ecological advantages

- Reduction of used engine oil pollution;
- Minimizing the number of heavy metals, polycyclic aromatic hydrocarbons and polychlorinated biphenyls that reach the environment;
- Reducing the likelihood of hydrographic network contamination.
- Mitigation of toxic emissions that could have originated from the incineration of used engine oil, preventing their release into the atmosphere;
- Reduction of pollution associated with the exploitation of petroleum products;
- Conservation of natural resources.

3.2 Economic opportunities

- Promoting the implementation of a circular economy and fostering a sustainable society;
- Minimizing the utilization of virgin oils and mitigating associated production expenses;
- Decreasing the financial burden of disposing of used engine oil through alternative methods;
- Establishing recycling facilities with the capacity to generate significant employment opportunities.
- Augmenting the economic value of a region through the establishment of companies dedicated to the recycling of used engine oil.;
- Winning European grants dedicated to solving environmental problems for used engine oil recycling projects.
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Short Comparative Analysis of Fuels for Thermal Engines concerning Performance, Efficiency, and Environmental Impact

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Abstract: This academic scientific article presents a comprehensive comparison of various fuels used in thermal engines, particularly internal combustion engines (ICEs) and gas turbines. Performance, thermal efficiency, and environmental impact are systematically evaluated for conventional fossil fuels (e.g., gasoline and diesel), alternative fuels (such as biofuels and natural gas), and emerging energy carriers like hydrogen. Through a combination of rigorous experimentation and computational modeling, the combustion characteristics, energy conversion efficiency, and greenhouse gas emissions associated with each fuel type are analyzed. The results yield valuable insights into the trade-offs inherent to different fuels, illuminating their suitability for various applications ranging from automotive engines to power generation. Furthermore, this research contributes to the ongoing discussion surrounding sustainable energy sources, providing data-driven recommendations for optimizing thermal engine performance while mitigating environmental consequences.
Keywords: Engineering, Environment, Fuel, Thermal engines, environment impact, comparative analysis.

1 Introduction

The pursuit of sustainable energy solutions in the face of growing global energy demands and environmental concerns has spurred extensive research into the development and optimization of thermal engines. These engines are vital in powering various forms of transportation, electricity generation, and industrial processes, and their efficiency and environmental impact are of paramount importance.

The selection of fuels for thermal engines is a crucial aspect of engineering and design, as it directly influences performance, efficiency, and environmental consequences. In this context, the present scientific paper, "A Comparative Analysis of Fuels for Thermal Engines: Examination of Performance, Efficiency, and Environmental Impacts," undertakes a comprehensive exploration of the various fuels commonly employed in thermal engines, offering a comparative analysis that goes beyond traditional boundaries

1.1 General Points

A diverse range of fuels used in thermal engines, including traditional fossil fuels, biofuels, hydrogen, and advanced synthetic fuels, is covered. Various performance metrics, such as power output, thermal efficiency, and energy density, are investigated to understand the influence of these fuels on engine operation, while the environmental implications, specifically greenhouse gas emissions, pollutants, and overall sustainability, are assessed. The complex interplay between performance, efficiency, and environmental impacts is delved into, considering trade-offs and synergies between these factors. Opportunities for innovation in fuel development, engine design, and policy-making

to enhance the sustainability and efficiency of thermal engines are identified. Practical insights and recommendations are provided for engineers, researchers, and policy-makers to facilitate informed decision-making regarding fuel choices for thermal engines, ensuring alignment with sustainability and performance goals. This comprehensive analysis, presented in image 1, contributes to an improved understanding of the intricate relationships between fuel selection and thermal engine operation, with a focus on the advancement of sustainable, efficient, and environmentally responsible technologies in the field [2].

Table 1. Primary Energy Consumed Globally in Million Tons of Oil Equivalent (Mtoe) Projected to 2000 [1].

Mtoe	1990		2000	
	Total	Share of Total	Total	Share of Total
Fossil Fuels	7,164	88.1%	8,128	86.8%
-Oil	3,161	38.9%	3,582	38.2%
-Coal	2,233	27.4%	2,369	25.3%
-Natural Gas	1,770	21.8%	2,177	23.2
Renewables	519	6.4%	654	7.0%
-Hydro	490	6.0%	602	6,4%
-Wind	1	0%	7	0.1%
-Solar	0	0%	0	0%
-Biomass and other	28	0.3%	45	0.6%
Nuclear	453	5.6%	584	6.2%
Total World	8,136	100%	9,366	100%

Table 2. Primary Energy Consumed Globally in Million Tons of Oil Equivalent (Mtoe) Projected to 2035 [1]

Mtoe	2014		2035	
	Total	Share of Total	Total	Share of Total
Fossil Fuels	11,193	86.2%	14,187	81.8%
-Oil	4,211	32.4%	5,065	29.2%
-Coal	3,882	29.9%	4,564	26.3%
-Natural Gas	3,100	23.9%	4,558	26.3%
Renewables	1,147	8.8%	1,994	11.5%
-Hydro	843	6.5%	1,112	6.4%
-Wind	154	1.2%	332	1.9%
-Solar	40	0.3%	431	2.5%
-Biomass and other	110	0.8%	119	0.7%
Nuclear	649	5.0%	1,167	6.7%
Total World	12,989	100%	17,348	100%

Table 1 and table 2 provide an overview of the global energy supply distribution by fuel type for the years 1990, 2000, 2014, and projected values for 2035. The values are presented in million tonnes of oil equivalent (Mtoe), along with each fuel's share of the total primary energy supply.

Fossil fuels (oil, coal, and natural gas) have consistently dominated the global energy mix. In 1990, fossil fuels accounted for 88.1% of the total energy supply, decreasing only slightly to a projected 81.8% by 2035. Oil has maintained the largest share among fossil fuels, starting at 38.9% in 1990 and dropping to 29.2% by 2035. Coal's share decreased from 27.4% in 1990 to 26.3% in 2035, while natural gas increased from 21.8% to 26.3% over the same period.

Renewable energy sources have gradually increased their overall share. In 1990, renewables contributed only 6.4% of the total, with hydroelectric power supplying nearly all of this (6.0%). By 2014, renewables had grown to 8.8% and are projected to reach 11.5% by 2035, largely due to significant growth in wind and solar power. Wind energy rose from a negligible share in 1990 to 1.9% in 2035, while solar expanded from 0% to 2.5%. Biomass and other renewables remain minor contributors, increasing from just 0.3% in 1990 to 0.7% in

2035.
Nuclear energy has shown modest growth, moving from a 5.6% share in 1990 to a projected 6.7% in 2035.
The aggregate global energy supply increased substantially over the period, rising from 8,136 Mtoe in 1990 to a projected 17,348 Mtoe by 2035. Although fossil fuels remain dominant, the data demonstrates a slow but steady transition towards renewable sources and nuclear energy, reflecting ongoing diversification in the world's energy portfolio and a gradual move toward more sustainable energy production.

2 Fossil fuels

Fossil fuels are hydrocarbon-based energy sources. They are formed from the remains of ancient plants and animals that lived millions of years ago. Over time, the organic matter from these ancient organisms was subjected to heat and pressure, and it transformed into the fossil fuels we use today. The three primary types of fossil fuels are:

Coal: Formed from the remains of plants in swampy, low-oxygen environments. It is a black or brownish-black sedimentary rock that can be burned to produce heat and electricity.

The extraction of coal, a prominent fossil fuel, entails a multistage process. The exploration phase involves rigorous geological surveys and drilling operations to pinpoint coal deposits within diverse geological strata. Subsequently, coal extraction predominantly transpires through two principal methodologies. Underground mining necessitates the development of intricate tunnel networks and shafts to access subterranean coal seams. Conversely, open-pit mining involves extensive surface excavation, frequently executed in expansive, accessible coal-bearing areas. Once extracted, coal enters a refinement phase aimed at the removal of impurities and contaminants. This preparatory stage ensures the coal's suitability for diverse applications, encompassing its utilization in electricity generation, industrial heating, and manufacturing processes [2,3].

Oil (Petroleum): Comprised of the remains of tiny aquatic organisms, primarily plankton, which accumulated on the ocean floor and were buried over time. It is a liquid hydrocarbon that is refined to produce various products, including gasoline, diesel fuel, and jet fuel.

The procurement of crude oil, or petroleum, represents a comprehensive process commencing with the exploration phase. Geological surveys and prospecting operations are conducted to identify underground reservoirs, often residing below the Earth's surface or beneath ocean floors in offshore locales. Extraction methodologies are predominantly realized through drilling, encompassing both onshore and offshore operations. Offshore drilling frequently necessitates the deployment of oil platforms in marine environments, a distinguishing feature of offshore oil exploration. In circumstances where unconventional oil reserves are targeted, such as shale oil, hydraulic fracturing, colloquially known as fracking, is employed. Post-extraction, crude oil undergoes a crucial refinement phase at specialized refineries. These facilities engage in a sequence of refining processes to derive various derivatives, including gasoline, diesel fuel, jet fuel, and petrochemical feedstocks, from the raw crude [4,5].

Natural Gas: Comprised mainly of methane, natural gas is formed similarly to oil but usually originates from deeper underground. It serves as a gaseous fossil fuel utilized for heating, electricity generation, and as a vehicle fuel. The extraction of natural gas, another integral fossil fuel, mirrors the multifaceted process

associated with oil procurement. Geological surveys and drilling operations are deployed in the exploration phase to locate subsurface reservoirs, frequently in proximity to oil reserves. The extraction phase typically relies on drilling techniques, similar to those used for oil. Such procedures are applicable to both land-based and offshore natural gas reserves. Furthermore, in the context of unconventional natural gas reservoirs, hydraulic fracturing, or fracking, is a pivotal technique, often employed to unlock gas reserves trapped in shale formations.

Following extraction, natural gas is subjected to a refining phase to eliminate impurities and ensure compliance with safety and quality standards. This processed natural gas is subsequently transported, predominantly through pipelines, for local distribution or international export, with liquefied natural gas (LNG) facilities serving as a conduit for the latter [4.5.6].

Fossil fuels have been the primary source of energy for much of the modern industrial era due to their high energy density and ease of extraction. Nevertheless, the combustion of fossil fuels releases carbon dioxide (CO2) and other greenhouse gases into the atmosphere, contributing to global warming and climate change. Consequently, there is a growing interest in transitioning to cleaner, more sustainable energy sources to mitigate the environmental impact linked with fossil fuel use.

2.1 Gasoline

Gasoline has been an integral part of modern transportation and industrial processes for over a century, serving as the primary fuel for internal combustion engines. This chapter delves into the characteristics, historical significance, production, and environmental impact of gasoline, highlighting its role as a cornerstone in the realm of thermal engines. Gasoline is a complex mixture of hydrocarbons, typically comprising alkanes, cycloalkanes, and aromatic compounds. The specific composition of gasoline can vary, leading to different grades and octane ratings. The octane number is a crucial property, indicating the fuel's resistance to knocking or detonation in high-compression engines. Understanding the chemical makeup of gasoline is essential for optimizing engine performance and reducing emissions.

Gasoline is a complex mixture of hydrocarbons. The chemical composition of gasoline can vary based on the source of crude oil and the refining process. However, gasoline primarily consists of hydrocarbons, typically alkanes, cycloalkanes, and aromatic compounds.

The main constituents are usually compounds with the general formula C_nH_{2n}+2 for alkanes, C_nH_{2n} for cycloalkanes, and $C_6H_5C_nH_{2n-6}$ for aromatic compounds, where "n" represents the number of carbon atoms in the specific hydrocarbon. The complete combustion of gasoline, which is a mixture of various hydrocarbons, can be represented more accurately as a balanced chemical equation. A simplified representation is as follows:

$2C_8H_{18}$ (Octane, a common component of gasoline) + $25O_2$ (oxygen from the air) → $16CO_2$ (carbon dioxide) + $18H_2O$ (water) + energy. (1)

In this equation, 2 moles of octane (C_8H_{18}) combine with 25 moles of oxygen (O_2) from the air to produce 16 moles of carbon dioxide (CO_2), 18 moles of water (H_2O), and energy in the form of heat.

This equation reflects the balanced chemical reaction that occurs during the combustion of gasoline. However, it's important to note that the actual composition of gasoline can vary, and incomplete combustion or the presence of impurities can lead to the formation of other by-

products, such as carbon monoxide (CO), nitrogen oxides (NO_x), and unburned hydrocarbons, which are pollutants and need to be controlled in modern engines for environmental and health reasons.

Due to the diverse range of hydrocarbons present in gasoline, it's a complex mixture with various chemical structures. This complexity is what allows gasoline to burn efficiently in internal combustion engines, releasing energy for propulsion. The precise composition of gasoline may vary among different grades and suppliers, and it often contains additives to improve performance and reduce emissions [7].

2.2 Diesel

Diesel fuel, a crucial component of the global energy landscape, has played an instrumental role in powering transportation, industry, and electricity generation. This chapter explores the chemical composition of diesel fuel, its historical significance, production, and the detailed chemistry involved in its combustion within diesel engines.

Diesel fuel primarily consists of hydrocarbons, like alkanes, cycloalkanes, and aromatic compounds. The chemical formula for diesel fuel can vary depending on its source and manufacturing processes, but it is predominantly composed of carbon (C) and hydrogen (H) atoms. These hydrocarbons possess higher energy density compared to gasoline, making diesel fuel a preferred choice for heavy-duty applications such as trucks, ships, and power generation.

The combustion of diesel fuel can be represented by the following balanced chemical equation:

$C_{12}H_{26}$ (Dodecane, a common component of diesel fuel) + 37/2 O_2 (oxygen from the air) → 12 CO_2 (carbon dioxide) + 13 H_2O (water) + energy. (2)

The chemical equation does not explicitly show the energy released during the combustion process, but it's understood that the process releases energy in the form of heat. This balanced chemical equation illustrates the chemical reaction that occurs when diesel fuel, represented by dodecane, is burned in a diesel engine. It outlines how dodecane combines with oxygen to produce carbon dioxide, water, and release energy in the form of heat [6,7].

2.3 Biofuel

Biofuels represent a promising avenue for reducing the environmental impact of the transportation and energy sectors while promoting energy security. This chapter delves into the world of biofuels, focusing on their types, production methods, and their potential to mitigate the environmental challenges posed by traditional fossil fuels.

Biofuels are categorized into two primary types: first-generation and advanced (second and third-generation) biofuels.

2.3.1 First-Generation Biofuels

These biofuels are typically derived from edible crops and are produced using conventional techniques. Common examples include:

a). Biodiesel: Made from vegetable oils or animal fats through a process called transesterification.

b). Ethanol: Produced from corn, sugarcane, or other high-starch and high-sugar crops through fermentation.

2.3.2 Advanced (Second and Third-Generation) Biofuels

These biofuels are developed from non-food feedstocks, including algae, woody biomass, and waste materials. Examples include:

a). Algal Biofuels: Grown from microalgae,

which can produce high yields of oil for conversion into biofuels.
b). Cellulosic Ethanol: Made from non-food plant materials like switchgrass and agricultural residues.

Biofuels offer several environmental advantages, including reduced greenhouse gas emissions. These energy sources have the potential to be carbon-neutral or even carbon-negative since the carbon dioxide released during combustion is balanced by the carbon absorbed during the growth of the feedstock. Biofuels produce fewer harmful pollutants like sulphur and particulate matter compared to fossil fuels. By diversifying energy sources, biofuels reduce dependence on fossil fuel imports.

Biofuels hold significant potential for a more sustainable and environmentally friendly energy future. As technological advancements continue and feedstock sources diversify, biofuels are poised to play an increasingly vital role in reducing greenhouse gas emissions and addressing the challenges of climate change. Understanding the different types of biofuels and their production processes is crucial in harnessing their potential to create a cleaner and more sustainable energy landscape.

The chemical equation for the combustion of biodiesel (fatty acid methyl esters) is as follows:

$2C_{19}H38O_2$ (Biodiesel) + $57O_2$ (oxygen from the air) → $38CO_2$ (carbon dioxide) + $38H_2O$ (water) + energy. (3)

The chemical equation for the combustion of ethanol is as follows:
C_2H_5OH (Ethanol) + $3O_2$ (oxygen from the air) → $2CO_2$ (carbon dioxide) + $3H_2O$ (water) + energy. (4)

These chemical equations illustrate the combustion of biofuels, such as biodiesel and ethanol, in which the biofuels combine with oxygen from the air to produce carbon dioxide, water, and release energy. This combustion process releases energy that can be harnessed for various applications, including transportation and power generation [8,9].

2.4 Natural gas

Natural gas is a versatile fossil fuel primarily composed of methane (CH_4) and small amounts of other hydrocarbons. It is widely used for electricity generation, heating, and as a transportation fuel. In this chapter, we will explore the chemical composition, extraction, combustion, and environmental considerations related to natural gas.

The primary constituent of natural gas is methane (CH_4), a simple hydrocarbon. In addition to methane, natural gas may contain small amounts of other hydrocarbons like ethane, propane, and butane, as well as non-hydrocarbon gases such as carbon dioxide (CO_2), nitrogen (N_2), and hydrogen sulfide (H_2S). Understanding the chemical composition is fundamental to comprehending its combustion and environmental impact. Natural gas is extracted from subterranean reservoirs using drilling and extraction techniques. The chapter provides insights into the extraction process, including drilling methods, hydraulic fracturing (fracking), and the significance of processing to remove impurities.

The combustion of natural gas is characterized by its clean-burning nature. The chemical equation for the combustion of methane is as follows:
CH_4 (Methane) + $2O_2$ (oxygen from the air) → CO_2 (carbon dioxide) + $2H_2O$ (water) + energy. (5)

Natural gas, with its methane-rich composition and clean-burning characteristics, offers an

essential bridge in the transition to a more sustainable energy landscape. Understanding its chemical properties, extraction processes, combustion, and environmental considerations is vital for harnessing its potential while mitigating its associated challenges [7,8].

2.5 Hydrogen

Hydrogen, with the chemical symbol H, exists primarily as diatomic molecules (H_2) and is highly reactive. Its unique properties make it a valuable energy carrier.

This section delves into the molecular structure and reactivity of hydrogen, laying the foundation for understanding its use in energy applications. Hydrogen's versatility extends to multiple applications, such as fuel cells for electricity generation, transportation fuel in hydrogen-powered vehicles, and industrial processes.

The combustion of hydrogen primarily results in the formation of water vapor (H_2O) and heat, with minimal greenhouse gas emissions. The chemical equation for the combustion of hydrogen is:

$$2H_2 \text{ (hydrogen)} + O_2 \text{ (oxygen)} \rightarrow 2H_2O \text{ (water)} + \text{energy.} \quad (6)$$

This equation (6) is useful to underscore the clean-burning nature of hydrogen and its environmental benefits.

Hydrogen, as a clean and versatile energy carrier, is poised to play a vital role in addressing the environmental and energy challenges of the 21st century. Understanding the chemistry, production methods, and applications of hydrogen is key to harnessing its potential and realizing a sustainable energy future [9,10].

3 Comparison analysis

Table 3. Comparison between the fuels [11].

	Gasoline	Methanol	Biodiesel
Chemical structure	C4 to C12	CH3OH	Methyl esters
Main fuel source	Crude oil	natural gas, coal, woody, biomass	soybean oil, waste cooking, oil, animal fat
Energy content per liter [MJ/kg]	47.3	19.93	37.27
Energy ratio compared with gasoline	1.00:1.00	1.75:1.00	1.10:1.00

Table 4. Comparison between the fuels [11].

	Hydrogen	Compressed Natural Gas	Liquified Natural Gas
Chemical structure	H_2	CH_4	CH_4
Main fuel source	natural gas, methanol, other sources	underground reserves	underground reserves
Energy content [MJ/kg]	120.971	53.6	54 to 56
Energy ratio compared with gasoline	3.94:1.00	1.55:1.00	1.55:1.00

The comparative tables 3 and table 4 outline the fundamental characteristics of six fuel types: gasoline, methanol, biodiesel, hydrogen, compressed natural gas (CNG), and liquefied natural gas (LNG). Each fuel is evaluated based on its chemical structure, primary source, energy content per kilogram, and its energy

ratio relative to gasoline.

Gasoline consists of hydrocarbons with carbon chains ranging from C_4 to C_{12} and is derived from crude oil. Methanol, represented by the chemical formula CH_3OH, is typically sourced from natural gas, coal, and various forms of woody biomass. Biodiesel is composed of methyl esters and produced from renewable resources such as soybean oil, waste cooking oil, and animal fat. Hydrogen can be obtained from natural gas, methanol, and other sources. Both compressed and liquefied natural gas consist predominantly of methane extracted from underground reserves.

The energy content per kilogram varies significantly among these fuels. Hydrogen exhibits the highest energy content, at 120.971 MJ/kg, followed by liquefied natural gas at 54–56 MJ/kg, compressed natural gas at 53.6 MJ/kg, gasoline at 47.3 MJ/kg, biodiesel at 37.27 MJ/kg, and methanol at 19.93 MJ/kg.

When normalized to gasoline (set as the baseline with a ratio of 1.00:1.00), methanol offers approximately 1.75 times less energy per unit, while biodiesel's energy ratio is slightly lower at 1.10:1.00. Hydrogen stands out, providing nearly four times the energy compared to gasoline (3.94:1.00). CNG and LNG demonstrate similar ratios of 1.55:1.00, indicating higher energy density than gasoline.
In summary, hydrogen is notable for its exceptional energy content, while natural gas variants (CNG and LNG) also provide more energy than traditional gasoline. Alternative fuels such as methanol and biodiesel have lower energy densities but derive from a diverse set of renewable and non-renewable sources, making them relevant for sustainable energy strategies.

3.1 Performance

When evaluating the performance of these fuels, several factors come into play. Gasoline and diesel, traditional liquid fossil fuels, have well-established characteristics in terms of energy density. They offer high energy content per unit of volume or weight, making them efficient choices for various applications. Biofuels, derived from organic materials, also exhibit energy density comparable to that of gasoline and diesel. Natural gas, while a gaseous fuel, offers respectable energy density and is widely used in transportation. Hydrogen, on the other hand, has a lower energy density, necessitating advanced storage and transport solutions. Additionally, hydrogen's combustion characteristics, including a broad flammability range and rapid flame speeds, can influence engine design and performance, posing both advantages and challenges.

3.2 Efficiency

Efficiency considerations are vital for determining the viability of these fuels. Gasoline and diesel engines, operating on the Otto and Diesel cycles, respectively, are capable of achieving reasonable thermal efficiencies, typically ranging from 20-30%. In contrast, hydrogen can be utilized in combustion engines or fuel cells. Fuel cells, in particular, exhibit higher thermal efficiencies, often surpassing 50%, due to the more direct conversion of chemical energy into electricity. Hydrogen's efficiency stems from the elimination of various energy losses associated with fossil fuel combustion, such as heat and friction-related losses.

3.3 Environmental Impacts

Assessing the environmental impacts of these fuels is pivotal in the transition to more sustainable energy options. Gasoline and diesel combustion release significant carbon dioxide (CO_2) and other pollutants, contributing to global warming and air quality deterioration. Biofuels, derived from renewable sources, have

the potential to reduce greenhouse gas emissions, especially when sustainably produced.

Natural gas combustion, while emitting less CO_2 compared to liquid fossil fuels, still poses environmental concerns. Hydrogen's environmental impact varies depending on its production method. When produced from renewable sources or through green hydrogen production, hydrogen can be nearly emission-free, aligning with sustainability goals. Hydrogen combustion generates minimal air pollutants, benefiting local air quality and public health [9,10,11,12].

In terms of resource sustainability, gasoline and diesel are derived from non-renewable fossil sources and are finite resources, often associated with environmental disruptions during extraction.

Biofuels, sourced from organic materials, can be produced sustainably, and their use supports circular economy principles. Natural gas, while relatively abundant, poses extraction-related environmental challenges. Hydrogen's sustainability depends on the method of production. Green hydrogen, produced from renewable energy sources, offers a sustainable alternative, while other methods may have varying environmental implications.

Finally, infrastructure considerations should not be overlooked. Gasoline, diesel, and natural gas benefit from well-established infrastructure, whereas hydrogen infrastructure is less developed and may require significant investment for widespread adoption. Ultimately, the choice between these fuels will hinge on the specific application, environmental objectives, and available technology, recognizing the continuous evolution of technologies and regulations [12,13,14].

4 Closing observations

In this study, a comprehensive comparative analysis was conducted on various fuels used in thermal engines, focusing on performance, efficiency, and environmental impacts. The findings indicate that hydrogen emerges as the best option for fuel in thermal engines, offering substantial advantages:

Performance Superiority: Hydrogen demonstrates exceptional performance characteristics, surpassing other fuels like gasoline, diesel, and natural gas. Its high energy density and combustion efficiency make it an attractive choice for engine designers and operators.

Efficiency and Emissions Reduction: Hydrogen significantly enhances the efficiency of thermal engines while concurrently reducing emissions. It stands out as clean and efficient fuel, making it an environmentally responsible choice.

Environmental Responsibility: The study underscores the crucial role of hydrogen in reducing greenhouse gas emissions and air pollutants. Its sustainability and minimal environmental impact position hydrogen as the ideal choice to meet emission reduction targets. Technological Advancements: Ongoing technological advancements in hydrogen fuel cells and combustion systems further solidify hydrogen's position as the frontrunner. These innovations offer immense potential for enhanced performance and reduced environmental footprints.

Policy Implications: Policymakers and industry stakeholders should recognize the compelling advantages of hydrogen as a fuel source. Effective policies and incentives that encourage the adoption of hydrogen in thermal engines are pivotal for a sustainable and clean energy future.

5 Conclusion

The evidence from this study strongly supports hydrogen as the premier option for fuel in thermal engines. Its outstanding performance, efficiency gains, and environmental responsibility set it apart as the optimal choice. Collaborative efforts between researchers, policymakers, and industry leaders are paramount to promote the widespread adoption of hydrogen and reduce the environmental impact of thermal engine operations.

The findings underscore the importance of recognizing hydrogen's potential and the need for continued research and development efforts to maximize the benefits of this exceptional fuel source.

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Theoretical Aspects Concerning Pollution Generated by Road Vehicles

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Abstract: The purpose of this scientific work is to present the pollution of the atmosphere generated by traffic in the road transport sector, whether the pollution is generated by exhaust gases or due to rubber particles resulting from tire wear. Equally the particles resulting from the use of brake pads and discs are polluting. Electric vehicles should not be avoided either, because they can pollute the atmosphere through tires and brakes and also through the construction, respectively the recycling of its components, such as batteries. Here we also find some ways to reduce road traffic pollution, such as the technical improvement of cars, resulting in a decrease in the emissions generated by them, the improvement of car construction, here generally aiming at the construction of electric vehicles, as well as the recycling of their batteries, because they contain a high amount of lead. Other source of pollution reduction would mean an important development of public road transport, using less and less personal cars. But in this aspect, the attractiveness of this public transport for the needs of everyone must be addressed.
Keywords: Exhaust gases, non-exhaust emissions, Brake dust, Tire wear

1. Introduction

demonstrating how big and dangerous is vehicle pollution on the air, because this pollution represents a massive environmental hazard. World Health Organization said that pollution on the air that comes from internal combustion engine on diesel or gasoline it has led to the premature death of over 800.000 people every single year due to pulmonary or cardiovascular diseases. Very well-known are the harmful effects of exhaust gases on the lungs and heart, as we also find in these scientific reports [1,2]. Nevertheless, emissions of these pollutants have a negative impact even on the brain, because in the last studies it was discovered that people who live or have long-term activity in these areas of intense vehicle traffic had different mental problems such as the most well-known anxiety and depression [3].

This scientific work is looking forward to

Of course, air pollution does not come only from the exhaust gases of these vehicles. Pollution can also come from non-exhaust emission sources, such as vehicle brakes or tires. Firstly, brake use can make an impressive amount of particulate matter (PM), especially in areas with high transport activity. As the emissions from the exhaust are more and more strict and kept under control, the rest of the emissions such as those from braking also become ones with an important significance even the most important source of pollution non-exhaust [4]. These metal particles that comes from brake pads friction which are found in the form of dust are causing inflammation and on the other side can reduce the efficiency of immune cells to kill bacteria [5].

Another source of pollution that is also non-exhaust is represent by tire wear and according to some studies, it looks like until now those particles that comes from tire friction are ones with the biggest contribution of microplastic pollution in the air. Local emissions due to the transport of tire wear particles requires an urgent need to collect some data on the inventories and flows of these particles [6, 7].

Therefore, it can be seen that air pollution due to vehicles does not only come from internal combustion engines, but also electric ones can be equally polluting. We can even discuss the manufacture of those batteries for electric vehicles that have sparked a lot of speculation and it is rumored that the manufacture of these batteries and also their recycling would present a much higher pollution than the pollution caused by classic engines.

Pollutants in the atmosphere are the main sources responsible for acute and chronic effects when it comes about human health. Pollution air caused by emission from motor vehicles is becoming a big problem in terms of environmental health and it affects all the developed countries of the world, especially the congested ones. The main pollutants resulting from traffic are hydrocarbons, carbon monoxide (CO) and nitrogen oxides (NOx), hydrocarbons, significant quantities of suspended particles. A study from 1992 belonging to Japan International Cooperation Agency, demonstrated that air pollution from Kuala Lumpur far exceeds acceptable air quality standards. Amounts of PM10, CO and ozone was monitored first daily, and then annually, and it was demonstrated that they exceeded the standard.

Unfortunately, previous studies, those from 1994, also showed still serious problems, and motor vehicles emerged once again as the most important source of air pollution [8]. Some recent studies shows that in Europe diesel emissions contain sulfur in gaseous form, which leads to the imposition of solutions to reduce this sulfur in diesel fuels. Sulfur dioxides represent a colorless gas with a powerful irritating smell, and this sulfur oxides comes from the burning of fossil fuel, which contains sulfur. The quantities of sulfur that are emitted represent a quantity indirectly proportional to the quantities of sulfur found in fuels. Exhaust gases from cars are responsible for the production of sulfur oxides, being a major source of sulfuric acid.

Recently, air quality has become a subject of huge importance in the entire world society. The main sources of pollution are suspended particles and organic compounds which are generated in the atmosphere by road vehicles [9]. Particulate matters represent particles with diameters equal or smaller than 10 μm and 2.5 μm, and these can retain on their surface different substances such as heavy metals (Pb, Cd, Ni, As) which are toxic substances, cigarette ash, bacteria, viruses, exhaust gases, and other different organic components [10]. Most PM from road vehicles has two sources: street dust that can become mineralized because of the soil particles, and particles that comes directly from the car exhaust, like smoke dust or different combustion residues. Another vehicle-related PM component is the oxide material that comes from chassis rust [11].

Although road transport is recognized as necessary and offers high flexibility, it contributes to environmental pollution. Transport, especially road traffic, represents an impressive source of polluting emissions. Through this work, the most important methods

of air estimation from road traffic emerge, some detailed levels of road traffic modeling.

Another source of pollution that is also non-exhaust is represent by tire wear and according to some studies, it looks like until now those particles that comes from tire friction are ones with the biggest contribution of microplastic pollution in the air. Local emissions due to the transport of tire wear particles requires an urgent need to collect some data on the inventories and flows of these particles [6, 7].

Therefore, it can be seen that air pollution due to vehicles does not only come from internal combustion engines, but also electric ones can be equally polluting. We can even discuss the manufacture of those batteries for electric vehicles that have sparked a lot of speculation and it is rumored that the manufacture of these batteries and also their recycling would present a much higher pollution than the pollution caused by classic engines.

Strategies that can reduce the air pollution are the contribution of some technical improvements of cars are presently technologically and affordable reliable. They refer to the reduction of vehicle emissions. Improving the management and control systems through a series of changes to the vehicle operation procedures, thus achieving optimal operation. Clear strategies which should reduce the use of the personal car. One focus specially on discussions about public transport. They show a high efficiency, but unfortunately the feasibility of these measures generally depends on a high availability and the attractiveness of these alternatives of transport, to the detriment of the personal car. These means that public transport must satisfy the individual's need for mobility.

2. Strategies to reduce air pollution by road vehicles

Proving studies have shown that around of the year 2005 the land transport sector (beside air transport and of course maritime transport) produced strong emissions of greenhouse gases reaching a percentage of 56% of the total NOx emissions. The variation of these pollutants before 2005 is even the opposite, when the quantity of NOx was decreasing by 40%, and the quantity of CO2 having a significant increase of 23% [12].

The reduction of air pollution due to road traffic has a series of strategies. These strategies could be explained as follows:

- The contribution of some technical improvements of cars, this leading to the reduction of vehicle emissions, for example improvements of engines and including fuels with the aim of reducing polluting emissions. Regarding this example, in recent years many updates have been made and brought to road vehicles.
- Improving the management and control systems through a series of changes to the vehicle operation procedures, thus achieving optimal operation. The example that can be given here is given by the decrease in the number of accelerations and decelerations within busy intersections, these modes of driving presenting high values of emissions.
- Clear strategies which should reduce the use of the personal car. They show a high efficiency, but unfortunately the feasibility of these measures generally depends on a high availability and the attractiveness of these alternative of transport, to the detriment of the personal car. These means of transport must satisfy the individual's need for mobility. These alternatives are usually quite difficult because it

is quite difficult to satisfy each individual need [13]. The improvement of air quality shows the need for some investigations on the traffic flow and the pollutant emissions resulting from it.

Considerable efforts for this purpose have been made by evolved models that can take these factors into account. Other macroscopic models were developed to integrate aspects regarding air quality . The evaluation of emissions in comparison with spatial variations and on the flow of traffic shows the need to develop traffic models at a microscopic level.

3. Specific models to estimate air pollution from road tragic generated by traffic

A model is defined in figure 1 which actually represents an emission simulation scheme, regarding the modeling process in order to estimate the entire air pollution as a result of road traffic. This traffic flow represents the interaction between a transport demand and its supply [14].

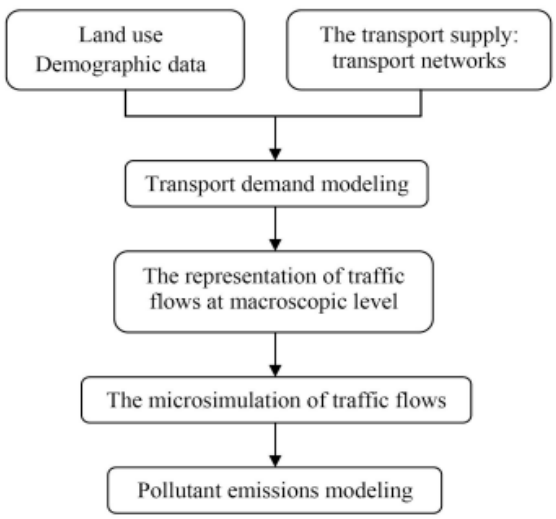

Figure 1. Emission simulation scheme regarding the modeling process

The network can be schematized through a plan with nodes and arcs, here the roads are represented by different oriented arcs and several junction points. The characteristics of the arches are road traffic capacity, its direction, length and of course the entire number of lanes together with their width. Intersections can be associated with nodes, such as for example the direction of traffic and the duration of traffic lights. The transport service has a high weight of quality and many differences [15].

4. Conclusions

The article resumes the Air pollution mainly due to all the activities performed by the human species, focusing on the use of vehicles. Road transport is the biggest source of pollution in the whole world. This pollution is basically due to fossil fuels used, but also electric ones can be equally polluting. The manufacture of the batteries for electric vehicles have sparked a lot of speculation and it is rumored that the manufacture of these batteries and their recycling would present a much higher pollution than the pollution caused by classic engines.

Other harmful consequences of traffic flow are related to different driving styles, such as acceleration, which pollutes through exhaust gases, deceleration, which pollutes through particles from braking or tires while braking, and queuing in traffic, which again generates pollution. Therefore, more attention is needed to analyze these factors.

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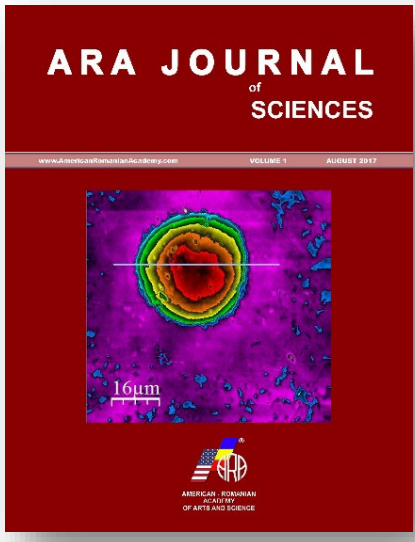

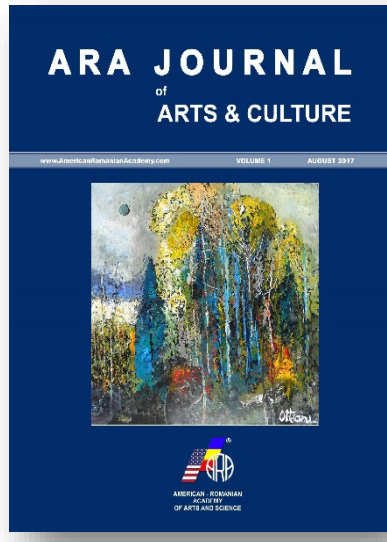

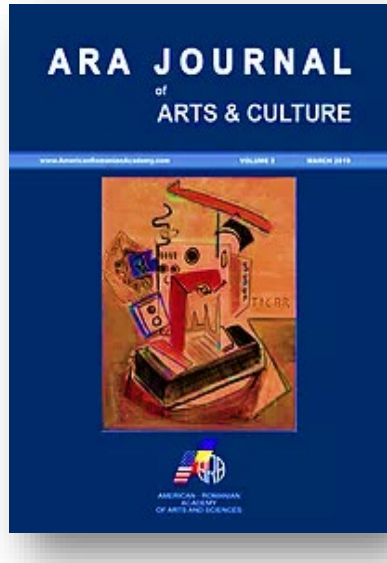

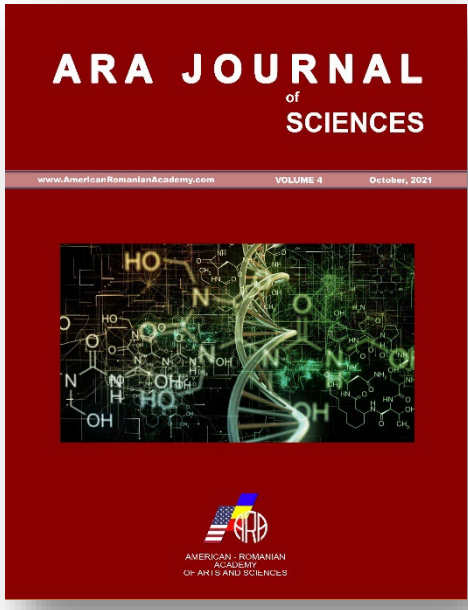
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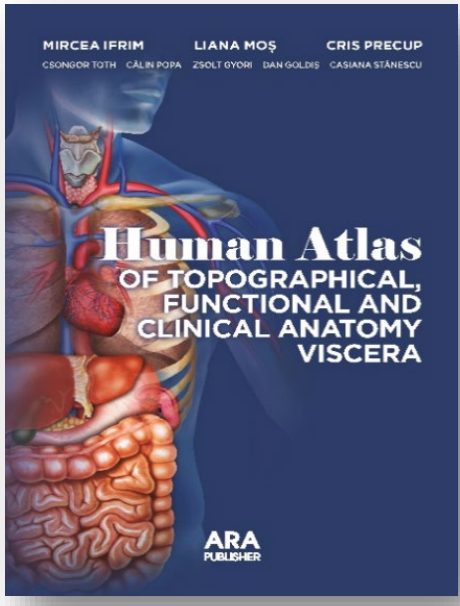
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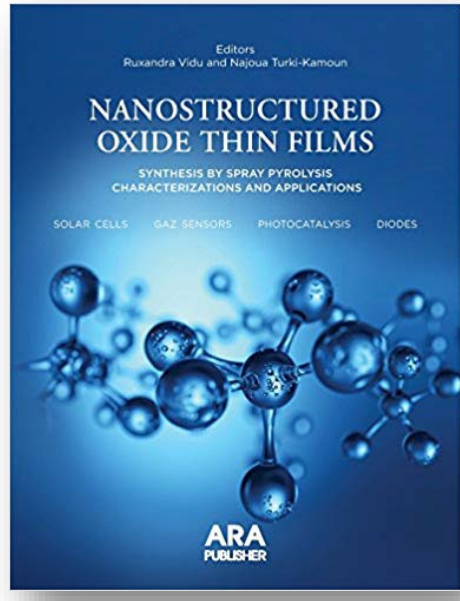
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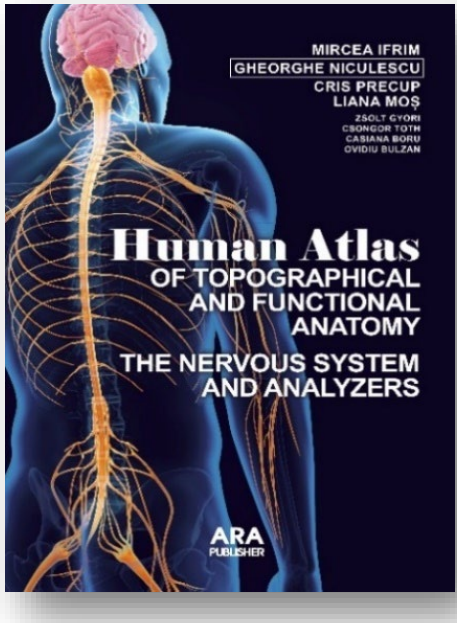
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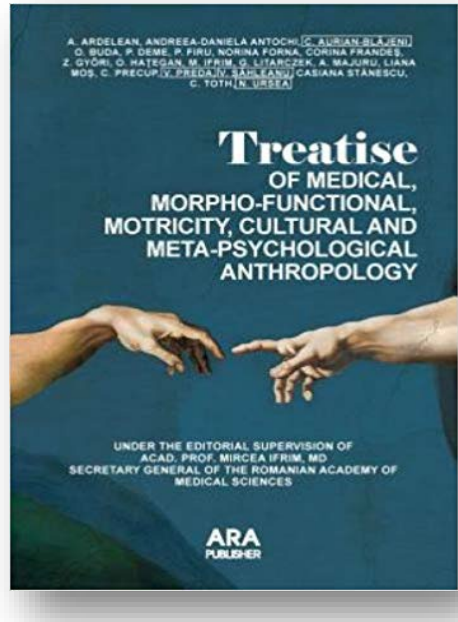
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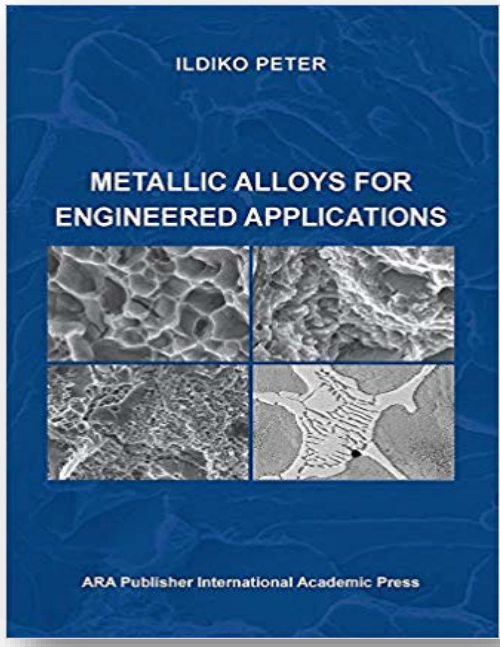
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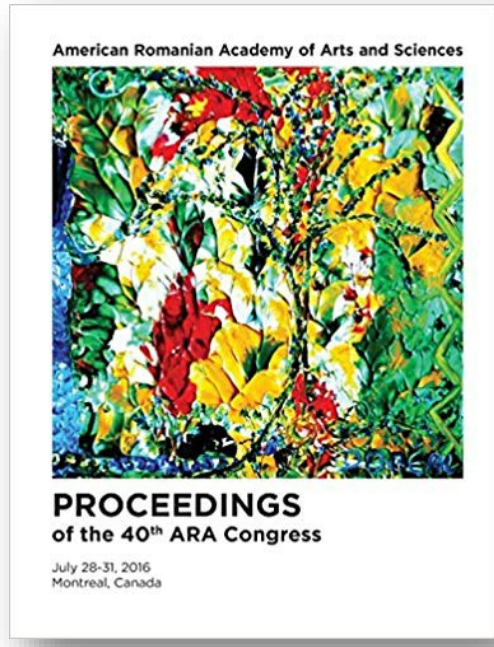
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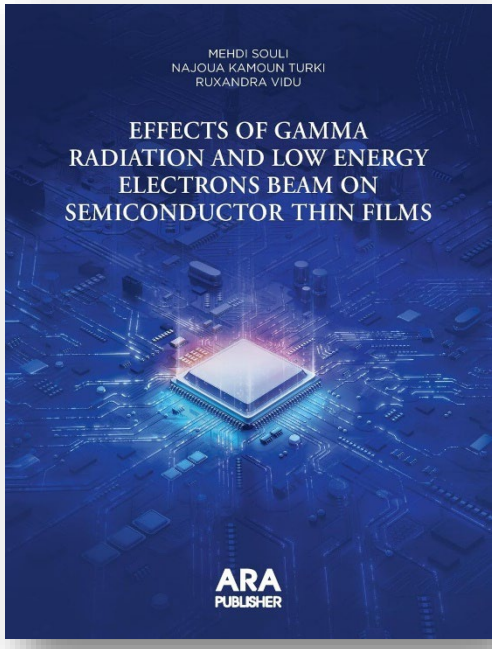
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